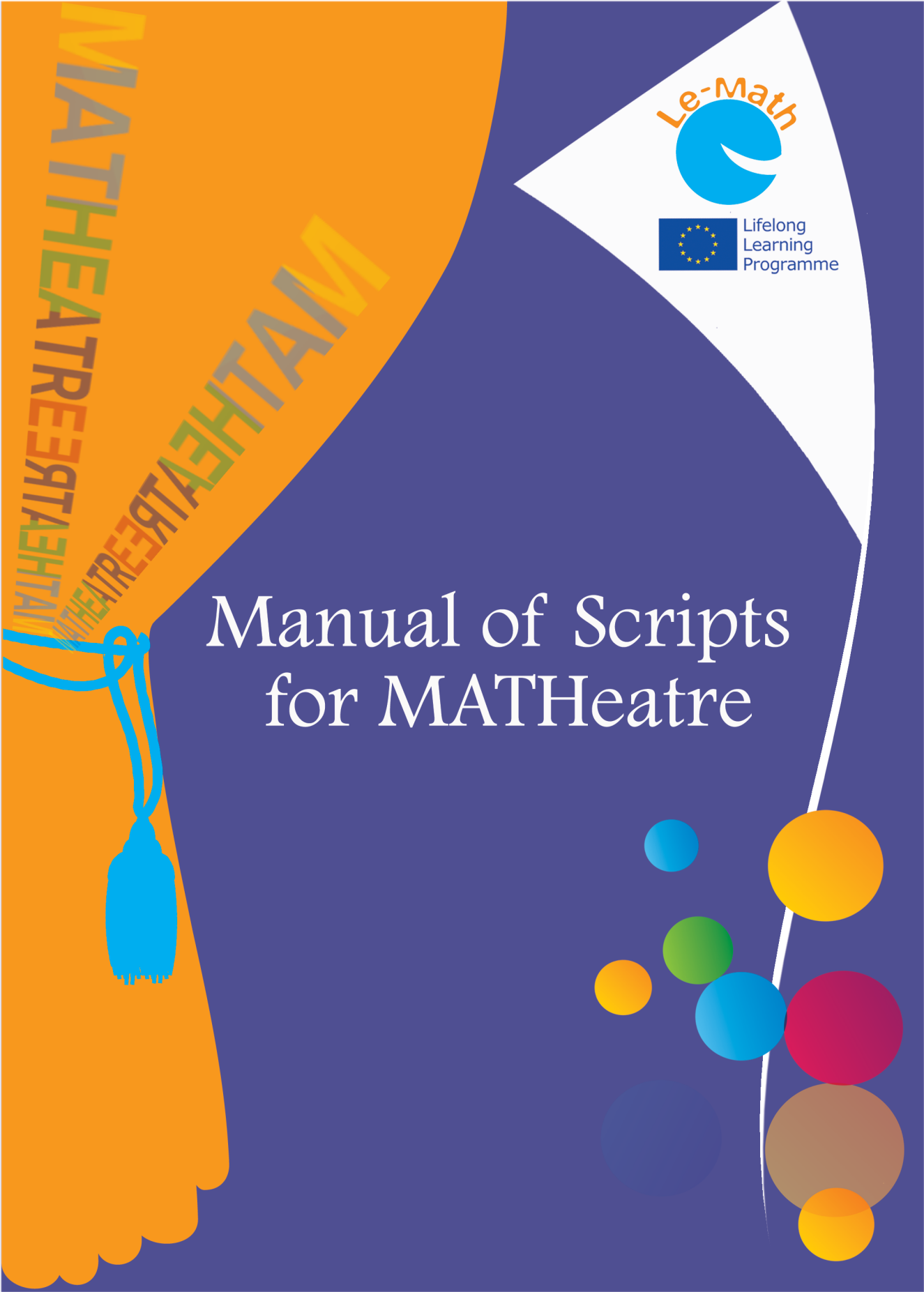
MATHEATRE
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Le-Math
Lifelong
Learning
Programme
Manual of Scripts
for MATHeatre

MATHeatre

Mathematics Theatre Plays

Manual of Scripts for MATHeatre

A collection of theatre scripts submitted for the Theatre Play writing competition on the theme of Mathematics 2013

Editors: Gr. Makrides and project partners*

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Preface

The European Project Le-MATH announced a competition for theatre play writing. The plays are expected to be performed by pupils of the ages 9-18 and the main theme is mathematics (theory, applications, history of mathematics, etc). The competition was open to all European Union citizens and beyond, and participants may be theatre play writers, teachers and trainers of all levels or specialists who can participate individually or in teams, representing themselves or their organization.

The scripts were evaluated on the basis of the criteria set by the project Le-MATH and were published in the project site. The scripts passing the eligibility criteria were then evaluated on the following six criteria:

- English language quality-easy to read and understand;
- The richness of the vocabulary of the play;
- Imagination, evolution, originality;
- The coherence of the main subject mathematics with the rest of the play;
- The satisfaction of the purpose of the competition, which is supporting the promotion of students' love towards mathematics through knowledge and understanding;

The script supports elements of ethos and passion for mathematics through the theatre play.

The first three scripts in this manual are listed on the basis of winners ranking for first, second and third prizes, while the remaining are listed on the basis of their submission receiving time. Scripts, which were found ineligible or no release form is provided are not published in this manual.

This manual of scripts is useful for teachers and pupils who would like to use them in developing a theatre play for the learning and promotion of mathematics. The manual is expected to be one of the materials used during the Le-MATH training course, developed by the project Le-MATH.

Dr Gregory Makrides,
project coordinator and partners*

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First Prize

FIVEPARTACUS

written by Sergio Vidal from Spain

Characters:

Five
One
Television salesman
Thousand

ACT I

(At center stage is Five, wearing sandals, white socks and a white Roman toga that has Velcro attached a "V" made of rigid black cardboard. Enters the scene One, also wearing a white Roman toga, white socks and sandals but with an "I" rigid black cardboard attached with Velcro. The set represents a public park.)

One: (crying) Buaaaaaa, Buaaaaaaaaa

Five: What is it One? Why are you crying?

One: (Standing to the right of Five) Hip, hip. The ... The ... Buaaaaaaaa (break to mourn again)

Five: One, calm down. But before you go, stand on the other side, here you subtract me.

(One is placed to the left of Five and this throws a sigh of satisfaction, as if he had removed a stone from his shoe)

Five: So much better. And now, count to ten to be quieter.

One: OK. Stick, stick stick, stick stick stick, stick V...

Five: That's enough, you're getting dizzy! Let's see, what happened?

One: (Now quieter) The Colosseum nightclub doorman didn't let us go.

Five: Again?

One: Yes

Five (With patronizing tone) I told you the other that if you go more than three together won't let you. Those are the rules.

A: No, it wasn't that

Five (With accusingly) You may not cast in front of a 1oo?

A: No, either.

Five: So what happened?

One: We've been missed because we had white socks.

Five (angrily) How dare he? He has no right to invent rules. (Now put an epic voice, such as Brave Heart, and looks at the sky declaiming) White socks symbolize peace and purity. Enough of colored socks. Down with the tyranny of Hello Kitty socks! They may remove our sandals, but they never take away our ankles in plaster! (Proudly shows his socks to the public)

One: And what will you do?

Five: I'm going to avenge. From now on call me "V for Vendetta" (points to V of the toga)

One: And me, from now on call me ... (Look at the "I", strokes his chin thinking, looks back at the "I", raises his eyebrows as if he had one very big idea) call me "Potato Fried" (Five hits his forehead with the palm of the hand and shakes his head while looking at the ground)

One: Do you have a plan?

Five: Yes, but you'll see it after the publicity

(Five and One out of scene)

ACT II (Advertising)

(Appears on stage television salesman. Carries in his hand a bottle of detergent with a big zero painted. The set represents the teleshopping program's set with a table in the middle)

Seller: You have a date with the girl of your dreams and you've spotted your lucky shirt with ketchup? Have you caused an explosion in the laboratory of the school and your dress has been tainted with toxic smoke? Do not worry, with "Multiply by zero" (says the bottle), your stains disappear. Any oil stain? Multiply by zero and will be a thing of the past. 1250 Coffee stains on your shirt? "Multiply by zero" and disintegrate as if by magic. (Pointing the bottle) "Multiply by zero" is environmentally friendly and contains no chemicals. It is very cheap and takes up no space at home. Buy "Multiply by zero"!

(The seller is leaving the halfway stage but seem to remember something and returns to the center)

Seller: Emm... do not forget that "Multiply by zero" is used directly on the spots. Don't use it on all clothing because ... (he shyly covers his body with his hands as if naked) will happen a disgrace.

ACT III

(On stage is Thousand, another character, dressed in Roman toga, sandals and colored socks. Wears a black M attached to the gown. The set represents the entrance to the Colosseum nightclub.)

Thousand: Look who comes through there

(They enter Five and One scene and placed against Mil)

Thousand: (with hectoring tone) Come on, you two, what do you want?

Five: We are going to enter in the nightclub

Thousand: With those white socks? Not a chance.

Five: We better pass, if not ...

Thousand: "If not" what? What are going to do two poor specimens like you? You have not yet reached even five!

(At this moment Five realizes that One is in his right, gives a cheek and points him on his left)

Five: Do you really think you're smart Thousand? So I propose a bet.

Thousand: You say.

Five: I bet you we add more than you. If we win, let everyone wearing white socks to the club, and if we lose, we will not show up here anymore.

Thousand: Deal (shake hands)

Thousand *(He steps forward and addresses the audience) You know the story of the two fools who believed that 6 was greater than 1000 and they were unable to enter the club ever? Those fools were Five and One (turns towards Five and One and evil bursts out laughing)*. Muahahahaha.

(Five by gestures, asks one to lend him the "I".)

Five: (Speaking to audience) You know the story of a fool that had to let people enter in his nightclub wearing white socks because he thought it was more 1000 than five... (at the time you place the "I" horizontally on his head forming V, five thousand in Roman numerals) thousand. Well that silly was Thousand, hahaha.

Thousand: (furious pounding the ground) Nooo!

(Five returns One his "I")

Five: There you stay, fool!

One: Good bye loser!

(Five and One go out of the stage dancing away and disco music is sounding background.)

Second Prize

GEOLAND

written by Marilena Vilciu and Theodor Draghici from Romania

Theme: A princess, rich in qualities (the square), needs to choose her prince, who she requires to have as many properties as possible. She allows her mother, the parallelogram to help her make the decision, while the narrator tells the story.

The candidates are other quadrilaterals: the normal quadrilateral, the rhombus, the rectangle and the inscribed quadrilateral.

Characters:

The square – the princess
The parallelogram – the empress
The narrator
The normal quadrilateral – knight
The inscribed quadrilateral – knight
The trapezoid – knight
The rhombus – knight
The rectangle – knight

SCENE 1

NARRATOR:

There once was, in land called Geoland, a princess with no siblings. She was spoiled, smart, beautiful, and was called Square.

PARALLELOGRAM:

Dear, I think it is about time you met your chosen one. I'll let everyone in the empire know, and I'll have a lot of cool knights come in here, and you shall pick one of them.

SQUARE:

Mother, don't you think you're hurrying? I'm fond on finding a knight that has at least as many properties as I do. I wouldn't want to make compromises, like our neighbour empress, the Equilateral Triangle, who married just a month ago the 30-60-90 triangle!

SCENE 2

NARRATOR:

Time passed by, and the long awaited date came. At the door of the official salon of the palace was a big crowd: knights that were more or less far-famed came, from all the corners of the kingdom.

PARALLELOGRAM:

Dear candidates, hello and welcome! As you probably know, you are here to steal my little princess's heart.

SQUARE:

Oh, poor thing, she doesn't want you to see you fight, so we won't have a tournament. All we are interested in are your properties. Let's hear you, gentlemen!

NORMAL QUADRILATERAL:

Honoured princess, let me introduce myself: I am the normal quadrilateral, and my biggest property is that the sum of my four angles is 360o.

Laughter from all of the stage's corners can be heard, the square is confused.

SQUARE:

Darling, I know you are really proud of your property, but that's the property we all have.

(The parallelogram, the trapezoid, and the inscribed quadrilateral burst into laughing)

THE INSCRIBED QUADRILATERAL:

Dear princess, I think it's about time I introduced myself: I am the inscribed quadrilateral, and besides the property we all have, I can also brag with the fact that my opposite angles are supplementary, which means that their sum is 180o! And even more than that, the angle made by one side and a diagonal is equal to the angle between the opposite side and the other diagonal!

RECTANGLE:

Hey! I also have that property!

PARALLELOGRAM:

Wow! That's actually really interesting! Even I can't brag about that. But, unfortunately, this is a property that the princess possesses as well.

THE TRAPEZOID:

But what about my qualities: I have to parallel sides!

SQUARE:

Oh, you must be the trapezoid, then. Anything else?

THE TRAPEZOID:

Yes, you recognised me. Well, besides that... The adjacent angles formed by a unparallel side with the parallel sides are supplementary. And even more, the angles made by each of the parallel sides with the same diagonal are equal!

THE RHOMBUS:

Trivial! Look at me, too, or at the empress, or at the princess, or at the rectangle! All of us can brag about that! Even more than this, all of us have the opposite angles congruent.

SQUARE:

Indeed, and our opposite parallel sides are congruent.

(The parallelogram, the rhombus, and the rectangle all confirm): Yeah, yeah, us too!

(The normal quadrilateral, the inscribed quadrilateral, and the trapezoid shamelessly leave the room).

SCENE 3

NARRATOR:

The room thus starts to empty itself, and the competition becomes fierce. The only candidates left are the rhombus and the rectangle.

SQUARE (as she turns to the rhombus and the rectangle):

sigh I guess you're the only ones left then. Let's see!

PARALLELOGRAM:

Will you excuse me for just a moment? I'm sure that they will both start bragging about their diagonals having the same middle. Darlings, don't bother, both me and my daughter have the same property.

RECTANGLE:

Yes, but, besides that, my diagonals are congruent!

RHOMBUS:

And mine are the bisectors of the angles!

RECTANGLE:

But my angles are all right!

RHOMBUS:

And my diagonals are perpendicular! Or should I even say that all my sides are congruent?

RECTANGLE:

So what? I am inscribed, this is something you can't say about yourself!

SQUARE (on a high tone):

Enough! I can't hear anything new! I also have all of these properties! Get out! (The rectangle and the rhombus leave the stage).

SCENE 4

(Left on the stage remain, as in the beginning, the square, the parallelogram and the narrator. The princess is sighing, while her mother tries to calm her down.)

NARRATOR:

The day that was supposed to be the happiest turned out to be so hard!

It looked like princess Square was so perfect that she couldn't find someone her own "size".

PARALLELOGRAM:

Darling... sometimes I feel so bad for stimulating your critical thinking so much. What if you will never find your right knight?

NARRATOR:

Ladies, don't give up! Another candidate just showed up! Did you ever hear about the Regulated Hexagon?

SQUARE:

I've actually heard about him. So what? He doesn't even have four sides.

PARALLELOGRAM:

No, darling... he doesn't have four. He has six! And all of them are congruent! And his angles are all congruent as well!

SQUARE:

Yes, but they're not right.

PARALLELOGRAM:

No, they are even bigger! They're all 120o!

SQUARE:

And diagonals? Does he have any?

PARALLELOGRAM:

Of course! He has not one, nooot two, noooot three, nooot four, nooot five, noooot six, noooooot seven, nooot eight, but nine diagonals! The three diagonals connecting diametrically opposite vertices are twice longer that the side, which means it is formed from not one, noot two...

SQUARE:

OK, Mother, get to the point!

PARALLELOGRAM:

Oh, sorry. So, it is formed from six equilateral triangles. And he is also inscribed! So, as you can see, he has more properties than you!

NARRATOR:

And the other six diagonals are congruent and determine two equilateral triangles, David's Star, if you ever heard of it.

SQUARE:

Alright, let him come, then! He IS the one! Watchmen, change the flag in front of my window to "in a relationship"!

Third Prize

An outcast for a blueblood

written by Ntinos (Konstantinos) Kordosis from Greece

The characters of the play are incarnated by pupils wearing signs (labels etc.) with the corresponding numbers.

The characters of the play

Halfie(1/2): A boy of about 12 or 13 years old. His is vivid and intelligently naïve.

Unita (1): A girl at the age of 12-13 years old, very vivid and cute.

Root-two ($\sqrt{2}$) : An attractive young lady.

Sextant (6): A young lady with an impressive appearance.

Twenty-eight set: (28): A young lady similar in appearance to Sextant.

Dozen (12): A stylish and good-looking young man.

The stage is set to resemble a club where numbers frequent. There are tables upon which table games, such as Ostomachion or Zatrikion, are placed. At some point Halfie storms the room.

Halfie: Wow! The club is totally empty. It seems everybody has gone out for business. But, I think that chatterbox called Unita didn't have anything to do today. Where on earth might she be? (Shouts aloud) Hello? Are you leaving me solo today? Anybody here?... I can be a good company no matter who you are: a dull decimal, a cranky repeating decimal, a sheer integer or even a blueblood natural number… Even if you are one of those outcasts, the irrational numbers, "come out, come out wherever you are"… Nobody is here… (Sits at a table and grabs the pieces of a game, starting placing them on the board. At that time Unita enters the room).

Unita: What in God's name are you shouting for? The whole town has heard your cries!

Halfie: Oh, here you are! I have been looking all over for you to play a game of Ostomachion together and… annihilate you! What's that you are holding?

Unita: (holding the instrument in a way that it produces sound) Can't you see? It is a crotale (rattle)!

Halfie: A crotale my eye! This is a baby rattle! Is it my fault, then, that I call you a tot? Only tots play with baby rattles!

Unita: This is my godfather's invention, Archytas'! A very practical toy for babies to play with while their moms do the house keeping!

Halfie: What? This is what Archytas was occupying himself with? I thought you said he was a great scientist!

Unita: My godfather was Pythagoras' worthy heir, if you want to know the truth! He researched on the relation between music and mathematics! He was the first air-modelist in the world as he built a functional full-scale model of a flying dove!

Halfie: Big deal!

Unita: He was seven times elected as a general in Taranto and he saved Plato's life once! Oh, why am I talking to you! Obviously, you are so jealous!

Halfie: (whining) Yes, I am jealous! What's wrong with being jealous? Nobody wanted to baptize me, you see! I am nothing, I am just a fraction, I am half the… whatever thing I should be!

Unita: Come on now, Halfie… Don't cry like that… You are breaking my heart…

Halfie: Waaaaaa! I don't want to live any more! I'll find zero and multiply with it! I will give an end to my miserable life! Waaaaa!

Unita: Oh, please don't say such things… Paradox is a part of life…

Halfie: What do you mean paradox?

Unita: Well, you see our creators, humans, are mortal but we, numbers, are… well, immortal. Besides that, how can you say that you want to put an end to your life? You, the representative of a whole class of numbers! Let alone that you are so beautiful…

Halfie: (changing mood instantly) Do you really thing that I am beautiful?

Unita: Of course! How can you not be with me being your numerator?

Halfie: What about that other thing you said? Something about me being the representative of a whole class of numbers… So, I am classy, huh? This must be something, right?

Unita: Certainly it is more than something! So, stop whining like that and think how things could be worse! Think about my friend Root-two! She's been underground for all her life!

Halfie: Root-two? Underground?

Unita: From the moment she was born!

Halfie: When was she born?

Unita: The real question is "HOW" she was born! She was discovered by Hippasus of Metapontum, second Pythagorean in rank after Pythagoras himself!

Halfie: So, are you of the same age, more or less?

Unita: Don't be stupid! I exist since the beginning of the world! It just took some time for humans to rank me as a number, because, initially, a "unit" meant a "distinct being", not "quantity".

Halfie: Whatever… Now, tell me some more about that haughty Root-two!

Unita: Haughty? That's new… Halfie! Did you hit on her and she rejected you?

Halfie: Like heck I didn't!... Oh, alright… I am really attracted to her and I will hit on

her again! I am not afraid of rejection… But, you were saying…?

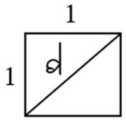
Unita: Pythagoras' school in Croton in Magna Grecia, was a closed sect of people. Those Pythagoreans, who were initiated into it, were called "mathematicians" and were allowed to be taught by Pythagoras while watching him at the same time; whereas others, called "the acoustics" were only allowed to listen to but not wahtch their master. What was said in those closed sessions was prohibited to be announced outside the school.

Halfie: So, a Pythagorean would only watch and listen - or only listen – and keep his mouth shut!

Unita: One day, Hippasus, who was the prime of the acoustics, while resting in the sun, got really bored. So he decided to solve a problem to kill his time; he drew a square having me as its side (Unita draws a square, having unit (1) as its side and its diagonal (d) on the board; she then tries to calculate the length of the diagonal using the Pythagorean Theorem. She writes on board:

$$d^2 = 1^2 + 1^2 \quad \Leftrightarrow \quad d^2 = 1 + 1 \quad \Leftrightarrow \quad d^2 = 2)$$

So, he tried in vain to find a fraction that would express the length of the diagonal but it was impossible!



Halfie: Maybe it was a vicious square..!?

Unita: Are you stupid? Is there anything like a "vicious square"?

Halfie: … there is the vicious circle, though….

Unita: (staring at him baffled, but goes on) So, he presents the mathematicians with his new problem. They tried to solve it but in vain! That was it! Everyone in the school slept over this new problem, trying to figure out possible solutions! Until one day Hippasus made the break-through! He proved, using the "reductio ad absurdum" method that there is no rational number that could express the diagonal!

Halfie: So, the first mathematical proof that ever existed proved that mathematics did not actually exist!

Unita: Exactly! The tragedy of this was that the Pythagorean Theorem contributed greatly to that solution!

Halfie: … and Pythagoreans' great advancement turned into a boomerang!

Unita: … to say the least. Everyone was devastated…

Halfie: Why were they so affected by that?

Unita: Well, the Pythagoreans believed that "God always geometrizes". For them that meant that God created everything according to geometry rules. He related natural beings to natural numbers…

Halfie: I still don't realize the reason for their panicking…

Unita: As you may have understood, Pythagorean Philosophy was not only about reason and logic but also about metaphysics. Now that they understood their

mistake how could they tell the world that God had open business with the underworld of the numbers? With guys like the number that expressed the diagonal of the square? The number called Root-two, later symbolized as ? Hippasus, who was the cause of this unrest having revealed the secret of the school, was condemned to death by drowning in the sea!

Halfie: What a shame! That poor guy paid for his cleverness! But, I still don't get why the discovery of the square root of 2 filled the souls of mathematicians with such fear…

Unita: Because this was the first number of his kind discovered by them! Their hearts were filled with fear towards the unknown. Later on, the mathematician Theodorus the Cyrenaic proved that other such numbers exist. The square roots of 3, of 5, of 7 up to the square root of 17. They called these numbers "irrational". That is "illogical"…

Halfie: Really? They were that scared…?

Unita: (goes towards the door where voices are heard and returns abruptly) Quickly, Halfie, let's hide and eavesdrop on what those "big shots", the perfect numbers have to say…

Halfie: Who..?

Unita: You know who, those bumblers: the Sextant and the Twenty-eight set. Come, quickly (Unita grabs Halfie from his hand and drags him to the interior while the perfect numbers enter the scene from the door).

Sextant: Oh dear! It is impossible even to go for a walk with this underworld surrounding us! It is too dangerous!

Twenty-eight set:

You are so right, darling! The whole world is swarming with suspicious irrational numbers! And if one dares to protest against them one is instantly accused as a xenophobic and racist by the media!

Sextant: They have such a nerve! They demand – God forgive me – social equality! The right to vote! Oh, may God protect us and punish those who advocate this irrationality!

Twenty-eight set:

God has nothing to do with that! Interests are behind this evil! They need them! They need them to finish their dirty jobs!

Sextant: By the way, just before I met you I came across that disgusting, abnormal conception called Root-two!

Twenty-eight set:

And I caught a glimpse of Dozen. I wonder if what is said about those two is true…

Sextant: You know how the saying goes: "If there's smoke there's a fire"! After all they don't even try to keep up appearances!

Twenty-eight set:

Can you imagine that! Dozen! A natural number of his caliber to be in an affair with a female like Root-two! What a shame!

Sextant: I warned him the other day! I spoke to him as plain as possible! "Have you investigated into her past, my poor fellow?", I asked him. "She 'did' the same person that brought her to this world! The person who created her! Her father, Hippasus! She is nothing but a disrespectful slut! A cold-hearted opportunist! Do you know where she worked before Hippasus found her?"

Twenty-eight set:

Where did she work? I don't know this information! (Sextent leans over to her and whispers something to her ear. Twenty-eight set opened her eyes widely and dropped her jaw. Then she put her palm over her mouth, exclaiming at the same time: "Oh dear! You don't mean that?!")

Sextant: I am telling you this girl has been around the block for some time!

Twenty-eight set:

So, what is his business with her, anyway?

Sextant: Oh, darling… He is bewitched, can't you see? She is a sorceress!

Twenty-eight set:

What can I say. Some guys are attracted to the unknown! Although, I have to admit that she is attractive in a curious way…

Sextant: What? What exactly is attractive of her? She is nothing but a malformed concept!

Twenty-eight set:

Do I sense jealousness, my dear friend, or am I wrong in my judgment?

Sextant: Jealous? Who me? What should I be jealous of? Of that outcast? Of that bass-class feminine? Are you out of your mind?

Twenty-eight set:

Oh, come now… You never miss a chance to show that you have a crush on Dozen!

Sextant: So what? Is there anything more natural than a perfect number falling in love with a superabundant number? After all, I think I am his other half…

Twenty-eight set:

You are "just" his half, not his "other" half! Your sum does not equal the unit! Oh, get over it my darling! Dozen is not the only superabundant number!

Sextant: No, he is not! But he is the smallest superabundant number and I am the smallest perfect number! See how we are made for each other? Besides, his affair with Root-two is doomed in the society of the numbers…

Twenty-eight set:

It is a difficult relationship, I admit, but…

Sextant: Aren't you listening to what I am saying? The other day Dozen had a really hard time. He was summoned to the "Council of numbers" and he was warned, unless Root-two was transformed to an explicit number, to cut all relationships with that freak or suffer the consequences!

Twenty-eight set:

And did he accept it?

Sextant: Of course he did! What else could he do? He was cornered by the council… But, I think we had better leave now because I know this despicable number frequents this place and I am not in the mood seeing her face… (They leave and Unita with Halfie enter the scene again).

Unita: Oh God! This is unacceptable! Forcing her to transform into an explicit number! It is outrageous!

Halfie: So, what is so wrong about becoming an explicit number?

Unita: What? Are you serious? Change the person she is? Her entire personality? This is sacrifice!

Halfie: But, actually she wasn't rejected! That is what love is all about, isn't it? Making mutual sacrifices!

Unita: Only in most cases it is the phallocratic masculine that demands single-side sacrifices…

Halfie: Let's have a closer look at the whole issue (writes on the blackboard):

$12 + \sqrt{2}$ Irrational. $12 - \sqrt{2}$ Irrational. $\sqrt{2} - 12$ Irrational
$12 \cdot \sqrt{2}$ Irrational. $12 : \sqrt{2}$ Irrational. $\sqrt{2} : 12$ Irrational.

All the operations produce an irrational number ! Now, what do you think; is it Dozen's fault that he wants Root-two to be expressed as an explicit number? Have you ever heard of a father being willing to have his kids have his wife's surname only?

Unita: There are places in the world where guys are not as selfish as they are here you know…

Halfie: Yeah, whatever… Now, tell me, what were those things they were talking about, concerning perfect and superabundant numbers? I didn't understand a single thing…

Unita: Well, look; Sextant and Twenty-eight set are perfect numbers because they are equal to the total sum of their divisors (she writes): : 6 = 1 +2 +3, 28 =1 +2 +4 +7 +14; while Dozen is superabundant because the sum of his divisors is bigger than him! 1+2+3+4+6=16>12 (Suddenly, voices are heard from the door) Come! Quickly, let's hide again Halfie! Our little pigeons are coming (they hide somewhere and Dozen and Root-two enter the scene).

Root-two: (Furiously) You hypocrite! You liar! You agreed to have me amputated! Isn't it so Mr Superabundant? (Ironically) So, how do you prefer me? How many decimals should I have, my master? Three? Four? A hundred? The less the better, huh? The less the further away I will be from the real ME! Admit it! Things would be more convenient for YOU!

Dozen: Please, darling! Don't judge me so wrong! I was panicked in front of that Holy Inquisition! I thought I would lose you for good!

Root-two: I don't believe you! Like the others, you also believe that irrational numbers are stains in the society of the numbers! (she suddenly stops and looks at the square which is sketched on the blackboard).

Dozen: What are you looking at?

Root-two: I am looking at the "Waterloo" of my life! The moment I was born!

Dozen: Don't be so harsh on yourself!

Root-two: Really? They say that I am cursed; that I am the main reason behind my father's, Hippasus', death! They say I doom whoever is near me!

Dozen: That is nonsense! Some may think that you are weird or strange… But, people just need some time to get used to you!

Root-two: What about you?

Dozen: What about me?

Root-two: Do you think I am weird and strange?

Dozen: Honey, I think you are strangely striking; that's why I was attracted to you from the beginning…

Root-two: Oh, really? Is this the reason you agreed to have me amputated, you liar?

Dozen: I made a mistake, alright? I want to make up for everything! I hereby renounce that agreement! I condemn it!

Root-two: I don't believe you!

Dozen: By the twelve gods! By the Twelve Holy Gospels! By the Twelve Apostles! I swear I tell the truth, may there never be a twelve-month year or may the twelve Plagues of Egypt befall my head…

Root-two: Oh, stop it, will you? The plagues of Egypt were Ten, not Twelve! Even in the oaths you take you think about yourself!

Dozen: Babe, the Plagues were Ten but for you I could suffer an extra Two! My sweet Root-two (moves to hold her hand, but she withdraws it)

Root-two: Don't touch me! I have no faith in you any more…

Dozen: (disappointed) So, that was it! The court has found me guilty! I am condemned! The capital punishment is my conviction! No mitigating circumstances are recognized! I am doomed (lowers his head and starts walking towards the exit).

Root-two: Wait…

Dozen: But, you said I am guilty…

Root-two: But I didn't say anything about mitigating circumstances, did I?

Dozen: (smiling and encouraged he reaches for her hand) Let's leave…

Root-two: (pretending that she wants to avoid his hand) Will you ever again denounce

me? Will you betray me again?

Dozen: I promise not to.

Root-two: (reluctantly) I am not sure about this….

Dozen: (playing the insulted) Oh, have some faith in me, will you? (Drags her by the hand towards the exit while Halfie and Unit make an appearance).

Halfie: Well well… Look who is here! What's up Dozen? (Unita kisses Root-two on the cheeks)

Dozen: Things are rough as you can see…

Unita: I am glad you made up you guys…

Halfie: (as Halfie is standing in front of Dozen and Unita in front of Root-two he says in an implicit way:) Hey, since the four of us are here now, why don't we try a…

Unita: You'd better watch what your mouth will say!

Halfie: … why don't we try a… a cross multiplication?!

Unita: You Satyr! (she grabs a stick and starts chasing Halfie around the stage, while Halfie is trying to hide behind the others, begging her to forget about it). I told you to watch you mouth, you little pervert! (Dozen and Root-two are laughing as the curtain falls).

It is the story that matters, not just the ending

Written by Skevi Hadjigeorgiou from Cyprus

Main characters:

1. Mum
2. Beth, 17 years old
3. Dorothy, 13 years old
4. Chris, 10 years old

Mum is in the living room vacuuming the carpet, while Chris is sitting close to her playing with his video game. The girls are in their bedrooms.

Mum: Dorothy, Beth, Chris, it's time for your homework. Stop whatever you're doing and get yourselves in the living room. Don't forget your books and pens. It's time for maths.

Beth: (from inside the room) Mum, can I do it later? I am kind of busy right now, chatting online with my friends about this really hot and cool guy I met a few days ago. Please...

Mum: No young lady. You cannot! Get yourself here immediately.

(Dorothy entering the scene holding her books, looking unpleased)

Dorothy: Life is terrible. Why do we have to study maths anyway? If you ask me, it is completely pointless. Just a waste of time. I think grownups invented maths, just to make our lives miserable and boring. I would rather go out shopping with my friends. It's mid-season sales mum!

Mum: One more reason to do your homework honey...so next time you go shopping you can even calculate how much money you will save (being a bit ironic and smiling)

Dorothy: Who cares about things like that? All I need to know is that I will pay less. That's enough for me. Anyway when it's time to pay the till will tell me the final price. Piece of cake!

(Chris laughing. Still sitting on the floor playing with his video game)

Chris: (talking to Dorothy) Girls are silly. All they think about is boys and clothes. Boring!!! Mum, if I finish my homework really quickly can I carry on playing after dinner??? Please mum..please...

Mum: Go get your books and we'll see about that later.

(All three children go in their rooms and return with their books and sit around the dining table with long faces. All exhaling deeply before sitting. Mum goes in the kitchen.)

Beth: You know what I think of maths word problems?

Chris: What? I am sure you are gonna say something you read on Facebook because obviously you're not able to use your tiny brain and think on your own (laughing)

Beth: Actually smartypants I did read it on facebook and I pressed 'like' immediately since I found it extremely true. (Hitting him lightly on the head)

Dorothy: So? Tell us...

Beth: Well, maths is like asking someone: if you have 4 pencils and I have 7 apples, how many pancakes will fit on the roof? And the answer would be: purple, because aliens don't wear hats.

(Everyone laughing loudly)

Beth: That is so amazing. I will definitely post it as well later on. Brilliant! I am sure it's gonna get so many 'likes'.

Mum: (from inside the kitchen) Guys, how is it going? Are you studying? Because I don't think all this laughter has to do with maths homework. Does it?

Dorothy: (in low voice) Actually it does. (All laughing quietly and in a sneaky way)

(They open their books and seem troubled, bored and stuck)

Beth: Seriously, why does maths exist? Huff...

Chris: Apparently there must be a reason since people have been studying it and practising it for so many years. I just don't get it.

Dorothy: Actually, now that mum can't hear us, this year maths isn't so bad!

(The other two seem surprised and puzzled)

Beth: What? Did you bump your head this morning? I can't believe that these words just came out of your mouth. What happened? What made you change your mind? Did an alien invade your brain? Or is the new professor extra cute and handsome? (Laughing) Because honestly, I cannot think of any other reasonable explanation.

Dorothy: Haha...so funny little sister. As a matter of fact it does have to do with the new professor but it's a she and she is really amazing. Not that things are any easier but the lesson is more interesting and maths actually started making some kind of sense.

Chris, Beth: Really?

Beth: How is it possible?

Dorothy: Well, it's difficult to explain but apparently, at least from what I understood, maths can be very useful in life and it's not all about memorizing formulas and theories but about thinking in a certain way, recognizing patterns, making connections and applying them in different forms in our daily lives.

(All seem sceptical)

Chris: Oh wait. I think I get what you mean. Like if when I'm playing assassin's creed and there is a secret puzzle I have to unlock to get to the treasure then I can use maths to help me get a better score! Or if I enter the battlefield with my player and instead of rushing onto the enemies I try to look at the map and see where our radars have spotted their movement and based on my amazing skills and experience (smiling in a silly way) I figure out which way they are going to move and who they are going to follow, it may seem random but I can tell you it isn't. So... I guess I'm already a math genius then. I just didn't know that until now mwhahahah.

Beth: Yeah, yeah. (smiling at him and turning to Dorothy) Seriously? You could use maths everywhere?

Dorothy: Exactly.

Beth: Even with boys and relationships?

Dorothy: I haven't thought about that. I am pretty sure it could be applied to almost everything because that's what Miss Patterson implied but I can't see how in this case. Especially since relationships function on many levels and I assume feelings don't follow a certain pattern.

Beth: I guess you have a point....(thinking for a while) but maybe....(pause). Wait!!! I think I found it. When you meet a guy and you start building a relationship, it's as if you are at zero. Slowly you start to discover the other person better and understand the connection between the two of you. If the guy is cool, and makes you feel special he gets extra points. If he has a bad temper, flirts with other girls or doesn't pay attention to you he loses points. After a while if the result is positive then the relationship should continue and the guy is worth keeping, if the result is negative then there is a problem and you should try to find a new guy that makes you feel better. Plus from previous experiences you can identify patterns that can confirm the previous numerical result and there you go. Wow...I am impressed, apparently I can be very good at maths too. (laughing)

Dorothy: See? I told you that maths is everywhere.

Chris: So what you are saying is that maths isn't just about numbers, difficult problems and endless formulas?

Beth: Apparently not. Maths has connections to subjects where you might not even expect it like art, music and poetry.

Chris: So why do we even bother with all these things that we'll never even use in our lives, unless we become mathematicians? Why don't they just tell us what you told us and end of the story?

Beth: Yeah, that would definitely be much easier.

Dorothy: As Miss Patterson says, everything happens for a reason. From what I understood the reason we do maths at school is to keep our brain awake

and functional. As I said before maths is everywhere. So through constant exercise it helps us think logically and as a coincidence to make better choices and become better problem solvers not only in the classroom but also in everyday situations. Once you are able to identify the hidden patterns and connections you become a better thinker and a harder worker.

Chris: Wow...that sounds logical! I never thought about that.

Beth: This Miss Patterson rocks! She taught you so many interesting things. I hope I will have her too next year. She sounds brilliant!!!

Dorothy: Yeah, she is. However homework still seems boring and we haven't done anything yet.

Chris: Oh gosh!...being a kid is so demanding and tough. (Girls laughing). Ok then lazy birds, go back to your homework and stop making fun of me. And who knows, maybe it will help you to finally convince a guy to be your boyfriend one day (laughing loudly)

Beth: Hahaha...you are extremely funny Chris. (being ironic)

(Mum enters the room holding a tray with lemonade and sweets)

Mum: How is it going here? (Checking the notebooks) I can't believe you haven't done anything yet! Don't you realize that it's for your own good?

Chris: (in a bored tone of voice) Yeah mum, we know. We were just about to start.

Mum: You'd better be. I will go and work a bit in the garden and when I get back I want you all to be done with your homework. And don't fight over the sweets.

Dorothy: Don't worry mum. I will take care of that.

(Mum goes away)

Beth: Great. Let's eat some sweets. Shall I share them in three equal portions?

Chris: Yeah, yeah, yeah!!!

Dorothy: Or shall we divide them based on the ratio of our age? or weight? Or even our height...?

Chris: Cool, can we do that? Do you know how? ...but wait a second. Does that mean that I get to eat less than you two? I don't want that! (Thinking for a while) Wow! Maths and its understanding are spreading. Once you enter the game there is no way back. Math is everywhere! It's even hidden behind sweets. We are trapped for eternity!!! (Said in a funny way)

Dorothy, Beth: You got that right Einstein.

(Everyone laughs and then get back to their homework)

Lights go off!!!

Honorable Mention

A letter to Ms MacNamara

Written by Dylan Coburn Gray from Ireland

CAST:

D, protagonist. Of school-leaving age.

Ensemble ONE through SIX. Of any age.

A SHADOW. Not seen, but onstage throughout.

SET: a white scrim, through which a lamp can be shone. A screen for projections. 8 chairs, on which ensemble sit. D stands downstage of them.

No single actor plays Ms MacNamara. Different performers voice her at different times.

The play uses people and their shadows to graphically render the 'pairs' when discussing powers of i and their resultants. Hopefully, this will make clear the intuitive logic which underpins this proof.

This is based on an actual incident in my final year of school, and the convoluted method shown for solving for powers of i is the one actually recommended by Irish schoolbooks. Shocking, I know.

D: Dear Ms. MacNamara, remember me? I remember you. You were small, slim, curly hair and glasses. Young. Attractive. REALLY attractive. Felim asked you to be his date to our graduation, and you said no. Laughter all round.

ALL: Ha. Ha. Ha.

D: And I laughed too but I was also pissed off. Because I had wanted to ask you, and if you said no to Felim you'd definitely say no to me because I wasn't even blonde and charming.

You were cute. You had a Mayo accent, and it meant you said 'remainder' funny. Like this:

ONE: Ru-MEEN-dur.

D: and that was cute. You had this habit of putting teacher pauses in the middle of words where they didn't accomplish anything, and THAT was cute.

You know what I mean by teacher pauses? You'd say:

TWO: *(points to scrim as though it's a blackboard, in character as MacNamara)*. And now that we've re-expressed the initial statement as two fractions, we should try and find a lowest common de-...? *(questioning intonation)*

THREE: *(raises hand)* -nominator!

D: What else was it going to be? It was cute. Particularly when people got it wrong.

FOUR: *(pointing at scrim like it's a blackboard, as MacNamara)* And now we find the square of the hypo-...?

FIVE: -potamus!

ALL: *(derision)*.

D: I remember the powers of i more than anything else. It was the first time I felt maths was creative. I solved something. Not for marks, but because I wanted to. For myself. i is the root of minus one. You said-

SIX: -which is tricky, because think about it. David, what happens when we square minus one?

ONE: Miss, I need to piss.

TWO: YOU CAN'T SAY PISS IN CLASS.

ONE: I need to go to the bathroom then.

SIX: Go on so. Ella?

THREE: You get one. *(projection screen shows up* **'-1.-1=1'**)

SIX: True. So what's the square root of minus one?

D: Trick question. No number squared can be negative. Minus times minus is positive. So the root of a minus number is notional. Doesn't conform to our understanding of the world. But i, the symbol, is a handy little hand-wave, because if we assume that minus 1 has a square root then we can manipulate negative roots like any other number. *(projector screen shows '***root -1 = i'** *a light behind the scrim shines brightly, throwing SHADOW'S shadow onto the scrim.)* We can't see it, but its behaviour is recognisable. Logical. *(SHADOW waves.)*

THREE: *(as MacNamara)* One of the questions they ask is to solve a power of i. And the way to do it is to break it down into known powers of i. i squared is **-1**. *(projector screen shows* **'i^2=-1'**)

FOUR: So i cubed is i times -1, which is -i. *(projector screen shows**'i^3=-i')***

FIVE: i to the power of 4 is i squared squared. -1 squared, which is 1. *(projector screen shows **'i^4=i^2.i^2=-1.-1=1'**)*

SIX: And i to the power of 5 is i to the power of 4 times i, which is i. *(projector screen shows **'i^5=i^4.i=1.i=i**)*

D: And when the exam gives you a power of i like i to the power of 27, you're supposed to just render it in terms of those quantities. *(projector show **'i^27=(i^3.i^3.i^3)^3=(-i.-i.-i)^3=i^3=-i')*** That's the way they teach in the book. But I hated that. It wasn't simple. It wasn't straightforward. So easy to get lost. So you said:

SEVEN: There are other ways. Think of one! (touches D on the arm.)

D: Instant butterflies. And this is the good bit for me. The exciting bit. Using my brain. I think: it's all about pairs. Because i squared is -1, any index which is a

multiple of 2 will give either 1 or minus 1. Those are the only possible results when multiplying minus ones.

ONE: i squared is -1. i to the power of 4 is two minus ones, makes 1. *(ONE and TWO move to scrim, a bright light downstage illuminates ONE such that ONE's shadow falls on the scrim.)*

D: *(counts ONE and his shadow)* i times i is minus one. *(counts TWO and their shadow.)* i times i is minus one. Minus one times minus one gives-?

TWO: One. But so will 4 minus ones.

D: Which would be i to the power of 8. *(THREE and FOUR move to the scrim so that their shadows are also visible.)* 1 2 3 4 i squareds, 1 2 minus one squareds, 1 2 ones. Doesn't matter how many 1s you have, they multiply to give 1.

D: So an even numbers of pairs of i squared will always equal 1.

*(projector shows **'i^n where n/2 is even = 1'**.)*

THREE: Why only even numbers of pairs?

D: Because if you have an uneven number -

FOUR: Then you have a minus one. *(FOUR steps away from the scrim, leaving ONE TWO and THREE.)*

D: *(indicates ONE and shadow, TWO and shadow, THREE and shadow in turn.)* 1 2 3 i squareds, a single minus one squared and a minus one left over. One times minus one is always minus one, so -

FIVE: Any uneven number of pairs of i squared will always equal -1.

*(projector shows **'i^n where n/2 is odd = -1'**)*

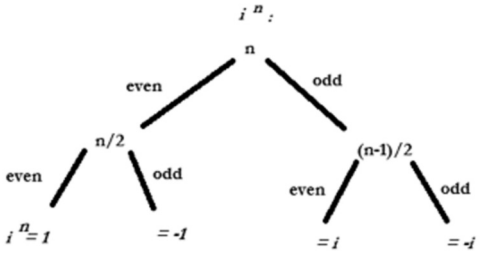
D: And if the overall index is uneven, then you don't have an i squared left over, but an i. An imaginary bit on its own.

(SHADOW is illuminated from behind the scrim, such that ONE, TWO, THREE and their shadows and a fourth SHADOW with no body can be seen.)

SIX: But the same rules apply, really, once you've taken away one i. An even number of pairs will give a 1, multiplied by i is i.

ONE: An uneven number of pairs will give a -1, multipled by i is -i.

*(projector shows **complete chart**.)*



D: I showed you this. You were impressed. And you said -

FOUR: That's really well reasoned.

D: And I said that the best bit is it works for ANY power, no matter how huge. Even i to the power of 5896.

ONE: 5896 divided by 2 is 2948 -

TWO: - which is even -

THREE: So in the end it's just 1.

FOUR: Very elegant. You should study maths.

D: I should?

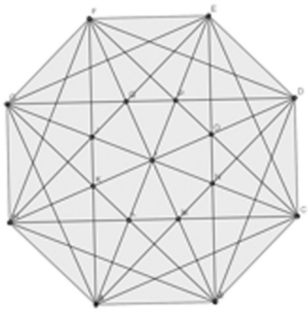
FOUR: We might end up working together someday. *(touches D's arm.)*

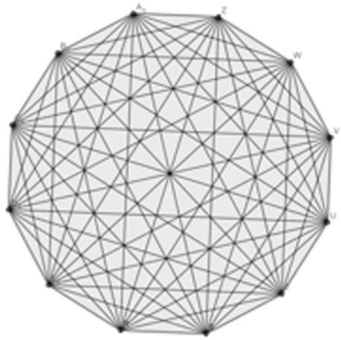
D: I didn't study maths in the end. And I didn't ask you to be my date to the graduation. But that's ok, because what was this all for if not pleasure in the imaginary? *(music starts. ONE through SIX leave, and D dances with the SHADOW.)*

Honorable Mention

A mysterious number

Written by Tobiasz Szemberg from Poland





The scenography for this play requires a large LCD display in the background or hanging above the scene, two or more smaller displays should also do the job. On this display a script written with a free software GeoGebra will illustrate geometrical situations discussed in the play. It may exhibit also the initial state of Alex' computer activity, he plays League of Legends (LOL for short), an extremely popular among teenagers multi-player computer game.

Characters (in order of appearance):

Alex: a teenager of 14 years old, loves computer games, hates school.

Charlie: Alex's buddy. Same habits.

Brain: His real name is Brian. He's nicknamed for his extraordinarily strong sense for exact sciences.

Place: Alex' room.

Time: Present.

Costumes: Everyday wear.

Setting: *Alex' room. Cloths and books lie all around on two extra chairs and on the floor. A lonely teenager sits at his writing desk and plays a computer game, LOL. He communicates over computer with some friends of his. We hear only what he says.*

Scene I.

Alex: Yeah, give him! Finish him of!

Alex: Oh, my God, where is the jungler?

Alex (screaming): Attention, they approach on the mid.

Alex (angry and resigned):

No, Danny! No! What have you done?... No!...No!

(Knocking on the door. No reaction from Alex. The door opens and Charlie enters the room.)

Charlie: Hi Alex!

Alex (turning in the chair):
Oh, hi Charlie! I didn't hear you knocking.

Charlie: I know.

Alex: But you still knock, I suppose?

Charlie: Sure. Good habits have deep roots.

(Both laugh.)

Charlie: How is the game?

Alex: We have just lost one. Danny...

Charlie (laughing):
Let me guess. He remained the whole game lost in the jungle!?

(Both laugh.)

Alex: Worse. Way worse.

Charlie: He forgot where his Nexus is?

Alex: No, he feeded the enemies all the time, waiting for his flash to form...

Charlie: ...and then throwing it at someone with less than 100 HP...

Alex: Exactly!

Charlie: Egh. (After a while of silence.) Shall we play together?

Alex: S ure. Get your laptop ready!

(Charlie is packing out his laptop and getting it started.)

Alex: Will you take over the mid?

Charlie: I love to control the diagonal!

(The door opens. Brain enters the scene. He wears thick glasses, his haircut is all confused.)

Brain: Diagonal? Did I hear right? You pals are doing some maths?

(Both guys turning to the door.)

Alex: Oh, Brain! I didn't hear you knocking...

Brain: I know, I don't bother anymore.

Charlie: Why? You are usually so polite.

Brain: Sure. But Alex never hears knocking on the door. He's too busy with his games!

(Brain approaches the desk and looks at the monitor.)

Brain: I see you are busy with LOL.

Alex (sighting):
As usual.

Brain: But what about this diagonal?

Charlie: That's the mid.

Brain (puzzled):
The mid?

Alex: We call so one of the lanes in the game. (He adds in a I—know—it better tone.) It's between top and bot.

Brain: May I have a look? I don't understand you quite.

Alex and Charlie (simultaneously):
YOU DON'T UNDERSTAND?

Brain: I don't understand.

Alex: But you know everything!

Brain: No, no. Certainly no. I ask questions and remember answers, that's it.

(Incoming SMS sounds on Alex' phone)

Charlie: Who's that? Some chick?

Alex (getting red):
You are stupid! (reading the SMS) It's my mum.

Brain: She opened the door for me.

Charlie: For me, too. She's home...

Alex: So?

Brain: Why is she texting you then?

Alex: Oh, she hates to enter my room. She keeps saying this is all so untidy (he waves with his hand around).

Brain and Charlie (simultaneously):
Uhm...

Alex: What? Anyway, she asks if you want to drink or eat something.

Charlie: I wouldn't mind a coke.

Brain: I'll take some tea with raspberry juice (typical drink in Poland).

Alex: Ok, I'll bring it for you.

(Alex leaves the room.)

Brain: Do you reckon he has some girlfriend?

Charlie (laughing):
Sure. Katarina.

Brain (surprised):
Who's Katarina?

Charlie (still laughing):

A character in LOL. Perfect for the mid.

Brain (also starts to laugh):

Oh, got it.

Brain: Coming back to this diagonal...

Charlie: Yeah. Have a look.

(They both look at the monitor.)

Charlie: I explain. This is the battlefield. (They browse the map of the game for a while)

Brain: That's a square.

Charlie: Sure. And that lane in the middle, that's the mid.

Brain: Or the diagonal?

Charlie: Nope.

Brain: What about the other diagonal?

Charlie (puzzled):

Which other diagonal?

Brain: Yes. There are two diagonals in the square...

Charlie: Well, I guess... (he hesitates for a moment) ... the other diagonal is right in the jungle. (he finishes cheerfully).

(Alex enters carrying the drinks.)

Alex: Will you play with us Brain?

Brain: Why not? I might give it a try.

Charlie (surprised):

Oh, great!

(Brain starts to pack out his laptop.)

Alex: You've got LOL on your comp?

Brain: Do I need to?

Alex: Yes, You need to install this on your comp.

Brain: I thought, it's an internet game.

Charlie: It is, but you still need to install it.

Brain: Ok. You tell me where I should browse.

Alex: Just enter LOL in google.

Charlie: But this will take ages to get it downloaded!

Brain: It has already started. And it's not so bad. It says about 40 minutes.

Alex (whispering):

Not so bad...!

(They drink for a while in silence.)

Brain: Are there some other battlefields?

Alex: What?

Brain: You know. If you can play only on a square?

Charlie: What else could you play on?

Brain: Some other regular polygon? It could be more interesting.

Alex (sceptical):

Really?

Brain: Yes. Let me show you while we wait for the download to finish.

(Brain starts GeoGebra on his laptop. We see what he does on the large screen.)

Alex: Cool. Can it draw for you?

Brain: Not really for me. But it can draw what I wish.

(Brain draws a square.)

Brain: See, that's the square.

Charlie (ironically):

I would never guess.

(Brain adds the diagonals.)

Brain: And these are the two diagonals.

Alex: But there is just one in LOL.

Charlie: I told him so.

Brain: I know. But let us forget LOL just for a moment.

Alex and Charlie (simultaneously):

Forget LOL? Never!

(All laugh.)

Brain: Ok, guys. As you see both diagonals meet...

Charlie: In the middle point.

Brain (beaming):

Very good, Charlie! They meet exactly in the middle point.

Alex: It will be always like this for these polynoms, right?

Brain: Polygons. Let us check this. I'm drawing now a regular pentagon. (He is performing a construction of a regular pentagon in his program.)

Charlie: Sounds satanistic.

Alex: No, pentagram is satanistic. (He is drawing the star using vertices introduced by Brain.) Can you see the difference?

Brain: Actually pentagram was already used by Sumerians.

Alex: I recall now that there was something about pentagram and Pythagoras, right?

Brain: Right. But this is not so important now. Look at the picture!

(A moment of silence.)

Alex: What?

Charlie: What exactly shall we see?

Brain: The midpoint.

Alex: Ah. I see. Oh! There is no diagonal passing through it!

Brain (smiling):

That's right!

Alex: This means I was wrong. It happens only for the square.

Brain: I would say that just your first guess was wrong.

Charlie: I have a guess now. We have now all diagonals of the pentagon in the picture. And they meet pairwise. That must be it! There are never more than two diagonals passing through one point!

Alex: And that's why the five diagonals of the pentagon cannot pass through the middle point!

Charlie: We have made a discovery!

Alex: Brain, your intelligence is contagious!

(All laugh.)

Brain: Not so quickly. Let us have a look at the regular hexagon. (He starts a drawing on GeoGebra.)

Alex: Oh, it looks that...

Charlie (interrupting):

Yes, these longest diagonals meet in the middle...

Alex: And there are exactly 3 of them!

Charlie (resigned):

Good bye discovery.

Brain: Don't give up! It happens extremely rarely in mathematics that the first idea works. We have just began our experiments!

Alex: You are right. We need more pictures.

Charlie: Let us all install this clever program. Then we can make more pictures in less time.

Brain: Good idea. This is a powerful program but its size is just peanuts when compared to any of your games.

(They work on their computer in silence for a while.)

Alex: I have a new idea.

Brain: A conjecture?

Charlie: What's a conjecture?

Brain: A conjecture is something you believe to be right but you cannot quite prove it.

Alex: And if you can?

Brain: Then it is a theorem.

Charlie: Like Pythagorean theorem?

Brain: Exactly.

Alex: Hey, we can get famous proving a theorem!

(All laugh.)

Brain: And we can earn money this way.

Alex: Really?

Brain: Real money.

Charlie: How real?

Brain: How about one million dollars?

Alex: What?

Charlie: One million dollars for doing some maths?

Brain: Not exactly „some maths". You need to go deep into the subject. (After a while.) Actually I don't understand exactly what you need to prove. One has to study the subject first.

Alex: Ok, ok. Before we make money, we can announce our theorem.

Charlie: Our ABC—Theorem.

All together:

Right! Alex—Brian—Charlie Theorem.

Charlie: Wait. What do you reckon, Alex?

Alex: Look. If the number of vertices is an even number, then there are exactly half that many diagonals passing through the middle point. Right? (He turns to Brain.)

Brain: Looks ok.

Charlie: And can we prove this?

Alex: Yes. Here is the idea. Say there are n vertices...

Brain: It's better to assume that there are 2n vertices.

Charlie: Why?

Alex: Ah, you are right Brain. I assume the number of vertices is an even number.

Charlie: Ok, I see. You can write it as 2 times some other number.

Alex: Yes, and it is more convenient this way. No need to work with fractions.

Charlie: I hate fractions.

Brain: Why?

Charlie: I always do everything just all wrong about them.

Brain: Come on, you would not pass that far in school without knowing how to handle fractions...

Charlie: Well, when I concentrate...

Alex: May we come back to our theorem, gentlemen?

Brain and Charlie:

Sure.

Alex: So, I label the first n vertices with numbers 1,2,3 and so on.

Charlie: And the other n?

Alex: The other n with numbers 1',2',3' and so on.

Charlie: But there are no such numbers.

Alex: Ok, ok. These are some symbols.

Brain: And now you join 1 to 1', 2 to 2' and so on?

Alex (cheering):

Exactly!

(Alex' cellular phone rings.)

Alex (looking at the display):

Oh, it's my dad.

Alex (picking up the phone):

Hi dad.

Alex (proudly):

I'm proving theorems!

Alex: In geometry.

Alex: I'm serious. It's so exciting.

(Listens for a while.)

Alex: No dad, don't worry. I'm home with Brain and Charlie and we have this program, I'll show you when you come back.

Alex: I love you too.

(Alex puts the phone aside.)

Alex: It was my dad.

Charlie: What did he want?

Alex: He saw that I'm not playing LOL for a while and got interested in what I'm doing.

Brain: He traces you in the game?

Alex: I guess he plays himself. But he would never admit it, of course.

Brain: My dad plays assassin or something like that.

Charlie: Your dad plays computer games?

Brain: Why not?

Charlie: But he is somehow always official and you know...

Brain: Yes, he is a dean at the university. When he comes home, he says he must kill some virtual beings otherwise one day he would kill one of his co-workers.

(All laugh.)

Charlie: What about our other question?

Alex: Which question?

Charlie: If there might be some other points apart of the middle point, through which more than one diagonal passes.

Alex (looking at his display):

Yes. There might be! Look!

Brain: It is an octagon.

Alex: Yes. There are four diagonals passing through the middle point.

Charlie (leaning over):

And there are... one... two...

Brain: Eight.

Charlie: Right, eight points where three lines meet.

Alex: Let me just mark these points...

Charlie: Awesome!

Brain: They form a new octagon.

Charlie: Just a smaller one.

Alex: Yes. And see! There are way more patterns in this picture.

Charlie: Which?

Alex: For example the Maltese cross.

(He points out the shape on the screen.)

Brain: I wonder if we can produce even more diagonals passing through one point, which is not the middle point.

Charlie: Let us check some polygons with more vertices.

Brain: Ok, I will draw a dodecagon.

Alex: A dode what?

Brain: A polygon with 12 vertices.

Charlie: Why is it called so?

Brain: I guess, this is Latin. But I don't know really.

Alex: It will take quite a while now. So many diagonals...

Charlie: Hundreds.

Brain: It cannot be that much. Actually we can compute it exactly.

Alex: There are 12 vertices and we join them in pairs. So there must be 12 times 11 diagonals.

Brain: Not quite.

Alex: Why?

Brain: You have joined already the edges of the polygon.

Alex: Oh. So I need to subtract something.

Charlie: It must be 12 times 9 then.

Alex: How does this 9 come?

Charlie: You have 12 vertices. You don't join the vertex to itself.

Alex: Sure, this was my 11.

Charlie: And you don't join it to its two neighbours neither. This gives 9.

Brain: You still need to divide by 2.

Alex: How does this come?

Charlie: He's right. We counted each diagonal twice.

Alex: Ah, I see. Once coming out from one vertex and then from the other end.

Brain: Exactly!

Charlie: This gives then 54 diagonals for 12 vertices.

Brain: I'm almost done with drawing them.

Charlie: And we can prove another theorem.

Alex: Which one now?

Charlie: On the number of diagonals.

Alex: Ah. We repeat the same calculations.

Charlie: Yes. Suppose that there are n vertices. Then we join one to (n-3) others.

Alex: And divide by 2.

Brain: So we have a formula. n times (n-3) divided by 2.

Alex: If we take n equal 100, then it's too much to draw...

Brain: I'm done with n=12. See!

(All lean over Brain's laptop.)

Charlie: Four!

Alex: And three again.

Brain: Many threes. I mean many points where there are 3 diagonals meeting.

Charlie: But only 12 points with fourfold meeting. I mean where 4 diags meet.

Alex: Yes, and these 12 points

All together:

form another dodecagon!

Charlie: Awesome.

Alex: Can we find five? Six? Hundred?

Charlie: If we have enough time.

(Knocking on the door.)

Alex: Come in.

(Door opens. Danny comes in.)

Danny: Hi Alex. I was talking to you on skype.

Alex: Hi Danny.

Brain and Charlie:

Danny, hi. How are you?

Alex: I'm not online.

Danny: I see. What are you doing?

Charlie: We are doing research!

Danny: You are kidding me! Show me what you have there. (He approaches the computers and looks puzzled)

Alex: I will explain you...

(Some music. Curtain goes down)

Scene II

(A couple of hours later. There are more empty glasses staying around. Also some pizza boxes lie on the floor. Four persons stretch they arms as after a long concentrated work.)

Charlie: I think, I have to go home.

Brain: Oh, gosh. Me too.

Alex: We need to write down tomorrow what we have discovered today.

Charlie: Absolutely.

Danny: I still can't believe in this number.

Alex: But we have a proof!

Brain: Rather, sort of.

Charlie: Seven. Why seven? How does it come that there cannot be more diagonals passing through a point different from the middle point?

Brain: No idea, really. This is very strange.

Alex: And very exciting.

Charlie: Even more exciting than playing games.

Alex: Way more.

Brain: Just imagine what else we can discover.

(The lights go down.)

A voice behind the scenes: And now that our show is over, can you, dear follower, find the argument to show what the boys have discovered that never more than seven diagonals of the regular polygon can meet in one point, unless it's the middle point of the polygon?

The logic of the stolen iPod

Written by Rimantas Pupeikis from Lithuania

The action takes place in the schoolbuilding. There are nine pupils and a teacher of mathematics in the schoolroom. One of the pupils is suspected has stolen iPod. The pupils and the teacher agreed without any help from outside to have a talk to find out who has commited the act. The mathematician is sitting at the computer. He types out pupils' confession by the computer keyboard. A projector shows them on a large screen for public viewing:

John: Victor has done that.

Bern: It is not true.

Mary: I stole it.

Vincent: Either Mary or Ann did that.

Victor: Bern is lying.

Steeve: Mary did that.

Lena: No, Mary did not steal iPod.

Ann: Neither Mary, nor I did that.

Ruth: Ann is right, but Victor is not guilty, too.

Teacher: Let us analyze this event mathematically in spite that Mary pleaded guilty. To this end, we shall use logic algebra based on statements. First, I shall make the following statements: `Y did that` or `Z did that`, etc. marking by Y and Z the first letters of your name, respectively. Second, we will write our problem mathematically as follows:

John: Vic; **Bern**: $\overline{\overline{Vic}}$; **Mary**: M; **Vincent**: $(M \vee A) \,\&\, \overline{\overline{M}} \,\&\, \overline{A}$; **Victor**: $\overline{\overline{Vic}}$; **Steeve**: M;

Lena: $\overline{\overline{M}}$; **Ann**: $\overline{\overline{M}} \,\&\, \overline{\overline{A}}$; **Ruth**: $\overline{\overline{M}} \,\&\, \overline{\overline{A}} \,\&\, \overline{\overline{Vic}}$.

Third, I shall mark the propositions `Statement X is true` or `Statement X is false` as follows: X=1 or X=0, correspondingly. Finally, assume that only three confessions from nine written by you are right. We add a premise that the committer of the act is one person. Who has stolen iPod?

(Confessions, assumption, and premise are displayed on a large screen for the audience to be viewed).

Thus, we will try to solve our problem using the statements of logic algebra. By the way, does anybody know the initiator of logic algebra?

Vincent: George Boole, English mathematician, is the founder of this part of mathematics. He published the study `Investigation of the Laws of Thought` in 1854. In his logic algebra there are logic variables X, Y, Z, ... , that can acquire only two values: true or false, 0 and 1, respectively. His mathematical system

became known as Boolean algebra.

Teacher: That is good. And, Lena?

Lena: Logic functions are related logic variables. The logic function F=F(X, Y, Z, …) can acquire only two opposite values, too.

Teacher: OK. Would you like, Vincent, to add something?

Vincent: Sure. In 1904 E.V. Huntington published the paper `Sets of Independent Postulates for the Algebra of Logic`, in which he described the elementary logic functions AND, OR, and NOT.

Teacher: Excellent. And you, Bern?

Bern: Well, well, I..., well, hm... I am interested in electronics... I know that Claude Shannon published the paper, – summary of his Massachusets technical institute master's thesis, – `A Symbolic Analysis of Relay and Switching Circuits`, in which he has used the Boolean logic for electric circuits for the first time.

Teacher: It is very interesting. I know that Steeve has a head for electronics, too. Do you want Steeve to tell us more about electronics?

Steeve: Well, it is known that all information in a computer is circulating in the form of electric signals of two levels, for example, a voltage close to the feeding voltage and a voltage close to zero. One of these levels is nominated as the unitary level and the other – zero level. Therefore, all operations in a computer are performed using the binary calculation system. The functioning of its elements takes place according to Boolean algebra.

Teacher: I see. Do you have anything else, Mary?

Mary: I read a crime story written by John Reese last year. The symbolic logic was used for investigating the cruel murder in the street. Its title is ... well, I don't remember accurately, but I know exactly that at least `the symbolic logic` was present in it.

Teacher: `The symbolic logic of murder` such is the title of fiction written by Reese. I suppose, our problem is simpler in comparison with computer operations and crime fiction. Now, I will try to remind you in short the essence of of the proposition logic that is the main part of the symbolic logic. A proposition is a statement which is either true or false but not both. A proposition is reputed to be a sentence about which one can say that it is correct or incorrect. One can build new propositions based on the previous ones. For example, it is possible to deny the statement `the plane does not start at eleven o`clock` using the new statement `it is not true that the plane does not start at eleven o`clock`. It is easy to build a new statement from the two previous statements `the bus is late` and `I can not wait till it comes`, like this:„ the bus is late and I cannot wait till it comes`. Thus, I presented here examples of composite propositions, that are made up by using other simple propositions. In such a case, some usable phrases are:

`not true that... ` (a negation marked by symbol `–` which is shown by a short stroke above the letter); `if..., then... ` (a material implication; symbol `→`); `... and ... ` (a conjuction or logical multiplication; symbol `&`); `... or ... ` (a disjunction or logical addition; symbol ` `); `... if and only if... ` (an equivalence; symbol `≡`); `... not identical to... ` (a non-equivalence; symbol `≢`).

We can combine any two propositions by means of the above mentioned phrases. These are called the logical connectives and frequently functors. Propositions which are related with the logical connectives are called compound propositions. A proposition without any connectives is called a simple proposition. Now, I show you how we can determine simple propositions making use of a special table.

The teacher types the table, as follows:

Table 1

X	$\overline{X}$
1	0
0	1

It is shown on the screen, too.

Teacher: Table 1 represents a negation functor having such a feature: if the proposition X has a meaning of correctness `true` (marked by sign 1), then the negative proposition $\overline{X}$ (we draw a short stroke over X) has the meaning of correctness `false` marked by sign 0. If X is `false` (the value in the second row below X), then $\overline{X}$ is `true` (the value in the same row below $\overline{X}$). Frequently, it may be used to determine the negation functor taking into account only its relationship with possible meanings of correctness, thus, loosing touch with the proposition`s content. This feature is obligatory for all functors that will be presented here. By the way, negations are used in the statement of our problem, too. Bern negated John`s proposition. On the other hand, Victor negated Bern`s proposition. Thus, he negated Bern`s negation. Therefore I draw two short strokes over `Vic`. Lena negated Steeve`s proposition. And that`s all for the moment because Vincent`s, Ann`s and Ruth`s propositions are not simple ones. They are *compound propositions* and require a further explanation. Well, Steeve, can you tell us which logic functions are secured by logic elements that are used in computers?

Steeve: Well, there are three logic elements in electronics that actions by Boolean operators AND, OR, NOT. As the output of the logic element, based on the operator AND, there appears a unit only if in all its inputs, there are acting units. As the output of the logic element, based on the operator OR, there will be a unit if at least one of its input there is a unit. As the output of the logic element, based on the operator NOT, there will be a unit only if in its input there is zero, and the contrary is valid, too. It is possible to build all computer nodes by connecting respective logic elements.

Teacher: You surprised me. I can say that a negation functor is called a one-argument functor, because the new proposition, that appears by negating, does not depend on other propositions. It depends only on the given proposition. Now, I shall show you a second table, containing compound propositions with functors of two arguments.

Table 2

X	Y	$X\&Y$	$X \vee Y$	$X \rightarrow Y$	$X \equiv Y$	$X \ Y$
1	1	1	1	1	1	0
1	0	0	1	0	0	1
0	1	0	1	1	0	1
0	0	0	0	1	1	0

The table is shown on the screen.

In this table, in the first two columns below propositions X, Y the meanings of correctness, are written, as usual. They are presented in four rows where all possible X, Y acquire the values of units (the propositions X,Y have the meanings of correctness `true`) and zeros (propositions X, Y have the meanings of correctness `false`), respectively. In the third, fourth, fifth, sixth and seventh columns, the meanings of correctness of compound propositions are given. Here the meanings of correctness of the functors &, $\vee$, $\rightarrow$, $\equiv$, are shown under a respective functor. The value of the first row corresponds to a combination of X, Y values 1,1, the second row to a combination 1, 0, the third row to a combination 0, 1, and the last one to the combination 0,0. Take a look at the statement of our problem. There is only one proposition that corresponds to a *compound proposition* with the respective functors of two arguments.

Ann: It is my proposition. Both of us, Mary and I, were talking when it happened.

Teacher: Sure. I wrote: $\overline{M}$ & $\overline{A}$. You see that M corresponds to X and A to Y.

Table 3

M	A	$\overline{M}$	$\overline{A}$	$M\&A$	$\overline{M}$ & $\overline{A}$
1	1	0	0	1	0
1	0	0	1	0	0
0	1	1	0	0	0
0	0	1	1	0	1

Next follows Ruth`s proposition: `Ann is right, but Victor is not guilty, too` which is of the form $M \ \& \ A \ \& Vic$. Thus, we have now a compound proposition with functors of three arguments. I show that in Table 4.

Table 4

$\overline{\overline{\overline{M}} \ \& \ \overline{\overline{A}} \ \& \overline{\overline{Vic}}}$.
0
0
0
1

The table is shown on the screen.

Finally, Vincent`s proposition is: `Either Mary or Ann did that`. By the way, I used brackets here, just like they are used in elementary mathematics. I represent it by the expression of the form $(M \vee A) \ \& \ \overline{\overline{\overline{M} \ \& \ \overline{A}}}$, having in mind that both of them could do that — to misappropriate the iPod. Am I right, Vincent?

Vincent: Sure. The girls could do that. They are crazy and unpredictable at all.

Teacher: Let us analyze the situation described in Tables 5 and 6.

Table 5

$M \vee A$	$\overline{\overline{M} \ \& \ A}$;	$(M \vee A) \ \& \ \overline{\overline{M} \ \& \ A}$
1	0	0
1	1	1
1	1	1
0	1	0

Table 6

$M \vee \overline{\overline{A}}$	$\overline{\overline{M}} \vee A$	$(M \vee \overline{\overline{A}}) \ \& \ (\overline{\overline{M}} \vee A)$
1	1	1
1	0	0
0	1	0
1	1	1

Obviously, if $(M \vee A) \ \& \ \overline{\overline{M} \ \& \ A} = 1$, then $(M \vee \overline{\overline{A}}) \ \& \ (\overline{\overline{M}} \vee A) = 0$ in Tables 5, 6, respectively. It means that either $M = 1$ and $A = 0$ or $M = 0$ and $A = 1$. There appear two situations here. Let us analyze the first situation.

If $M = 1$, then $A = 0$ and $Vic = 0$. Then, $M = 1$ is Mary`s proposition, and $M \equiv \overline{\overline{A}} = 1$ satisfies Vincent`s proposition. Steeve`s proposition is $M = 1$, too. At last, Bern`s proposition is $\overline{\overline{Vic}} = 1$. Thus, Mary`s, Vincent`s, Steeve`s, and Bern`s propositions are right. However, four right propositions contradict the initial condition, which declares that only three confessions are right.

Therefore, let us analyze the second situation.

If $M = 0$, $A = 1$, then $Vic = 0$, $\overline{\overline{Vic}} = 1$. Then $\overline{\overline{M}} \equiv A = 1$, $\overline{\overline{M}} = 1$, $\overline{\overline{Vic}} = 1$, or in other words, Vincent`s, Lena`s and Bern`s propositions are right. The remaining six propositions are wrong. It follows that the thief is ...

Suddenly a girl jumps to her feet and quickly runs outside.

Decimal form of numbers: to be "huge" or not to be...

Written by Ntinos (Konstantinos) Kordosis from Greece

Two fractions, 1/4=0,25 and 3/8=0,375 are having a conversation.

¼: Being a member of the high society of the class of fragments, having finite numbers in the decimal form, is indeed an advantage; but having one or two decimal elements is magnificent my friend, the greatest form of elegancy, to put it in other words.

3/8: Even having three decimal elements is magnificence and elegancy my friend!

¼: Of course! Considering all those plebeians that surround us, dragging their long tails as they walk… Yes, having three decimal elements is classy!

3/8: The most important quality is to know one's self! Be in charge of one's self, know one's own limitations!

¼: Yes, indeed! For what is it worth being a decimal fraction when one is obliged to drag behind him such a heavy burden?

3/8: Quite right, but at least decimal fractions possess a finite number of elements in the decimal form. The other day, I unexpectedly met $\frac{3758435820_4}{1000000000_8} = 3{,}758435820_4$

He was struggling to bear the weight of his own body! Sweaty and clumsy as he was at least he had some dignity!

¼: You are exaggerating, I think… Elegance is not a quality of the decimal fractions and as for dignity… one might suggest that they suffer from a type of arrogance!

3/8: Huh! Even those fractions expressed as repeating decimals are arrogant! Oh! Speak of the devil… Here comes 3/7 (at that moment 3/7 approaches the two interlocutors having a sign on his chest with the number: He wears a long tailed dress upon which the number is written in its decimal form as follows: 0,428571

428571

428571

428571

…….)

3/7: Hello everybody!

¼: Hello Mr. "Infinitepede"!

3/8: Welcome Mr. Zero point four two eight five seven one, four two eight five seven one, four two eight five seven one, four two eight five seven one… (moves his hand in rhythm and toots like an old train).

3/7: Do I sense a hint of mockery in your greetings, gentlemen?

¼: Noo! How did this cross your mind? On the contrary we are very serious! How did you end up with this long ugly tail?

3/8: Tail? What tail? Better say train! A train with a never ending row of wagons! It keeps coming from the tunnel and I don't see the end of it anywhere!

3/7: Yeah, right! You say these things only because you are so jealous and because all your decimal elements are getting bored of each other! You are so poor and hollow! Lacking any trace of mystery…

¼: So, where is your mystery? Is it in your tail which looks like a rattlesnake's tail with infinite segments?

3/8: Mystery, my foot! Every wagon coming out from the tunnel is the same as the previous one… Monotony, yes, mystery, no!

3/7: This ever repeating component that you disgracefully call "a rattlesnake's segment" or "train wagon" is my emblem! The thing that makes me identifiable in the crowd!

¼: Identifiable you said? Ha ha ha…

3/8: Look at him! He thinks he is a celebrity!

3/7: Stick to your knitting, you guys… I am not just anybody. I have a name in the streets, you know! I even have a fan club!

¼: Oh, my poor fellow… You are losing your mind…

3/8: … a fan club… Ha ha ha…

3/7: Yes, a fan club of integers!

¼: Yeah, right, I believe you… So which integers are in your fan club?

3/7: The sextant! Do you want to know what compliment she paid me the other day?

3/8: The sextant? She paid a compliment to you? The sextant, the first perfect number, which is equal to the sum of its divisors? What compliment was that, if I may ask?

3/7: She was looking at me… - no, not looking, better say gazing at me – and finally said: "Oh, honey, you are so huge…"

¼: Oh my God! You are such a big hoax!

3/8: That guy is dreaming…

3/7: (arrogantly) …And for those who have not succumbed to the charm of my tail… wait until I get my new suit which has been tailored for me by the mathematicians!

3/8: What new suit? What is he talking about?

3/7: Here! Have a look if you please: 3/7=0,428571 (He reverses the sign on the back side of which the number is written symbolically)

¼: What on earth is that? It is like a crown covering the decimal part of the number? I have never seen anything like that in my life…

3/8: If you were a bit more interested in fashion you would have… This is the last piece of haute couture presented recently in a collection. It set the stage on fire…

¼: Holly molly! Look! The tail is gone!

3/8: It is true! The freak turned into a normal!

3/7: I don't hear you laughing now, you guys. I guess now it is my turn to laugh and you know how that saying goes: "He who laughs last, laughs best!" Ha ha ha ha…

Equation: the tragedy of the unknown.

Written by Ntinos (Konstantinos) Kordosis, Greece

The stage is set to resemble a club, in this particular case a club of mathematical entities. The **Unknown** is sitting alone at a table. He looks disappointed and depressed as the waiter, enacted by no " ", approaches...

Unknown: Can I get a refreshment, please?

Waiter: Are you alright? You seem a bit pale...

Unknown: Sorry – really, I am not in the mood for chitchat – can I get that refreshment, please?

Waiter: Coming right up! (The waiter brings the refreshment and grabs the chair next to Unknown). Alone again, huh?

Unknown: Hum..., appearances can be deceptive... Especially when you're around....

Waiter: Well... Sometimes loneliness makes a good company...

Unknown: ... Says the guy who has never been left alone...

Waiter: Hey, leave it! You cannot help it! You see, being the Unknown attracts other people's attention! Everyone is curious to discover you!

Unknown: Oh, this far exceeds any curiosity!! This is a remorseless manhunt!! I am perpetually "Wanted"!

Waiter: My dear friend... This is the price you have to pay for being renowned, I am telling you! Look at me! I am completely undesirable! People hear "irrational" and the next thing that pops up in their minds is "unreliable"!

Unknown: That has got nothing to do with it…

Waiter: Oh, yes, it has everything to do with it! Look at me! Rarely do variables seek my company. As for the integers, they try to remain as far apart from me as possible as if I were a leper; and even though I have the most popular sub radical my reputation does not even match it! Had I not had this job here, I would have been totally excommunicant!

Unknown: What about me? What is my sociability? What is my benefit from it? From the moment I start hanging around with a number it transforms into a famous Hollywood star! People start calling it Coefficient and, next thing they try, is separating us by this vicious operation they call "Division": 2x=12<=> x=12/2<=> x=6. This is called "Division by the Coefficient of the Unknown"! I am warning you! This "Division" is a vicious, sneaky little thing!

Waiter: Seriously?

Unknown: What am I telling you? I cannot have a real, serious, undistracted bond!! I am not allowed to love anyone!

Waiter: Maybe you could try being a bit more evasive??

Unknown: … Meaning..?

Waiter: For example, you could try bonding with a number by an operation of inferior degree! Let's say by …"addition"?

Unknown: Oh, that! You think I didn't try that? Here: x+2=6 and here comes subtraction to separate me again! x= 6-2 <=> x=4! This is what they call the "separation of the unknown from the known numbers"! There can be no break-up with out pain!

Waiter: What about subtraction?

Unknown: It is all the same! There comes addition, subtraction's mommy, to separate me again! Look! X-7=1 <=> x=1+7 <=> x=8!

Waiter: I think you should follow a different course of action. Try not to appear but in very dense equations, so that people will not take notice of you.

Unknown: So, you suggest I should frequent wider representations so that I disappear in the crowd of numbers, right? Save your breath… I have tried it innumerous times before. It is a waste of effort! People reside to the most devious actions; they summon all mathematical operations to isolate me!

Waiter: How do they do that?

Unknown: They use strategy! Initially they use multiplication as their spearhead, supported by his daughter, division; they try to discard with the denominators in the representations I am in. Here:(x-1)/2 +x/3=2. What they do is multiply both parts of the equation with the Lowest Common Denominator (LCD), so: 6(x-1)/2+6x/3=6·2. Then they simplify, 3(x-1)+2x=12 an operation they call "Cancellation of Denominators".

Waiter: Yes, but you still have a bond! See?

Unknown: Hold your horses… Multiplication along with its sister, division – in this case – or with its mommy, addition (in other cases) are summoned by people to help them proceed with their destructive work: 3x-3+2x=12. The "Distributive property". That is my nightmare!

Waiter: Hmmm… Clearly they're getting closer to you…

Unknown: Next comes the "separation of known from unknown elements". In the one part they isolate those representations in which I participate. The other part of the equation contains the known numbers. Whichever element changes parts will also have to change signs: 3x+2x=12+3

Waiter: Devilry!

Unknown: … and once more they use Distributive property to totally isolate me: (3+2)x=12+3 meaning 5x=15: This is the notorious Reduction.

Waiter: Oh, my poor fellow…

Unknown: Eventually, as shown previously, the operation of division delivers the final blow! x=15/5 <=> x=5. There is nowhere to hide any more! I am desperate!

Waiter: Well, it's you who is to be blamed! Why do you walk around as a first degree Unknown? Can't you see that being a first degree makes you vulnerable?

Unknown: It is all the same as a second degree, too… They use the same methodology, only they take a bit longer to drag me out of my hole and my suffering is longer! They even use the Square Root to hunt me down!

Waiter: Then you should try equations of even higher degree! 3rd, 4th, 5th…

Unknown: I wish it were that simple… The higher the degree the longer the suffering! In such cases they use machines to track me down. These are those wicked machines they call computers! They will find me no matter what I do! Besides, I prefer living a simple life…

Waiter: By God I now realize how happy I am to be an ordinary number! Fame has its price..! Say, would you like a straight coffee? I think you need one…

Euclid's Dream

Written by Ntinos (Konstantinos) Kordosis from Greece

The act of multiplication, impersonated by a male pupil, is standing in front of the board, writing on it and mumbling: 56=28·2, 56=14·4, 56=7·8, 56=6·…

Multiplication: No, no, no… No such thing exists… (The act of addition, impersonated by a female pupil, enters the room).

Addition: What does not exist, son? You sound really troubled…

Multiplication: Look! There exists no natural number whose multiplication with 6 results in 56. I can split 56 into pairs or into groups of 28, groups of 14 or 4, by 8 or 7 but it is impossible to do it by 6, since 6·9=54 and 6·10=60! The same applies in the case of 5, since 5·11=55 and 5·12=60… and so on and so forth…

Addition: Excuse me, but, I don't understand why this is so important to you…

Multiplication: How could you understand!? You are the operation of Addition! You can express whichever natural Number you want as the sum of two other numbers!

Addition: This is just the result of my being the most fundamental, the simplest logical operation!

Multiplication: What do you mean by saying the "most fundamental"?

Addition: For example, I am the operation made by God to create Man! He took some dust from the ground and added his breath to it and lo! Adam was formed! Then he used subtraction! He subtracted a rib from Adam's side and by it He formed Eva! Then, when the two first humans were fooled by Temptation, God removed them from the Garden of Eden and sent them to Earth to perform multiplication… The rest you know…

Multiplication: Well…what do you know..!

Addition: Seriously! I may be always achieving my goals, but this requires a lot of effort on my part; while, you, as a more advanced operation, you need to put less effort in achieving your goals, albeit sometimes you have some drawbacks.

Multiplication: Can you become a bit more specific?

Addition: Look, let's say that you want to express number 35 by 5s. It only takes you one single try! 5·7=35; while I have to try six times to get to the same result! 5+5+5+5+5+5+5=35!

Multiplication: Yes, but you always get what you want, while I…

Addition: Oh, please stop whining… Listen, I'll help you! We are going to unite our forces together and, by the swiftness of multiplication and the simplicity of addition, we are going to achieve what you want. You said

that you can not express number 56 as the product of 6 multiplied by another natural number.

Multiplication: No, I can not because if I choose number 9 as the second factor then the product is less than 56 by two units: 6·9=54

Addition: Perhaps I could help by expressing 56 as: 56=6·9+2?

Multiplication: Yes, but…

Addition: There is no BUT! This is what you wanted, isn't it? To express 56…

Multiplication: Yes, but as the product of 6 multiplied by another factor…

Addition: I understand my boy, but this is unfeasible..! There! Your mom offered her help, take or leave it!

Multiplication: Hmm … as it seems it cannot be done otherwise… I can not divide 56 into sextants or groups of nines…

Addition: Did you say "divide"??

Multiplication: Yes! In other words "to partition", "distribute" or "to separate" 56 into sextets or into groups of nines...

Addition: You mean to say that it is not always possible to break 56 into several even parts?

Multiplication: Exactly my point! If one wants to express 56 as the product of 6 and 9 one has also to add 2. Meaning that the operation is neither addition nor multiplication!

Addition: True! One might say that this is a whole new operation…

Multiplication: Yes, a more advanced one and consequently one with more flaws.

Addition: Now you got it…

Multiplication: … and since we use this operation to divide a whole, let's call it "Division"!

Addition: The number which is to be divided should be called "Dividend" and the number of the resulting parts should be called "Divisor".

Multiplication: So, in our case the Dividend is 56 and the Divisor is 6. This means that number 9, which we use in order to approach – without surpassing – 56 as its product with 6 should be called Quotient. What name should we give to number 2?

Addition: Obviously "Remainder" or "Residue", as it is the amount that misses to get from the product of 6·9 to the desired 56.

Multiplication: Consequently the operation is as such: 56= 6·9+2. Generally if we symbolize the numerical quantities with their initial letters the representation becomes as such: $D=d\cdot q+r$ where the Remainder is always minor than the Divisor: $r<d$

Addition: Deal! Now, let's see if it works (Addition and Multiplication leave the center of the scene and sit by the side while the Quantities storm the

scene: The Dividend, the Divisor, the Quotient and the Remainder. The Dividend and the Divisor are impersonated by male students or pupils that wear T-Shirts bearing the corresponding symbols while the Quotient and the Remainder are impersonated by female students. The Dividend – preferably impersonated by a stout student – slowly lies on chaise-longue, followed by the Divisor. The Product remains standing while the Remainder is swirling vividly around them shouting, making gestures and protesting.

Remainder: There! You see? I am nothing but an errand boy in here!

Quotient: (addressing the Remainder) Relax, will you? And please stand still for a moment, we are getting seasick!

Remainder: Relax? How can I relax? This is a luxury for the MASTERS (pointing towards the Dividend and the Divisor) and for their PRIVILEGED (this time she points to the Product).

Quotient: (Annoyed) Are you suggesting something? I don't seem to understand what you mean…

Remainder: I mean that I am the most tainted, the most dishonored of all of you, bound by the desires of others; the one who does the errands and the dirty job!

Quotient: Dishonored? Bound? By whom or what?

Remainder: By the Divisor, of course! He does not allow me to move freely. I am always obliged to be minor than him! If I dare to equate with him I am instantly transformed into a ZERO, while you are augmented by a whole unity! That is no life, it is SLAVERY!

Quotient: Well, you cannot help it. We all have our genetic defects… As if I was not dependent on these two whiners! I am being pulled to and fro like I was made of rubber! If the Divisor sets his mind on rising, I get reduced and if he wants to decrease, I get pumped up!

Remainder: See? I told you, the Divisor is a DEMON!

Divisor: Hey, hold on a minute you two over there! Is that what you think about me? That I am the privileged one here? Hear this: I also have my limitations…

Remainder: Look who is talking now… I am telling you the dude has a lot of nerve to say that shamelessly!

Quotient: So… what are your limitations then?

Divisor: First of all, I cannot always surpass the Dividend…

Quotient: Huh! That is something I can NEVER do!

Divisor: And the worst of all is that… (while hiding his face with his palms)… the worst is that…

Quotient: WHAT?? Tell us…

Divisor: The worst is that I don't… I don't have the right to… to touch zero… for my whole life I cannot touch zero WHOAAAAAA...! (bursting into tears).

Remainder: Oh my God! What a hypocrite! He is playing the victim now…

Quotient: Come on now, you! Don't be so harsh with him. Obviously this is a problem for him.

Remainder: Ok, then! If he is not the culprit, then who is to be blamed for all our misfortunes?

Quotient: (pointing towards the Dividend) He is the one remaining, so this is the guy who has caused all this unhappiness to us!

Dividend: (surprised and lightly alarmed) … Sorry?

Divisor: (also pointing towards the Dividend) Yes! Do you see anyone else around? He is the one responsible for all these!

Remainder: By God, you are right! It is definitely him! Oooh, look at him playing it cool and innocent…

Dividend: (extremely worried) What are you talking about? Have you all lost your minds?

Remainder: Go get him! We will give him what he deserves! (They start moving menacingly towards the Dividend, who stands up ready to leave the scene in panic. At that moment Addition and Multiplication intervene).

Addition: Hey, you there! Behave yourselves! Stop accusing the dividend of all you unhappiness!

Remainder: Really? Then who are we to blame for all this grief?

Multiplication: No one. Just blame the way you perceive things…

Quotient: Do you mean that it is all a matter of philosophy?

Addition: Exactly! You, Remainder, need to take into account the fact that you have the advantage to relate with zero. As for the Divisor and the Quotient, they can swap their roles, whereby they could also relate with zero and thus enabling Remainder to have more potentialities.

Divisor: That is true! How come we never thought about it?

Quotient: What can I say? I never thought you were that much an altruist to deliver your role to me!

Multiplication: Now, leave in peace and stay out of troubles and fighting (The Divisor, Quotient and Remainder leave the scene but, Dividend remains in the scene standing).

Dividend: I am not going with these loony tunes! They hate my guts!

Addition: Don't worry; you are out of any danger. You may go with them. They know that their existence depends on yours. (the Dividend leaves the scene). Well, from what it seems distributing roles is a tricky affaire. There is always someone not happy with their part.

Multiplication: Yes, but we pulled this one off nice, though… We still have to give a title to this short performance.

Addition: Piece of cake. We are going to call it "Euclid's Dream"!

Multiplication: It sounds good but… I have an objection.

Addition: Why?

Multiplication: Well, you see those things you mentioned about God, Adam and Eve… By the time Genesis was translated Euclid had been dead for several centuries… There was no way he could have known all these, which are written in the Bible…

Addition: My child, when you talk about a man of Euclid's range the conventional notion of time is suspended. There is no "before" or "after" and time does not flow only towards one direction…

Multiplication: Oh… Ok, then! We have a deal! Let's call it "Euclid's Dream".

A Beauty Contest For Quadrilaterals

Written by Ntinos (Konstantinos) Kordosis from Greece

We are in an imaginary hall where beauty contests of geometric shapes are held. Currently, there is a quadrilateral beauty contest in progress. Shapes are incarnated by pupils wearing t-shirts that have the corresponding quadrilaterals imprinted on them. The contestants are the following: The convex quadrilateral, the concave quadrilateral, the parallelogram, the rectangle, the rhombus and the square. The panel of judges, who critique the contestants' performances, consist of the circle, the equilateral triangle and the regular hexagon. The stage resembles the Café of the hall, which is run by a polygonal chain, while the line segment works under her as the waiter. There are two doors at the Café, one leading outside the building and the other leading to the hall where the contests are held. There is a whiteboard placed at an apparent spot on the stage, upon which the previously referred shapes are drawn. The line segment, dressed as a waiter, is dusting the tables. After a while, he sits heavily on a chair, puffing. Then, referring to the audience, he begins a monologue.

Segment:

Huff! I am exhausted! As if I did not have everything on my head, I have to run for the contest, too… My boss, the polygonal chain, hastened to participate in the tender for the Café of the hall. She thought it was a bargain… and, to my dismay, she got it! The only nice thing is that I am going to have great laughs considering that the panel is formed by the circle, the equilateral triangle and the regular hexagon while the contestants are the convex quadrilateral, the concave quadrilateral, the parallelogram, the rectangle, the rhombus and the square! The contest will turn out to be a great carnival! (The polygonal chain enters the Café from the right door).

Polygonal chain:

Hey, kid, how is it going? Have you served the refreshments to the members of the panel, yet?

Segment:

No, boss, not yet. I was about to do it…

Polygonal chain:

You useless little monkey! You forgot it! Oh, God, I can not even stand the thought of that grumpy hexagon's whine again… Quickly, don't lose a moment! RUN! (She slaps the boy on the back of his neck).

Segment:

(complaining) Ouch that hurt! The heck with it all! Everyone is taking it out on me!

Polygonal chain:

Well, then maybe you should take it out on your inferiors!

Segment:

MY inferiors? And who might those be? The only inferior to me is that weird geometric entity called the Point, which has a place but does not have any

dimensions! It is an actual "nothing"! One moment you find it here the next it is over there! How can I take it out on something that is nothing?

Polygonal chain:

Come on now, cut the talking and do your job!

Segment:

Oh, alright (irritated, he grabs the tray and heads for the door, but, suddenly, turns around and angrily shouts to his boss): You all think you are the greatest in here and you all walk proudly like the king of France! Well, hear THIS: I am the greatest in here! If you want to know I am a primary geometric concept! I am not bound by any definitions! I DEFINE other shapes! One day I will be recognized and my pride will be restored!

Polygonal chain:

Move it! We will not strike up a conversation! (the convex quadrilateral enters the room from the interior door and collapses onto a chair, devastated, holding his face in his hands. Polygonal chain approaches him). What happened? Why are you in such a mess? Were you rejected?

Convex quadrilateral:

Rejected is light… I was humiliated! Almost eaten alive!

Polygonal chain:

Which ones of the three?

Convex quadrilateral:

Those two who play the big shots! That arrogant creature, the equilateral triangle said that my participation in the contest is a direct insult to the panel and that I am a disgrace for the family of quadrilaterals, a dangerous and anomalous geometric form without a hint of symmetry… This is a total intolerance towards difference. It is a hysterically racist behaviour!

Polygonal chain:

…Typical of the equilateral triangle! He is giving himself airs and graces, I am telling you! But the other guy, the circle, is much more polite, isn't he?

Convex quadrilateral:

He is all the same! As dogmatic as the triangle! They are alike! Only he is more diplomatic and plays it cooler. In reality he is a poser! Of course I know why he voted against me!

Polygonal chain:

Really? Why then?

Convex quadrilateral:

Because I refused to have one night stand with him! I refused to become inscribed! For centuries he has been trying to circumscribe me in vain! His ego can not take this.

Polygonal chain:

What a shame! What about the regular hexagon?

Convex quadrilateral:

Oh, what can such a docile creature say? He is completely submitted to the circle. Even his side is equal to the circumscribing circle's radius! Let alone that there is interplay with him and the equilateral triangle…

Polygonal chain:

What kind of interplay?

Convex quadrilateral:

Look: The angle of the regular hexagon is 120 degrees. It equals the central angle of the equilateral triangle. The angle of the equilateral triangle is 60 degrees and equal to the central angle of the hexagon!

Polygonal chain:

Wow! Not just interplay but crisscross corruption!

Convex quadrilateral:

Yes! This is why I am saying that the regular hexagon will never speak his mind! He just nods to what the others say…

Polygonal chain:

My poor fellow… You really are in serious trouble… Here, drink your coffee. It is straight to keep you up! Soon, the second rejected candidate will appear and the grief will be double…

Convex quadrilateral:

(staring at polygonal chain) What about you..?

Polygonal chain:

What about me?

Convex quadrilateral:

Well… Hum… I mean… Aren't you scared walking among all these Bigheads? Because… I mean… Hum… You are not perfect either, you know.

Polygonal chain:

(Examining herself for a moment, demonstrating the part which is not polygonal). What? Hey, you keep it to yourself, ok? After all I am NOT a contestant.

Convex quadrilateral:

You are not now! But will you not be when a line beauty contest will be held?

Polygonal chain:

Come on! Don't take it so hard! This is how life is. It is not about winning all the time… (the interior door opens suddenly and the concave quadrilateral storms the room, highly irritated. It goes and sits on a chair).

Concave quadrilateral:

I wonder how they came up with such a panel! (turns over to the polygonal chain) Can I get a shot of vodka?

(The Polygonal chain brings the spirits and sits next to him)

Polygonal chain:

You didn't even make it to the semi-finals, huh?

Convave quadrilateral:

It was inevitable… We live in times when regularity is taken as an asset and symmetry is a synonym to beauty!

Polygonal chain:

So, you were rejected by all three judges?

Concave quadrilateral:

With all of them being anachronistic and short-sighted and not a single one representative of progress, what did you expect? Conformists and old-fashioned!

Polygonal chain:

Everyone against you, huh?

Concave quadrilateral:

What am I telling you? The equilateral triangle freaked out by my participation in the beauty contest. How did a shape like me, he asked, dare to participate in such a serious affair having concavity as its only qualification? He eventually marked with a "ZERO" my regularity and, consequently, I got the same grade from regular hexagon in symmetry.

Polygonal chain:

What about the circle?

Concave quadrilateral:

He thought about it for a minute, for, in my case my opposite angles are supplementary and, hence, I am circumscribable. But, then he just went along with the others and agreed with them.

Convex quadrilateral:

So, you didn't get any vote in favor, either, huh?

Concave quadrilateral:

Neither did you?

Convex quadrilateral:

Yes, only it was much worse in my case… I was totally rejected as a miserable being, a public danger for the society of the two-dimensional shapes!

Concave quadrilateral:

So, I should thank them for just reprimanding me, you think?

Convex quadrilateral:

The whole thing is staged from the beginning! When necessary qualities are overlooked and when the only criteria are concavity, regularity and symmetry (or whatever other qualities the judges possess), then…

Concave quadrilateral:

It seems that Trapezoid realized all these and decided to abstain from the contest.

Convex quadrilateral:

I was more impressed by the absence of the Isosceles Trapezoid! He had all it took to make it to the finals.

Concave quadrilateral:

He knew that he wouldn't make it for a vote…

Convex quadrilateral:

What do you mean?

Concave quadrilateral:

Oh, come on! Which planet did you come from? Don't you know that the equilateral triangle accuses the Isosceles Trapezoid of the massacre of one of his brothers – of one Isosceles Triangle?

Convex quadrilateral:

How about that? I did not know it!

Concave quadrilateral:

Of course! He claims that the Isosceles Trapezoid came into existence after a line segment cut an Isosceles Triangle in parallel to its base side! Grotesque!

(The interior door opens and Segment enters the room laughing and holding his stomach)

Segment:

Gee! What a laugh..! Hey, boss, you had better prepare double straight coffees and keep anti-depressing pills within reach! Here comes the third loser! Parallelogram..! And he is about to collapse!

Polygonal chain:

What kept you so long, you little weasel? Don't tell me you are not asking for it (she approaches the boy menacingly).

Segment:

(backing slowly away and raising his hand to protect his face) Come on, boss, relax, will ya? I was admiring the beauty of the contestants and lost track of time! You can't believe what laughs I had! That poor parallelogram! Really, from a point on, I felt sorry for him!

Polygonal chain:

What did they do to him?

Segment:

They lifted him in heavens and then threw him into Tartars!

Polygonal chain:

What? Don't talk with riddles, you little rat!

Segment:

This is what happened: The Triangle decided that he wanted to pass the parallelogram to the next phase, because he was impressed by the bisection of its diagonals, he was fond of the equation of its opposite angles and of the "supplementarity" of its adjacent angles.

Polygonal chain:

So?

Segment:

So, the regular hexagon said that he liked the equation and parallelism of its opposite sides and concluded that he wanted to give a chance to the parallelogram… Everything seemed to go alright and the parallelogram started to celebrate... Ha ha ha ha ha…

Polygonal chain:

Stop laughing like a monkey and tell us what happened! You start getting on my nerves…

Segment:

THEN… ha ha ha… (Polygonal chain looks at him angrily) then came the circle's turn to speak... and everyone was struck by what followed…He hit the desk in front of him with his fists shouting that he would never allow a non-circumscribable shape to get to the next phase; then came total reversal!

Polygonal chain:

How? There were two votes in favour and one against!

Segment:

Not exactly! No sooner had the circle thundered his objections, the regular hexagon changed his mind. He started mumbling, saying that he hastened to decide on the matter and that the candidate, indeed, did possess neither axonal symmetry nor regularity…

Convex quadrilateral:

So much for the equation and parallelism of the sides… I told you that he is the circle's Yes-man.

Segment:

And so, the parallelogram does not make to the finals…

Polygonal chain:

Oh that poor little thing… I bet it would feel like the sky fell on his head!

Segment:

… To say the least! (The parallelogram enters the room from the internal door, walking as drunk and mumbling to itself)

Parallelogram:

I am not circumscribable, I am not regular… No, no… no, I am neither symmetrical nor circumscribable…

Concave quadrilateral:

Hey, partner, sit with us and lets cry all together…

Parallelogram:

(Keeps mumbling as if not listening) No, no… I am not regular or symmetrical…

Convex quadrilateral:

Hey YOU! Aren't you listening? He is talking to you, my friend. Come here and sit with us…

Parallelogram:

Staring at them with an empty gaze) who… who are you, you guys?

Concave quadrilateral:

We are also failed quadrilaterals…

Parallelogram:

Oh, forgive me… I didn't recognize you…

Segment:

(addressing the audience) I told you he lost all contact…

Polygonal chain:

Will you have something? I think a double straight coffee is what you need in your condition.

Parallelogram:

Huh… no, thank you.

Segment:

Gee! What a thrifty, miserable guy! We would be broke if everyone was like him (offers the coffee). Here! A treat from the organizing committee!

Parallelogram:

(accepting the coffee) Thanks (sips but remains silent).

Convex quadrilateral:

These things are unacceptable! We are judged by the same criteria that existed centuries ago! I can not accept that curvature is an element of beauty!

Concave quadrilateral:

… or regularity or symmetry.

Convex quadrilateral:

Sure thing…

Concave quadrilateral:

We need to protest against the panel of judges. It is unfair to pick them up from the conservatives only!

Convex quadrilateral:

Right! We demand the participation of progressive elements! The world is changing, it is not stagnant…

Concave quadrilateral:

What do you think my fellow rejected co-candidate?

Parallelogram:

Me… I… what about?

Convex quadrilateral:

Do you agree to protest with us?

Parallelogram:

Yeah… sure…

Concave quadrilateral:

Alright then! Let's not waste any more time! Let's go to our place and prepare our manifest. If we want things changed, we have to fight and struggle!

Convex quadrilateral:

Exactly! Nothing will be given to us for free! Off we go! (the Concave quadrilateral and the Convex quadrilateral head for the exit, while the parallelogram does not move. The Concave quadrilateral returns and pushes the parallelogram towards the door).

Concave quadrilateral:

Off we go, we said! (All three of them exit the Café).

Segment:

Yeah, right! You will change things when line segments get two centres…

Polygonal chain:

I am going out for a while to get something. Keep your eyes open you little weasel.

Segment:

Don't worry about it, boss! Everything will be fine! (the Polygonal chain exits the place. The segment starts speaking to himself): Don't worry I will show you who I am, you tyrant! Beating me and shouting to me like that… (the interior door opens and the rectangle enters followed by the rhombus).

Rectangle:

… For a moment I though that even the regular hexagon would vote against me!

Segment:

I welcome the avant-garde and the pride of the world of Quadrilaterals! From what I heard things look nice for you! I wish you good luck for the next phase.

Rectangle:

(Goes on speaking as if it did not hear what segment said) … for, you see, I possess regularity! Thankfully, the parallelism and equation of my opposite sides, the equation of my angles and my being circumscribable secured two of the three votes of the panel.

Rhombus:

The hexagon, as you might have observed in the cases of the other candidates, never opposes the circle's decisions. Consequently, being rejected only by the Isosceles triangle is not surprising…

Segment:

What can I offer you? We have Functions syrup, Logarithmic aperitif, Pythagorean cocktail…

Rectangle:

Get me a "batida de côco".

Rhombus:

I want a "tia maria"!

Segment:

Coming right up! (addressing the audience) It seems everybody avoids mathematical cocktails these days…

Rhombus:

The total revolution came in my turn! It was the first time that the regular hexagon objected a decision made by the circle! Despite the circle declaring that he would never allow a non-circumscribable quadrilateral to make it to the next phase!

Segment:

Your drinks gentlemen (The segment serves the drinks).

Rectangle:

But this time things did not go the way he wanted; for the other two judges admired the parallelism of the opposite sides and the equation of all sides, the equation of opposite angles, and the perpendicular bisection of diagonals… But, I am afraid that…

Rhombus:

What?

Rectangle:

… that the square is the favorite to win the conquest, as proved…

Rhombus:

Yes, but the favorite doesn't always win the race…

Rectangle:

This it will.

Rhombus:

You think so, huh?

Rectangle:

This can be logically deduced: The equilateral triangle voted against me because I didn't possess equation of sides, hence, regularity; you, despite possessing regularity, were rejected due to lack of equation of angles and, as far as the circle was concerned, because you are not circumscribable.

Rhombus:

It is true…

Rectangle:

So, tell me a reason why should one of the judges vote against the square? The square has all the qualifications it takes: it is circumscribable, regular, axonal and has central symmetry, perpendicular diagonals…

Rhombus:

You are right! It seems flawless! Hence the attitude!

Rectangle:

Not to mention that old affair with the circle…

Rhombus:

What old affair?

Rectangle:

Oh come on! Everyone knows about it… They were lovers in the past.

Rhombus:

No kidding!! And why did they break up?

Rectangle:

For the usual reasons… In the end the one could not satisfy the needs of the other. While the circle was able to circumscribe the square, the square was unable to square the circle!

Rhombus:

And you are saying that there is still something between them, huh? So, we don't stand a chance! Better withdraw now and save ourselves from the trouble…

Rectangle:

I think that is our only option…

Rhombus:

Let's leave, then! (The get up and exit the place)

Segment:

Hey, where are you going, you haven't finished your drinks! They are gone… That was it. No more beauty contest… Oops, boss will take it out on me again… (Heads for the door, opens it and looks outside). My God! Here she comes! (The Polygonal chain storms the Café).

Polygonal chain:

Prices are getting up day by day! I can't believe they raised prices in the middle of the season!

Segment:

… at the end of the season.

Polygonal chain:

I said middle … (Looking puzzled) What are you talking about?

Segment:

We are not in the middle of the season; we are at the end of it… The beauty contest is over!

Polygonal chain:

Have you lost your mind? Speak clearly you dump little monkey! Are you joking?

Segment:

Nope! Rectangle and rhombus have quit the contest. The only candidate remaining is the square. So, the contest is over!

Polygonal chain:

Oh my God, we are broke!

Segment:

(addressing the audience) Oh my God, YOU are broke!

Polygonal chain:

How did this happen? How do you know all these, you little rat? Why did you let them go? Why didn't you stop them? Were you wandering around again, you useless little liar? Why didn't you try to change their mind?

Segment:

What could I do, boss? They didn't even finish their drinks! They left in a rush! Besides, who would listen to a segment?

Polygonal chain:

You double-crossing weasel! You think I don't know things about you, huh! The whole market whispers about you and your efforts to rally all segments and convince them to defect and abandon all two-dimensional formations! You are undermining the coherence of society, you traitor! This is an act of high treason, you little criminal! You are a terrorist, that's what you are…

Segment:

(acting surprised) Who, me boss? (Crosses his heart and makes an oath). If that is true, then I turn into a Point!

Polygonal chain:

I am going in to see if things are the way you told me! If they are not, you are fired because you are a liar. If they are, you are fired again because we are broke.

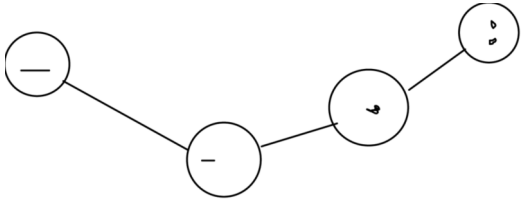
Segment:

So, either way I am fired, huh! (Shouting loudly towards the door) I want my compensation for my services, you tyrant! I am not leaving without it! And I will sue you for calling me a traitor and a terrorist! If standing up for my rights makes me a terrorist then, yes, that's what I am! A TERRORIST!

An one-act play for four operations

Written by Ntinos (Konstantinos) Kordosis from Greece

The stage is a place where the mathematical operations exist. Subtraction (incarnated by a woman) stands in front of a tripod, painting. There are two doors on stage. The one to the left (from the point of view of the audience) is the exit and that to the right is an interior door. Addition (a rather elderly but still attractive woman) enters the room from the interior door. Her identity, as that of Deduction, can be stated with the symbols (-) and (+) on the T-shirt they are wearing or with badges on their arms.



Addition: Oh, please spare me! Are you painting abstract forms again? I am sick and tired of watching you painting senseless things!

Subtraction:

It is inevitable, my dear. Considering my mother's heritage – yours that is – this is the only thing I can paint!

Addition: Better say that such paintings boost your self-confidence. Although… I sense a hint of narcissism in this activity of yours…

Subtraction:

(reacts in anger) How dare you speak of narcissism after the prosthetic you have had in the breasts? You can not even keep your eyes away from your mirror!

Addition: There it is again! Did you get up on the wrong side of the bed? (The exiting door opens and a teenage girl, Division, enters the room, frustrated and sitting heavily on a chair).

Division : That was it! My application was rejected for good! The committee reached a unanimous decision: "Division by zero is impossible!"

Addition: Oh, don't take it so hard… It is not worth dying for your relation with zero! After all he is the youngest number around! For thousands of years we were not even aware of his existence and, yet, we survived!

Division: (while holding a teddy bear) Granny, don't say that, please! I have heard you many times saying that zero is an amazing, an outstanding nothing with a huge potential! No sooner was he discovered, you immediately hastened to associate with it! All of you did, that is…

Addition: No, things are not the way you describe them.

Division: Oh, yeah? Didn't you hasten to name him your "neutral element"? (She writes on the board) 0+a=a+0=a. Didn't you call him "the sum of the additive inverse"? (she writes again) a+ (-a)=0.

Addition: But, darling, you father…

Division: Oh, yes, my father! The great, almighty Multiplication! Well, HE gave everything to zero! He granted him the right to devour everything! His "Zero element", he called him! (writes on the board) a·0=0·a=0.

Addition: I meant to say that you father believes that in your case, associating with zero would be a serious mistake.

Division: So what? Am I not allowed to make my own mistakes?? I want a relationship with zero! I am tired of your paternalism and manipulation! Got it?

Subtraction:

The kid has a point! All feminine are victims of manhood. Don't cry like that, my little one. Nothing will change. Men! They are the privileged of our world. Females are for riddance!

Addition: I think you are unfair! Or, at least, exaggerating!

Subtraction:

Oh, really? Let's have a look at how things really are: Was I independent from you? Was I free to do what I wanted? I have always lived in your shadow! You raised me in such a way I could never do anything without you!

Addition: …The truth is I was overprotective with you…

Subtraction:

The actual truth is that you were competitive to me! Yes, competitive! For, who am I? I am Subtraction; that is "the SUM of the ADDITIVE inverse"! Yes, I, Subtraction, am some sort of an addition and that's the way everybody sees me! Where is independence in this? Where is my personality?

Addition: I have always wanted to have you near me.

Subtraction:

Ha! What a joke! You mean you wanted to manipulate me! To control me! That's what you wanted! Even the shop-keepers avoid using me! Instead of subtraction they use addition to give the change!

Addition: They have trust in my experience, you see…

Subtraction:

Experience? Every one likes you because you play it nice and cool! "You are all my kids" you keep saying! So, I look unreliable. Every one turns their back on me! They put me aside! They turn me into addition! a-b=a+(-b)!

Addition: I thought working with me was something that would please you…

Subtraction:

On equal terms, yes! But not with you playing it my boss!

Addition: I think pessimism is the source of you hard feelings, my dear!

Subtraction:

You are such a hypocrite! How can I be optimistic? What good did I get from you? You passed all your good properties onto my brother, the Multiplication! The commutative property, the associative property, the neutral element (she writes the corresponding properties of Addition and Multiplication into two columns):

a+b=b+a	a·b=b·a	the commutative property
(a+b)+c=a+(b+c)	(a·b)·c=a·(b·c)	the associative property
a+0=0+a=a	a·1=1·a=a	the neutral element

And to prove how scandalously fond you are of your son, here: the distributive property of Multiplication in relation to addition: a·(b+c)=a·b+a·c. In this way you have daily direct communication with your favorite son!

Addition: I think you are unfair. Your brother loves you so much! After all, he shares the distributive property with you, too! Look: a·(b-c)=a·b-a·c!

Subtraction:

Oh, now I am really touched! When I get along with him, everything is fine! But if I dare to say a word against what he wants he turns the minus sign into a plus! a·(b-c)=a· [b+(-c)]! And so my nice brother turns to his mommy once more! And there goes distributive property! It is just a show for the people!

Division: That's right auntie! You hit the nail on the head! My father, Multiplication, is doing exactly the same things to me!

Addition: (addressing Subtraction) Oh, you are so upsetting today! As for you, my little one, you ought to have faith in those that care about you! Is that understood?

Division: Suure! The only thing I don't get is how "caring about me" means that I have to do what my parents want or what suits them. I am not a child any more! I am in the position to know how to take care of my self! I don't need other people making all the decisions for me, without me! It's MY life! Is that clear?

Addition: Alright, calm down now, I think your father is coming.

Multiplication:

Oh, what a nice surprise! The whole family is here!

Subtraction:

To what purpose do we owe your esteemed presence here, your highness, Master of the Powers of the Numbers?

Multiplication:

Do I sense a tone of sarcasm and irony in your words my little sister? May I ask why this attitude of yours?

Subtraction:

Aren't you the Master of the powers? Aren't you the Master of exponentiation? Of course you are, since you can raise one number to the power of another: an = a·a·a·a….(n times) and, so, exponentiation corresponds to repeated multiplication! And we… we are just relegated to secondary roles…

Multiplication:

Really… I am trying to understand what lies behind this attitude… Something is wrong here…

Addition: Don't pay any attention to her, me beloved son. Nothing is wrong…

Subtraction:

(repeating the words in a sarcastic way) "Don't pay any attention to her, me beloved son. Nothing is wrong…"! You do everything to keep your son's spirit up! This is the only thing that matters to you! You don't even care about how the others feel! That's ok, I don't mind, I am used to it! But why should this girl here (pointing towards Division) be treated so unfair?

Multiplication:

I really don't know what you are talking about… But, surely, something is wrong with her… (He turns the irritated face of his daughter towards him).

Division: (complaining) Leave me alone!

Subtraction:

You have some nerve! You made her totally dependent on you and on top of it you expect her to be happy! Do you really believe that she should be happy that division is just the multiplication with the reciprocal? That she does not have the right to even touch "zero"! That she has inherited all her father's flaws without any of his advantages?

Multiplication:

Oh, I see where you are getting at. Ok, so I am the master of exponentiation… But isn't she the Queen of the analogies?

Subtraction:

She just got lucky when she got picked out by Thales who wanted to express his theorem; were she to rely on her father's heritage none would trust her!

Multiplication:

It seems that you forget that you share a common property with her in exponentiation: am:an =am-n

Subtraction:

So, what? You share the same property with your mommy! am·an =am+n and (am)n= am·n. You kept the best for yourself and you threw a bone to us!

Multiplication:

what about the definition a-n = 1/ an ?

Subtraction:

Pugh! Big deal! Nothing changes! This is a negative exponent not a subtraction and this just the reciprocal, it is not a division! Even if we see it your way, there are n multiplications and only ONE division!

Multiplication:

I don't understand what you are talking about, really! What I see here is a holy alliance between the niece and the aunt! But, you have always been miserable and suspicious! For all your life, you have misunderstood the intentions of others; you rejected whatever good they offered you and you have always been negative to others!

Subtraction:

Huh-ha! So, you don't understand what I am talking about, huh? I will explain it to you! Not only am I the victim of genetic flaws but also of spiteful propaganda! No better proof than the Pythagorean Theorem.

Multiplication:

WHAT? What about the Pythagorean Theorem?

Subtraction:

I will tell you what!! "In any right-angled triangle, the area of the square whose side is the hypotenuse is equal to the sum of the areas of the squares whose sides are the two legs"!! So addition and "square" are the leading figures! That is Addition and Multiplication!

Addition: So, what does this have to do with us??

Subtraction:

Don't give me that Mother Addition! I know you very well and I know what a flatterer you are! You would do everything to be close to your favorite son!

Addition: Are you suggesting that Pythagoras was influenced by me?

Subtraction:

All I know is that he was a very secretive person and that did everything in secrecy! It is impossible to know how you lured him but I am sure that you put your finger in this!

Addition: (looking at Multiplication) Oh, Lord, help us…

Multiplication:

Are you totally out of your mind? You don't have any proof for what you are saying and this is called sycophancy!

Subtraction:

Why do I need proofs? All I need is common sense! There was definitively some sort of intervention or else why didn't Pythagoras chose the equivalent phrase: "In any right-angled triangle, the area of the square of one leg is equal to the difference of the area of the square of the other leg from the area of the square of the hypotenuse"!

Multiplication:

What are you talking about?

Division: Yeah! Auntie is right! He could rephrase but he didn't!

Multiplication:

May I ask why?

Subtraction:

You tell me! Why should Pythagoras chose the relation a2=b2+c2 instead of b2=a2-c2 or c2=a2-b2?? Explain this! The chances were 2 out of 3 to pick out a subtraction rather than the only addition!!

Multiplication:

I don't know what to answer to this question! Probably you should go and ask Pythagoras himself! One thing is sure, though. I never thought of tricking you or doing anything unjust to you! Nor did mother…

Subtraction:

Oh, yes, you are right my dear brother… How could I forget? You did me the honor to let me participate in the subtraction of vectors!

Multiplication:

Finally! It was about time you appreciated something!

Subtraction:

You keep on fooling me, aren't you? Both of you like making fun of me! Isn't it so, my dear mother? Subtraction of a vector from another is nothing else but that addition to the latter of the opposite of the former! (writes on board) $\vec{a} - \vec{b} = \vec{a} + (-\vec{b})$

Addition: What can I say my dear… You are hopeless…

Subtraction:

Ok, then.. I accept I have this minor contribution… What about her? (She waves towards Division who starts crying like a baby)

Division: Whoaaaa!

Multiplication:

(Addressing Subtraction) Look what you did! You are torturing the kid…

Subtraction:

You are torturing her because of the injustice you are doing to her! After that dogmatic "division by zero is impossible", there came the fascist "vector division is indefinable" dogma!

Division: Whoaaaa!

Multiplication:

But, these are restrictions imposed by the nature of vectors!

Subtraction:

Imposed by your conservatism and narcissism, you mean!

Multiplication:

Are you implying that I am serving my personal interests and for that I do injustice to my own daughter?

Subtraction:

I am not implying it! I am positive about it! Isn't true that there exist two kinds of products when talking about vector multiplication: Inner product and Outer product, while "division of vectors" is indefinable?

Multiplication:

I told you it is because of the nature of vec….

Subtraction:

Yes, yes I know! The nature of vectors blah-blah-blah… Stop being a hypocrite my little brother! You want everything for yourself! You always want to get the lion's share!

Multiplication:

…But there can be a division of a vector by a number!

Division: (complaining in an infuriated and sarcastic way) Oh, thank you! That's a BIG deal! Don't be so generous…

Multiplication:

(addressing Division) My little one I just wanted to keep you away from all the trouble! Do you know what it means to try to calculate outer products? You go from a two-dimensional to a three-dimensional space! As for inner products… You try to pair two vectors and the result is a number. This is something hard to understand! That's why I am asking you to keep to you business with the numbers, which are easy to handle!

Division: I don't want to handle only easy numbers! I am tired of your thinking that I am a baby! I don't need your patronizing! You think that you are protecting me but you are taking the life out of me! (She gets up frustrated and irritated) I am tired of you, do you hear me? I am tired of all of you! (she angrily throws away the teddy bear she had been holding in her arms and exits the room)

Multiplication:

There! See what you have caused me? Now go and calm her down…

Subtraction:

If you want your problems to disappear then remove their real cause and stop pinning your faults and mistakes on other people!

Addition: (rising from her chair) Now, stop talking like that and let's leave, you spirit of rebellion… (she leads her slightly to the door)

Subtraction:

(turning back suddenly) Down with the privileged!

Multiplication:

(moving aggressively towards her) Get out of my sight or else…

Addition: (addressing her daughter) Stop talking in such a rude way and leave with me now I said (they exit the room)

Multiplication:

My sister crossed the lines this time! It is all my fault; I should have restrained her long ago… (Falls heavily on a char and addresses the audience) Consider that I was hoping to get home, relax and enjoy some peaceful family moments after such a horrible day at work; I should have known better! Working my self into the ground every day… And they say that Math is difficult! Well, wait until you get a sister and a daughter like the ones I have! Being the head of such a family is much more difficult, I am telling you! (He holds his head with his hands and shouts to himself) Hold steady Captain! Hold steady!

Percentages: the haughtiest of all fractions

Written by Ntinos (Konstantinos) Kordosis from Greece

$\frac{10}{100}$ and $\frac{6}{60}$ are in a clothes store shopping during sales period. A salesclerk goes back and forth, arranging the merchandise while murmuring.

Salesclerk:

The way business is nowadays I doubt if we can hold much longer. First day of the sales today and not even a soul entered the shop for the last hours. To make things worse I also have to rearrange the display, a hard task considering my moral… I bet I will soon be looking for another job… (Collapses on a chair, discouraged. 10/100 and 6/60, incarnated by pupils wearing the corresponding insignia on their chest, begin quarreling).

10/100: Don't you get it? You don't stand a chance. They will choose me again. Leave now on your own will and save your face!

6/60: …At least may I ask why they should choose you?

10/100: Why? Because I am a decimal fraction! I am perfectly tailored to meet human standards! Accept it!

6/60: But we are equal fractions! We express the same fraction of the total! It is unfair that people prefer you just because some guys brought the decimal numeral system from India and Al-Masur, some Arab Caliph, adopted it!

10/100: Oh, come on! The base-10 positional notation is one of the highest concepts of the human spirit! Besides, my denominator is a superabundant number!

6/60: Big deal!

10/100: What do you mean?

6/60: I mean that my denominator is also a superabundant number, which additionally has more divisors than yours! There! Its divisors are 1,2,3,4,5,6,10,12,15,20,30 and their sum is

1+2+3+4+5+6+10+12+15+20+30=108>60 while the divisor of 100 are:

1,2,4,5,10,20,25,50; and their sum is 1+2+4+5+10+20+25+50=117>100.

So, as you can see, both numbers are superabundant but in terms of quantity of divisors and of their total sum 60 is by far superior!

10/100: … But my numerator is the base of the decimal system!

6/60: …and mine is the base of the sexagesimal system!

10/100: (ironically) Oh, what memories you have awoken! The first days of Creation! The ancient peoples of Mesopotamia! I am sorry I have to tell you this but you need to put it into your MIND: The sexagesimal numeral system is surpassed! It is dead for good! Nothing but a fossil of human thinking!

6/60: Yes, sure! What about the measurement of angles? Isn't it in degrees? Isn't a degree divided into 60 minutes and doesn't a minute consist of 60 seconds? Or maybe I should remind you of how we measure time: 1 hour has 60 minutes and every minute has 60 seconds!

10/100: Oh, come on! You can't be serious! These are some sad remnants of the past that just remind us of how the sexagesimal system was like…

6/60: What are you talking about, you little whiner? When humans were using the sexagesimal system, making wonders, the decimal system had not even been born!

10/100: Exactly my point! The decimal system was conceived in order to cover the developing needs of humans! That is why it has many more advantages than the sexagesimal system.

6/60: Don't take the whole thing so seriously. You are just in fashion and fashionable things are as a rule outfashioned by new things!

10/100: Put it into your head! You are just and O-R-D-I-N-A-R-Y fraction!

6/60: Oh, yeah? And you are not?

10/100: Of course I am not! I am the PERCENTAGE!

6/60: (mocking) "I am the PERCENTAGE!"

10/100: Yes, I am the percentage! I have under my control the whole banking system! Purchases, sells, loans, payments…

6/60: Oh, you are right, sorry, I forgot! As percentages you are the main tools of loan sharks! In elections campaigns you manipulate the public opinion…

10/100: There! You see? You only look at the dark side of things and you tend to overlook our general contribution… Financial transactions, elections, and generally most of the statistics would have been impossible without us!

6/60: Other fractions could be used…

10/100: Yes, but only decimal fractions are understood by people! It is the numeral system that fits their wits!

6/60: This is an unsubstantiated claim…

10/100: Not at all, considering that the average human being has 10 fingers in its hands and 10 toes in its feet; not 6 or 60, but 10! Accept it! You don't stand a chance here on Earth! Better move to another planet! The planet of the "sixtypedes"!

6/60: You are the most despised being I have ever met!

10/100: Oh, really? Think of a guy standing in front of a display, admiring a pair of trousers and then, reading underneath, "Sales, 6/60". He would go crazy!

6/60: That's only because he would be used in percentages!

10/100: No, that is only because we, percentages, are plain and simple! We are comprehensible. We are elegant. We are…

6/60: (irritated) Get out of my sight you hollow little fraction! You are nothing else

but a fraction like all of us, do you hear me? Just a fraction! This doesn't change no matter how you call yourself! (The salesclerk approaches and looks at 6/60 and places it aside).

Salesclerk:

About time I put those signs in the display before my boss gets back here and starts shouting (stands in front of 6/60 and looks at it inquisitively). Well, look at that! What is this doing here? (then stands in front of 10/100). Oh, here we are. This is what I need! (writes on a chalk board "Discount 10%")

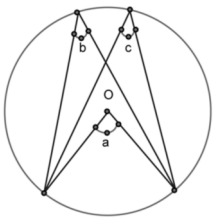
10/100: (towards 6/60) what did I tell you? Now off you go back to your rabbit hole! (6/60 leaves the scene angry, biting his finger).

Living down-town or in the suburbs? a hard question to answer…

Writing by Ntinos (Konstantinos) Kordosis from Greece

The stage is set to resemble a room with a tripod upon which the shapes that correspond to the sketch can be placed. The shapes may be fixed on contexts made of hard paper. Regarding the adjacent supplementary angles, their common edge may be articulated to the context enabling, thus, its rotation and the alternation of angles z and 180-z. Additionally, one of the edges of the vertical angles may be articulated to point O. The roles may be incarnated by female pupils, bearing on their chests the appropriate symbols.

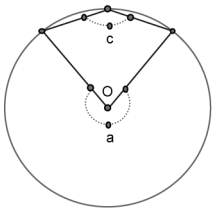
The inscribed angles b and c, which subtend the same arc, are gossiping the corresponding central angle a. Finally, angle c addresses angle a, who is standing remote, with her back turned on them, making-up her face and trimming her fingernails.

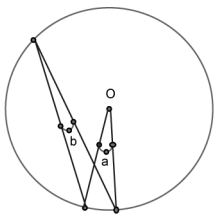


Angle c: Hey, you…hey, can I have your attention for a moment, please? (Angle a does not answer back).

Angle b: I told you! It is pointless talking to her! She will never get into the trouble answering you! She thinks she is the One and Only! The Hollywood-Star… And we are just ordinary angles; inscribed and always under her command…

Angle c: All I wanted to ask from her was to avoid becoming obtuse and especially to stay off 360o. I face some arthritic problems and I don't think I can handle ballet exercises.





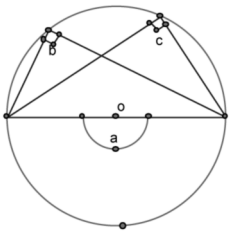
Angle b: Why would she care?Angle c: Really? How come?

Angle b: Because she lives downtown! In the Center!

Angle c: It seems you are right… But what can be done? You see we are inscribed; we are doomed to live under the state of dependence imposed on us by the "inscribed angle theorem", which states that "an angle inscribed in a circle is half of the central angle that subtends the same arc on the circle".

Angle b: "Theorem"? Better say "CURSE"!

Angle c: Come on! You are exaggerating… Look at the bright side of life. Remember when the central angle becomes straight? Then we become right angles – what a joy! "The angle that subtends the diameter is a right angle". ECSTASY! TRIUMPH! Even Pythagoras dealt with it…



Last time she decided to drop her degrees into a single digit number I suffered so much from my spinal disc herniation that I started screaming like crazy! Albeit, in vain! She didn't even notice! I am telling you she is playing Bourgeois!

Angle b: So what? This happens once in a blue moon! Is it worth living in the misery and uncertainty of dependence for this once-in-a-blue-moon joy? (Angle b whispers to angle c) I suggest we fight for our rights! We need to change this relationship! It is unfair to have one single angle making all the decisions for countless inscribed angles just because she is CENTRAL!

Angle c: This is not a bad idea... But, realistically speaking, it is impossible to realize.

Angle b: Oh yeah? Why so?

Angle c: Because we need to reach a decision by voting. This means that the number of voters must be known, hence finite. But in our case the number of inscribed angles corresponding to the same central angle is infinite!

Angle b: Oh God… I can't stand it any more… I will break free!

Angle c: … and go where? You know that there is no life for us, inscribed angles, outside the circumference.

Angle b: Mark my words! I will part with this vicious circle!

Angle c: Think twice before you act! Good fences make good neighbours! At least now you are an inscribed angle! You have a social life and a protection! If you escape you expose yourself to dangers; and loneliness can bring depression, you know.

Angle b: You think so, huh? Oh, I am so jealous of simple and straight relations… Relations that are not bounded by such a vicious circle; like the ones between supplementary or vertical angles (at that particular moment angle x, one of the two vertical angles, and angle z, one of the two adjacent supplementary angles, enter the scene).

Angle x: Hi girls! It is nice to see you again! We overheard what your chitchat and, really, things are not the way you describe them!

Angle c: Really?

Angle x: Yes! There is no curse worse than being a vertical angle!

Angle b: … a curse you say?

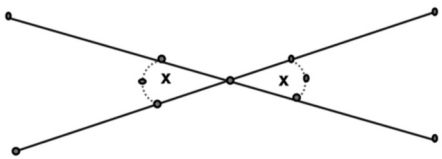
Angle x: Yes! I it is impossible to meet with my twin sister! I can not even look at her! We only share a common point at the tips of our heads, called the vertex!

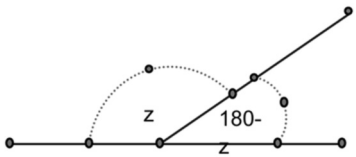
Angle z: Yes, but you also share some advantages…

Angle x: What kind of advantages?

Angle z: You are in complete accordance! There is no disagreement between you. If you become acute your sister becomes acute, too. If you become obtuse you sister follows. This is equality!

Angle c: She is right!





Angle x: What are you talking about? When I face West my sister faces East! When I turn my face towards the North my sister looks literary the other way! We have antithesis in our nature, since our sides are opposite rays. O-p-p-o-s-i-t-e; OPPOSITE!!

Angle z: Alright about that but, in the case one of you becoming right the other follows swift! And then you both make a straight angle! What else can be more compensating than that? There is no better feeling of accomplishment than that!

Angle x: Oh, don't remind me of that, please! Last time we became a straight angle we mixed our sides in such a way that we took pains to unravel them!

Angle z: Nonetheless, it is great and amazing to keep pace with your sister!

Angle c: Yes! It is great AND amazing!

Angle z: Of course! And it has nothing to do with the drama we are going through!

Angle x: You girls share a common side! There is nothing better!

Angle z: Quite the opposite! This common side is the cause of all my unhappiness!

Angle b: … the cause of all your unhappiness? I don't get it…

Angle x: Me neither! Why?

Angle z: Because my sister – I mean the supplementary one – gets bored very easily! Bored to death, that is… One moment she is acute and the other she wants to become obtuse. She then pushes our common side and from the point where I was relaxing, lying on a chaise-longue, in a blink of an eye (she rotates the common side so that z becomes acute), I suffocate as if I were in a hydraulic press!

Angle x: No kidding?

Angle z: … and by the time I start getting used to my new condition, she pulls our common side again (she rotates the common side so that z becomes obtuse again) because she decides that being obtuse doesn't fit her and there I am, stretched like a rubber!

Angle x: Can't you just reach a consensus?

Angle z: How can we reach a consensus when trapped in a straight angle!? We suffocate in there!

Angle b: (muttering to her self) she suffocates in here, too…

Angle x: I mean, why don't you agree to have each a half of the straight angle, that is to become, both of you, right angles?

Angle z: I told you already! My sister can not stay put! She wants to change herself all the time! Oh, I am so desperate that even suicide has crossed my mind!

Angle x: Nah, there wouldn't be any point in that…

Angle z: Only vengeance! This way I would doom her permanently to 180o! That would be the eternal torture for her!

Angle x: Oh, my poor girl! You really face some serious problems…

Angle c: (addressing angle b) see? There is no relationship without obstacles, indeed!

The circle and the others

Writing by Ntinos (Konstantinos) Kordosis from Greece

There is a circle on stage, incarnated by a male student holding a green hoop. There can also be a tripod upon which some of the corresponding shapes can be placed so that the actors demonstrate them while acting. Suddenly, a female student, incarnating a circle and holding a red hoop, short of breath, storms the stage as if chased by somebody.

Green Circle: Hey, what's wrong with you? Why are you running like the devil?

Red Circle: Phew! That was a close shave! A really CLOSE shave!

Green Circle: What do you mean a "close shave"? Is somebody chasing you?

Red Circle: A crazy square was right after me trying to…

Green Circle: … Trying to… what?

Red Circle: … Trying to square me!

Green Circle: Oh boy! Are they still trying to after so many centuries? I thought they were disappointed and had given up on it!

Red Circle: Well, apparently they haven't!

Green Circle: A square's persistence and self-confidence are legendary!

Red Circle: What self-confidence?

Green Circle: Haven't you noticed? The square considers himself to be of the utmost beauty, the most charming of all the quadrilaterals! He walks around pretending to be the Don Juan of the quadrilaterals, to put it in other words…

Red Circle: Bah! A Don Juan demonstrates his indifference towards the others. He tries to provoke the interest of the others by being snob! The square on the other hand was quite persistent!

Green Circle: You mean he hit right on you?

Red Circle: Yes and he has been for quite some time now. At first he was really gentle. He used to say that he was stunned by the beauty of my absolute symmetry and guided by the brightness of my circumference like a ship guided by a beacon!

Green Circle: No kidding! The guy is a poet!

Red Circle: Don't you get it? He was trying to appeal to my feelings!

Green Circle: Then what happened?

Red Circle: Things became more and more cynical. He started pressing me by saying that he wanted to become more intimate with me, be a close friend… and he kept getting closer and closer…

Green Circle: Oh, that despicable square!

Red Circle: Then he started becoming tangent to me… you know, adhering to me…

Green Circle: What a devious slime!

Red Circle: And then he became totally unabashed and lustful! He started speaking despicably, saying "Oh, mama, what a circumference! I surely want to square you, honey!"

Green Circle: This is sexual harassment!

Red Circle: "I would do anything to intersect a part of your disc, even suffer concavity!" he said!

Green Circle: Oh my God! He really has the hots for you! Oh, that shameful square! What did you do?

Red Circle: What could I have done? I took advantage of my rolling resistance coefficient as opposed to his coefficient of kinetic friction and made a run for it! And now here I am!

Green Circle: Phew! That was really a "close shave"!

Red Circle: I don't know how to handle this anymore! The other day I faced the same problem with a shameless straight line! I have become a target for harassment!

Green Circle: Be careful with those straight lines! They are the most dangerous geometrical forms!

Red Circle: You're telling me! They are savages! Uncontrolled! I took pains to get rid of him!

Green Circle: How come you got so close to him?

Red Circle: As if I knew he was there! You know, straight lines appear out of the blue! As I was taking a walk on a sine curve, I didn't notice that it was leading to a straight line and….

Green Circle: … and there he was tangent to you at radius distance!

Red Circle: Exactly! But things got worse! He wasn't satisfied with just one point of my circumference. He asked for another one! He wanted to become my chord!

Green Circle: I know the rest, save your breath… From chord he wanted to pass by your center and there he was, being your diameter and symmetry axon at the same time! Right?

Red Circle: Yes! How did you know?

Green Circle: It is the typical behavior of a straight line…

Red Circle: I couldn't get him off my back! He settled in my center and started spinning around and around!

Green Circle: He was looking for another victim like you to take over its center.

Red Circle: You think so, huh?

Green Circle: Don't you know that it is the dream of every straight line from the moment they are born to become the line of Centers of two circles or at least their common tangent line?

Red Circle: I am telling you he wouldn't leave me alone! On top of it he swore! He called me unsociable and a vicious circle! Can you believe it?

Green Circle: … give him an inch and he will take a mile…

Red Circle: I am impressed by how most of the rectilinear shapes want to have an affair with a circle! Check the polygons for example. The more sides they have the more proud they are!

Green Circle: It is because the more sides they have the more round they become, resembling thus a circle!

Red Circle: Yeah, tell me about it! The polygon dreams of becoming a circle from the moment he is born…

Green Circle: Exactly! But you can't turn into a circle if you weren't born one!

Red Circle: Just as you can not become modest unless you were born so!

Green Circle: What I don't get so far is how you get so often into trouble!

Red Circle: What do you mean?

Green Circle: Well, it is just that everyone seems to be hitting on you… Are you sure you are not asking for it?

Red Circle: What do you mean I am asking for it?... I am just passing by…

Green Circle: Passing by…? Like what?

Red Circle: Like that! (She puts the hoop around her waste and starts walking while spinning the hoop around her, causing her hips to swing)

Green Circle: (Watching with irony) Oh, just like that, huh…? Well, you are definitely NOT asking for it. DEFINITELY NOT…

The poor thales becoming rich

Writing by Constantinos Koupparis from Cyprus

Important Note: We have estimated that this theatre has a duration of about 12-14 minutes. The duration of a play is subjective and depends on many factors. Therefore, since the maximum time of this theatre must not exceed the appointed 15 minutes, if you estimate that this scenario is too lengthy, simply ignore the first scene, which is independent from the others.

The story takes place in Ancient Greece (Miletus) at about 600 BC. Therefore, the scenes and clothing of characters are of this period.

CHARACTERS:

THALES (Protagonist): A self-sufficient man having the appearance of a philosopher, 45 years old.

ANAXIMANDROS (Second role): A young, village man, 18 years old, who works in the fields and who will later become student of Thales.

ALKANDROS (Third role): A village man, 30 years old, who works in the fields.

ARSINOE: An old village woman.

IOLAS: A man 35 years old, owner of olive trees fields.

DIMARETI: A woman 30 years old, working in olive trees fields.

KRATIS: A man 40 years old, owner of olive mills.

SCENE 1

(It is dark and Thales is looking at the sky and studies the stars. Arsinoe is about to take water from a well.)

ARSINOE: Hello Thales!

THALES: *(looking at the sky and taking his time to response)* Hello Arsinoe…

ARSINOE: What are you doing in the dark?

THALES: I am studying the positions of the stars, Arsinoe.

ARSINOE: Don't you ever have any serious work to do? Everybody is sleeping at this time of the night, in order to be ready for their work tomorrow in the fields; and you? You always waste your time on something that does not have any serious purpose for anybody…

THALES: You cannot understand woman what the knowledge of Astronomy and Mathematics can offer to you. That is why you are talking like that…

(Thales continues looking at the sky carefully, very distracted and as a result, he falls into the well.)

ARSINOE: (She is laughing at Thales) Thales, you cannot see what is happening in front of you and you want to see what's happening over your head? (Continues laughing at him).

SCENE 2

(It is afternoon time and Thales is sitting at an open place under a tree, making Mathematics theorems and Geometry shapes on the ground. Some fellow villagers of him have just finished their work out in the fields and go to sit with Thales.)

ALKANDROS: Hello Thales!

ANAXIMANDROS:
Good afternoon Thales!

THALES: Hello friends! Join me if you'd like.

(The two men sit near Thales by a rock under a tree)

ALKANDROS: What are you doing Thales?

THALES: I am doing Mathematics.

ANAXIMANDROS:
What is this "Mathematics"?

THALES: It is called like this, because it is the main "Mathema", which means the main subject of Philosophy. It helps me think about the meaning of life correctly and understand the rules of nature, and this makes me feel happy.

ALKANDROS: (With a dose of irony). Mathematics makes you feel happy…? So, tell us Thales… Who is considered to be the happiest man?

THALES: Someone who has a healthy body, a discovering mind and a natural ability to receive knowledge. I think you are missing the last two things to be happy.

ALKANDROS: (With a dose of irony) So Anaximandros, since you are younger than me, you have to listen to our great philosopher Thales and learn Mathematics.

THALES: The easiest thing Alkandros is to give advice to others…

ANAXIMANDROS: And what is the hardest thing Thales?

THALES: The hardest thing is to discover your inner self, Anaximandros.

ANAXIMANDROS:
Thales, I think that Mathematics is really difficult for me; something that I will never understand…

THALES: To learn Mathematics is not as difficult as you think, Anaximandros. You never really try to understand Mathematics. This knowledge is so important in all sectors of life, especially to young people like you.

ANAXIMANDROS:
Thales, what do you mean by saying before "I am doing Mathematics"?

THALES: "Doing mathematics" involves all kinds of mental capacities: numerical, quantitative, linguistic, and symbolic ways of reasoning, as well as

spatial, logical and diagrammatic reasoning, plus reasoning about causality, the ability to handle abstractions, and maybe some other that I have overlooked.

ALKANDROS: Thales, what does Mathematics help you with in practice? You spend all your time doing Mathematics, looking at the stars and making theorems and observations. You know so many things, but you are a poor man. We do not know anything about Mathematics, Astronomy, or Philosophy and we are much richer than you and any other philosopher…

(Both of them are laughing at Thales)

THALES: Look friends, your way of thinking is very materialistic. It is our choice to live quite simply. We can become rich anytime we want with the knowledge that we have, but we prefer to do more serious things…

ANAXIMANDROS:

With all the respect Thales, we do not believe you. Your knowledge in Mathematics and Astronomy cannot earn you money. You can become rich only in theory.

(Both laughing at Thales)

ALKANDROS: I agree with Anaximandros, Thales. It is up to you to prove to us that you can become rich by using your knowledge.

ANAXIMANDROS:

And then, I promise that I will become your student and pay you to teach me Mathematics.

(Both laughing at Thales)

(Thales is thinking nervously)

THALES: I do not like your ironic comments, but because your challenge is very sarcastic and cynical, I will prove to you and to all our village mates that with my knowledge in Mathematics, I can become rich in only a year and then, we'll talk again.

ALKANDROS: Okay Thales, we look forward to seeing you a rich man. Bye!

ANAXIMANDROS:

Bye, Thales!

(Anaximandros and Alkandros leave the scene and Thales is speaking by himself).

THALES: By my observations of the stars' movements and the mathematical-geometrical analysis of this data, I am almost sure that next year the climate will be fairly good and thus, olive trees will be greatly fruitful.

(Thales takes a pause thinking…)

THALES: I will prove to my entire village mates, who are laughing at me that the knowledge of Mathematics can help me understand the future climate and create a successful business. I will rent all the olive mills in Miletus and the island of Chios for the next year!

SCENE 3 *(A place with an olive mill.)*

THALES: Hello Kratis!

KRATIS: Hello Thales! How are you?

THALES: Thank you, I am fine. Have we met before? How do you know my name?

KRATIS: Of course I know you great philosopher and mathematician! You are a pioneer, since I remember a couple of years ago that you made the first, correct prediction of the sun eclipse; and your concept that the polar star always points to the North, helps me find my way home in the dark!

THALES: That's really good to know. What about you Kratis? How are you doing?

KRATIS: I am okay philosopher, but my work at the mill is not doing that good unfortunately… In the last years, the production of olives is quite poor.

THALES: I have to make you an offer. I want to rent all the olive mills that you have for a year. Just tell me how much you want.

KRATIS: It is very strange for a great philosopher like you to want to do business, but if you give me 80 drachmas, I will have a respectable profit without doing anything.

THALES: Okay Kratis, we have a deal.

SCENE 4

(6 months later, in the same place with the previous scene.)

IOLAS: Hello Thales!

THALES: Hello Iolas!

IOLAS: I was informed that you have rented all the olive mills here in Miletus and Chios. I want to use a mill for eight days to make olive oil. How much do you charge?

THALES: There is a very large demand for the mills Iolas, because of the high fruition of olive trees this year. This is my last free mill and I want 35 drachmas for it.

IOLAS: This is a very high price Thales, but I do not have any other option. Okay…

(Iolas is leaving the scene and a bit later, Dimareti appears)

DIMARETI: Hello Thales!

THALES: Hello!

DIMARETI: I am Dimareti and I work at the olive fields. My employers sent me here to rent a mill from you. You seem to be the only one in our area that has olive mills. I want one for 4 days.

THALES: Yes, but I do not have any available now. The first available mill will be after five days.

DIMARETI: In five days… the oil will not be so good…

THALES: Sorry Dimareti, but all of them are rented. The price is 20 drachmas, but because of the high demand you have to tell me now if you want one, or not.

DIMARETI: Do keep one for us, since we do not have any other option. Bye Thales!

SCENE 5

(Four months later. Anaximandros and Alkandros are walking towards the olive mill to find Thales. The same place with the previous scene.)

ALKANDROS: Anaximandros we were very unfair towards Thales and his inability to become rich.

ANAXIMANDROS:

I am very surprised with what he has achieved Alkandros. We obviously underestimated him.

ALKANDROS: He rented all the olive mills of Miletus and Chios for a year at a very low price and he has had the monopoly.

ANAXIMANDROS:

And because of this monopoly, he is now the richest man in Miletus.

ALKANDROS: He was right; the knowledge of Mathematics is a very important thing. He knew from his observations of the stars and with the help of Mathematics, that this year would be very favorable for the fruition of olive trees.

ANAXIMANDROS:

I will surely become a student of him if he accepts me. I think that Mathematics is very interesting. Even if I do not gain as much money as Thales, I will learn at least how to think correctly and logically.

(Thales is coming and the two men bend their heads)

THALES: Hello friends!

ALKANDROS: We truly apologize for our horrible attitude before Thales.

ANAXIMANDROS:

You were right Thales. The power of Mathematics is evident in all sectors of life and if you want, you can gain money from your knowledge, too. We are honestly sorry.

THALES: It is very important for someone to understand his mistakes! Now I have proven it to all of you that we (the philosophers) can become rich anytime we want with the knowledge we have, but prefer to do more serious things!

ANAXIMANDROS:

Yes, Thales, you are right. Please accept me to become a student of you. I want you to teach me Mathematics, not necessary to gain money, but at least, to learn to think logically and practically. Maybe, if I am good student, in the future I can discover something new that is useful to humanity just like you!

THALES: It would be my pleasure Anaximandros. You have already begun thinking as a well-thinking student and I believe that with effort you will succeed.

ALKANDROS: Thales, what are you going to do with all this money that you've earned?

THALES: Surely, I will not change my simple way of life. I will use my money to go on a trip to Egypt and study the pyramids and other discoveries. Now with my money, I have the commodity to discover more useful things for humanity during the rest of my life, using my knowledge of Mathematics.

A Number of Numbers

Writing by Simone Spiteri from Malta

Description:

This short 15 minute play takes place inside a moving bus. It would be ideal if the set created for this piece is a cross section along the length of the bus in such a way that you can see part of the rows of 2 seaters set agains the windows. This can be created in a variety of ways from using basic chairs set in twos to a more elaborate (realistic or stylised) setup. The illustration accompanying this play is there to only give an idea of how it can be visually rendered.

During the play MAN, will often point to or refer to the large windows on his side which, due to unexplained 'magical' powers, he will use as a sort of screen to illustrate what he is speaking about. In practice this can be created in many ways depending on the age of the students taking part in the play as well as resources available. The images running along during various parts of the dialouge are illustrated in the play by text boxes or reference pictures only to give an idea of what Man is speaking about. These projected images may be illustrated and creted by students themselves as class projects/ reserach particularly in the case of slightly older students for whom this play is predominantly aimed.

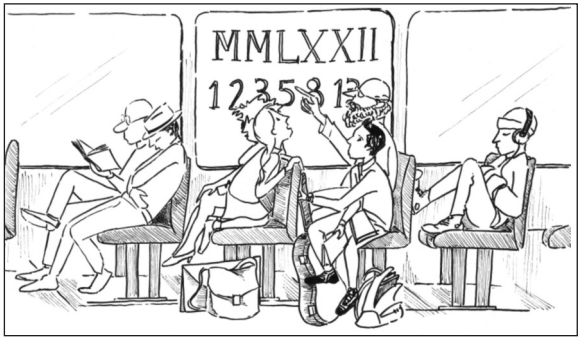


Illustration by Christine Tong

Characters:

Oliver
Nina
Man
Driver
Bus passengers

In a blackout we first hear the SFX of a heaving bus slowing down towards a bus stop . There is the faint sound in the background of a radio playing music. Lights come up and we can see a cross section of a half bus in length, it's not full but there are quite a few people sat in the seats. Some people are reading the paper, others dozing off against the window, some staring into space, a few young people are listening to their ipods while

others are just chatting away. The driver seems lost in a world of his own.

The screen *(which is doubling up as the bus windows)* is showing scenes of streets, shops and so on whizzing by.

Off stage we hear two voices:

OLIVER *(Off stage)* Waaaaait!

NINA *(Off stage at the same time)* Waaaait up!!!

Two teenagers appear at the bus door, out of breath, wearing uniforms and carrying school bags. Oliver has a guitar case slung over his shoulders while Nina is carrying an art case.

DRIVER *(annoyed)* Yeah, yeah, you take your sweet time. Come on, hop in! I've a schedule to keep!

Nina and Oliver pay for their ticket and start looking for a place to sit. In the meantime the bus is on the move again and is bobbing gently. Oliver and Nina seem to be in a rush and quickly look for a place to sit. There isn't a double seat available so Oliver sits next to an old MAN while Nina takes the seat in front of him.

OLIVER *(rummiging in his school bag)* Come on, quick! We've only got 30 minutes to go!

NINA *(fishing out a book and copybook)* Look, I managed the first three and the last one, the rest of it 's a total disaster, I've no clue! Did you manage?

OLIVER *(opening his copybook)* That's four more than I knew! *(groans)* This is nuts! Why do I have to do this!! The test's is during the first period and I'm just going to fail this epically. Mum's going to kill me, she already said that if I fail this one too there's no band practice for a week!

While Oliver's speaking the bus breaks sharply. All the passengers sway forward grabbing on to whatever they can to keep steady. Oliver's books slip out of his hands and straight onto the passenger sitting next to him's lap.

DRIVER (honking the horn- shouting out of the window) Watch where you're going!

OLIVER *(to man sitting next to him)* I'm sorry Sir.

MAN That's alright. Not your fault.

He hands over the book and copybook back to Oliver and peeks at them quickly.

MAN *(with glee)* Ah! Mathematics I see!

OLIVER *(sighing)* Yeah..... (over-dramatic) Tragedy of my life!

MAN (laughs) There are worse things in life young man.

OLIVER I'm not so sure. Can't quite think of anything more tragic than skipping a week's worth of band practice 'cos of a bunch of stupid numbers!

MAN *(horrified)* But numbers aren't stupid!

NINA Well if you like Math, then I guess yeah that's fine. Each to his own. But it's just not fair that people like us who prefer languages and arts have to suffer all this complicated stuff when we are never ever going to use them again in our entire life!

MAN You might just be wrong there young lady.

OLIVER I just don't get the point of all of this *(points at books)*. I don't have a head for numbers and there's nothing I can do about it.... except fail that test that now starts in exactly....*(looks at wrist watch)* 27 minutes!

Oliver and Nina groan in despair.

MAN But that's it! You may think you don't have a head for numbers, but I can assure you young man, that you certainly have a head full of numbers.

OLIVER Yeah right.... I wish.

MAN But you do! Look. Answer me this. Don't think about it, ok? Right: how did you wake up this morning?

OLIVER *(hesitatant- not sure where this is heading)* Erm.... mum shouting in my ear cos it was late?

MAN *(giggles)* Yes, but after how many beeps of what?

OLIVER Alarm clock?

MAN Showing-

OLIVER 06.40.

MAN Exactly. Which bus did you catch?

OLIVER The 7.09.

MAN And how much did the bus ticket cost?

NINA €1.50.

MAN What radio channel is this? (points to the air at soft pop music in the background)

OLIVER That's Magic101.

MAN And what is the exact time right now? *(Oliver is about to raise his wrist to look)* No, no. Without looking at your wrist watch.

OLIVER Well I can't tell you that!

MAN Well of course you cannot. Want to know why? Because to do so you need to use the help of a gadget that is created through amazing technological discoveries that can only happen through the clever use of numbers. What's more this tiny gadget and many others that you use everyday will give you the answer you need through messages made up of numbers which mean different things to you. Therefore, yes, might not have a head for numbers but it is definitely full of them. (smiles) How about that?

NINA But that's different!

MAN No at all! Most things you do everyday depend on numbers because your life is conditioned by them. Man has always felt the urge to count, to organise life around him because it was necessary and because it made things run smoother. Can you imagine if buses, airplanes and trains had no schedules- and you just turned up at the airport randomly hoping to get on a plane and maybe run the risk of missing your holiday?

OLIVER *(giggles)* My mum would go mental.... she's always running on a tight schedule!

MAN We've always felt the need to count, even when we had no numbers to do that with. Have you ever heard of the Ishango and Lebombo Bones?

NINA Nope.

MAN Well, have a look.

Image of ISHANGO BONE	Image of LIBOMBO BONE

When Oliver and Nina see this they reel back in shock.

OLIVER Whoaaaaa!

NINA How did-

OLIVER Did you see that?!!!!

NINA Is anyone else seeing that?

Oliver and Nina frantically turn round and look at the other passengers, trying to gauge whether they they'd just seen what the Man did but everyone on the bus seems to be oblivious to it and keeps reading the paper, listening to their ipod, chatting or snoozing. They don't even seem to hear Oliver and Nina's agitated words.

OLIVER *(turns to the Man)* How on EARTH did you do that man!!!?

MAN *(smiles mysteriously)* There are ways and means.

NINA *(awestruck)* This is unbelievable, amazing!

MAN Well the Ishango and Lebombo Bones certainly are. They are some of the oldest examples of human computation – that's the act of calculation as you know - ever found in Congo, that's the Ishango while the Lebombo Bone was found in in the Mountains of Swaziland. Can you see the scratchings on the bones? Those are ways in which people at the time counted. The Ishango Bone, here on the right- that shows tally marks in three coloumns probably a 6 month moon calendar and the Lebombo one.... well those 29 notches were made on the leg bone of a baboon!

OLIVER Cool! *(jokes)* Better than a boring copybook, right?

MAN Indeed. They used anything that could help them count- sticks, bones... It's why we call numbers 'digits' and where the word calculate comes from. Digitus, in Latin is a finger and calculus a pebble. Both very important tools for counting in ancient times.

NINA So we went from scratching on a baboon's leg to all these numbers that give me a headache?! I think I prefer the baboon's version!

MAN Well it took a bit longer than that- and also change didn't come about at the same speed in every corner of the world. It actually took much longer for us Europeans to catch up to the Easterns.

NINA Really?

MAN Yes. For quite a while we depended a lot on Roman numerals- do you know the ones? *(clicks his fingers a myriad of iages showing places where we use Roman Numerals or examples of them on the screen)*

OLIVER Yeah, those are the funny letters you find on old buildings or old clocks, right?

MAN Exactly. Well it was quite a good system that organised units by representing those units through a letter-symbol. But there were several challenges with this way of counting things.

NINA Like what?

MAN Well adding or subtracting figures was alright but there were plenty of complications when multiplication or division came into the equation.... if you excuse my pun. I mean can you imagine working out these? *(clicks fingers, on screen)*:

MMLXXII

times XXVII

OLIVER *(scratches head)* Dude.... and I thought my stuff was complicated!

MAN In reality that's not a complicated problem to work out in modern numbers: *(clicks fingers and the Roman Numerals sum morphs into its modern version)*:

2,072
x 27

MAN *(continues)* Pretty basic long multiplication that you learn in middle school.

OLIVER Even I can work that out!!!!

MAN So can you imagine having to use those kind of figures to carry out advanced scientific research, experiments, business deals and technical work? It was very inconvenient and impractical!

NINA Clearly!

MAN And there was another huge problem.

NINA What was that?

MAN Well the Roman Numeral system had no zero!

NINA And that's a problem?!!!!

MAN Enormously so!

NINA *(looks doubtful)* Hm.... I'm not so sure. I mean zero is.... zero! It's nothing! Means nothing.

MAN Ah, but does it?

Man looks around him at the other passengers very quickly. And notices a young man snoozing a few seats behind them with his head bent backwards, his mouth wide open while he snores gently. He is holding a piece of paper in his hand resting on his belly.

MAN See that young man over there? That paper he is holding?

NINA Yeah.

MAN Well that's a shopping list his mother gave him just on his way out-

NINA Wait- how do you know that?!

MAN Nevermind.

Nina looks at him suspiciously.

MAN *(laughs)* See for yourself. *(Pause as Nina looks around as she doesn't want people to see her take a peek)* It's fine... all the passengers here can't see this *(signals to them and the screen)* All they can see is us sat looking forward bobbing along with the bus in silence. Go. It's alright, just a tiny peek.

Nina stands gingerly. Walks almost on tiptoe. The bus jolts a bit and she holds on the first seat on her side gently hitting a lady's arm.

NINA *(to the lady)* Oh, I'm very sorry!

But the lady keeps sitting staring ahead reading her book as if no one's even spoken to her. Nina looks at the Man with wide eyes.

MAN *(laughs)* Told you!

Nina is now more confident and walks up to the snoozing boy and very slowly takes a peek at the paper in his hand. She is shocked.

NINA It's true! How did you- but he's too far-

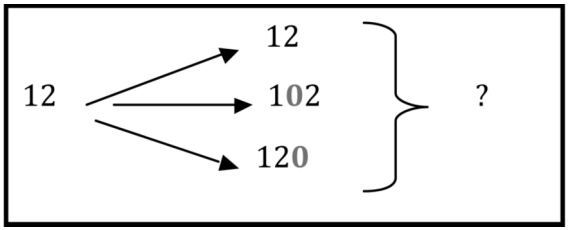
MAN Let's not lose concentration. Tell me what the first item of the list says.

NINA Well it says '12 eggs'.

MAN Right, 12 *(clicks his fingers and the number 12 appears on the screen)* Well now as you very well said before zero is nothing, means nothing and represents nothing. But Roman Numerals had no way to show that there was indeed nothing to represent.... and that would cause a few fair problems in this case.

NINA How so?

MAN Well let's take this shopping list as an example. Because we now know what symbol represents a zero, we know for a fact that 12 eggs means just that *(counts on hands)*- one-two-three-four-five-six-seven-eight-nine-ten-eleven-twelve eggs. Had his mum added a zero between that 1 and 2 we'd know that she needed a hundred and two eggs. But imagine if we didn't have a zero to use or not use, it would be a guessing game and you're stuck at the supermarket stall not knowing whether your mum mean that 1 and 2 meant as *(clicks fingers and illustrated what he is saying on screen)* twelve? A hundred and two? A hundred and twenty? Can you imagine turning up in your mum's kitchen with a hundred and twenty eggs?



OLIVER *(cheekily)* I'd rather not!

NINA So we invented the modern numbers and added zero?

MAN It didn't quite happen like that. In fact while everyone in Europe was still struggling with a zero-less life the East was already using the numbers we use today which we refer to as the Hindu-Arab system and was first developed in India and completed around 700 CE... that's quite a while before the Europeans.

OLIVER And the zero?

MAN The idea of zero was developed by an Indian mathematician called Brahmagupta.

OLIVER Cool name!

MAN Amongst many things he explored in the world of Math, he who came up with the idea of using a circle to represent a missing value and who said that zero should be regarded as much a digit as the other nine.

NINA How cool to be the guy who invented the zero! When asked what it is you're famous for you can say 'Yeah, I invented nothing!'... literally!

MAN *(smiles)* Well he certainly didn't invent nothing. His discovery changed everything.

OLIVER So we waited for these guys to develop all the modern numbers and zero then we took them on for ourselves here in Europe when we realised that Roman numbers were causing complications?

MAN Ah, not exactly. This is where my friend Leonardo da Pisa comes in.

NINA Your friend?

MAN As a matter of speaking. Hang on.... I might just.....*(starts rummaging in a briefcase he has had on his lap all along)*....I was sure it was here.... ah, there it is! *(he fishes out a book)* This is Liber Abaci and you should thank this book here and the man who wrote it for having Hindu-Arab number-filled days including the zero!

Image of Liber Abaci

OLIVER Who's he?

MAN Well, Leonardo da Pisa.... as you might guess, what a mathematician from Pisa, Italy.

Image of Learning Tower of Pisa

NINA I went on holiday with my family there last summer!

MAN Charming city isn't it?

Image of Leonardo da Pisa's portrait

OLIVER Is that him?

MAN Supposedly.

OLIVER Serious-looking dude!

MAN *(scratches chin)* Do you think?

NINA So what did he do?

MAN Well Europeans were still using Roman numerals when Leonardo was a boy. His father, who was a customs official in what today is Algeria, sent for him when he was a young man to join him there and to learn the family trade. And it was in this new land that he started meeting people from far and away in the East. These people introduced him to this different- and more efficient- number system. Leonardo probably knew how to speak Arabic, as it was usually a requirement of his father's job. This means that he could speak and read works about mathematics which the Arabs had written when they had discovered these wonders for themselves during their own travels even further East!

OLIVER So then he wrote this book about it and brough it to Europe?

MAN His work was very important because it created a bridge between the Arab and European world at the time, particularly where math was concerned. In fact it's thanks to most of these new ideas he brought back to Europe that so many scientific and engineering wonders were to follow in this continent.

NINA Wow, he must have spent his entire life studying in school!

MAN Not exactly. Schooling at the time was a pretty basic affair- none of the amazing tools and opportunties for learning you have today.

NINA What was it like then?

MAN Well, education was largely in the hands of the church or monasetries at the time so students learnt writing, reading a bit of geometry. They had no desks or chairs and had to sit cross-legged on the floor. That really hurt!

OLIVER Sure must have!

NINA So this Leonardo guy was famous for bringing over someone else's work? Didn't he actually invent anything?

MAN Hang on. One question at a time. Let's take the first one: Was he famous for bringing over someone else's work? I am going to try answer that question with another question.: Look at this and tell me who and what these images are: *(clicks his fingers)*

Images of
ipod, ipad, iphone and Steve Jobs

OLIVER That's easy! Ipod, ipad, iphone an the great man himself: Steve Jobs.

MAN Correct. Well no one can quite dispute what Mr Jobs did for computer technology, right? But did he actually invent the computer itself?

NINA No.

MAN Who did then?

Oliver and Nina keep looking at each other, unable to come up with an answer.

MAN Well there isn't a clear answer to that because there were several amazingly gifted individuals over history who contributed to what we now call the modern computer. But people like Steve Jobs and Bill Gates, who didn't exactly invent the machine itself, certainly made the computer an accessible gadget to literally everyone through their amazing products, no?

NINA Yeah, that's true. *(smiles)* Even my Grandma has an iphone!

OLIVER So Leonardo did the same with these numbers- he made them accessible to more people.

MAN That's one way of putting it.

NINA And what about the second question. Did he actually invent anything himself?

MAN Well there is one simple problem tackled in this book which Leonardo is very famous for.... though the starting point wasn't exactly something he had invented.

OLIVER What is it?

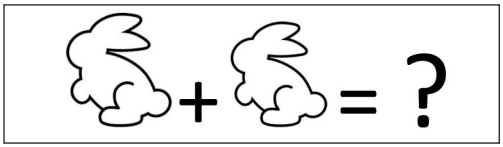
MAN Have you heard of the Fibonacci Sequence?

NINA No.

MAN Leonardo was occassionally known as Fibonacci which might mean 'son of the family of Bonacci'- a nickname a historian gave him many centuries after his death. The Fibonacci sequence started from a simple mathematical question asked in this book that was first discussed by an Indian mathematician a long time before him.

OLIVER What was the question?

MAN It said: imagine a man – right?

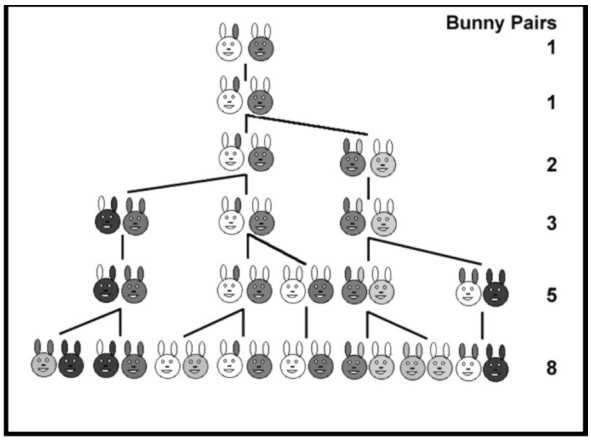


MAN If he had a pair of rabbits in one place, how many rabbits would be created from those two by the end of one year if they have a pair within the end of the first month and the new pair will have their own pair at the end of the next one and so on?

Oliver and Nina look fixedly into space, frantically trying to count on their fingers and getting mixed up each time.

MAN *(smiles at them and clicks his fingers again)* The answer is 377. This how it would probably look if you had to map all the rabbits in that one year.

(Image reference: http://www.mathgoody.com/2-6-Fibonacci/Fibonacci.html)



OLIVER But how-

MAN Leonardo realised that he could get to the answer through a pattern he discovered in the Fibonacci sequence... look....*(clicks fingers)*

1,1,2,3,5,8,13,21,34, 55,89....

MAN *(continues)* ....each number in the sequence was the result of adding the previous two. Can you see? 1 + 1 is 2, 2 + 1 is 3, 3+ 2 is 5 and so on!

NINA Wow, he's right... look.... it still works when the numbers are much higher!

MAN And Leonardo discovered something even more awesome about this sequence!

OLIVER What was that?!

MAN Well he realised that if each number in the sequence is divided by the number that comes before it the answer will always get closer and closer to a special figure... roughly 1.618... a special number that mathematicians call The Golden Ratio.

NINA What's the Golden Ratio?

MAN In short, the Golden Ratio is what we call a mathematical constant and it appears many times in geometry, art, architecture and many other areas. You can try it out yourself if you divide a line in two parts so that the longer part divided by the smaller part is also equal to the whole length of the line divided by the longer part... the answer will be the Golden Ratio. Many architects, artists and engineers thought that this ratio provided results in their work that very nice and pleasing on the eye. Which is why people like the Greeks supposedly used it a lot when planning their architectural projects.... including the Parthenon.

Image of Parthenon

OLIVER That's just awesome!

NINA So cool!

MAN But that is not the most fascinating thing about the Fibonacci Sequence and the Golden Ratio!

NINA There's more?!

MAN Indeed. It became quickly clear that someone had beat us to it when it came to realising how 'cool'... as you put it, the Fibonacci Sequence and the Golden Ratio are.

OLIVER WHO?!

MAN *(smiles)* Mother Nature.

NINA Mother Nature?!

MAN Indeed. Everywhere mathematicians and scientists looked around in nature..... there they found the Fibonacci Sequence and, as a result, the Golden Ratio.

OLIVER Where did they find them?

MAN *(grins)* Are you ready to have your mind blown way?

OLIVER *(simulataneously)* YES!!!!

NINA

MAN OK. So.... this is just a sample, otherwise I could go on forever! Right, so let's look at the Fibonacci Sequnce one more time *(flashes on screen)* and then tell me what the stuff coming up reminds you of, ok?

OLIVER Yeah.

MAN Ready?

NINA Sure!

MAN *(While he lists away related images appear on the screen)* Let's start off with flowers and their petals: an iris has 3 petals, primroses 5, delphiniums 8, corn marigold 13, daisies 13, 21 or 34 while sunflowers have spirals with 21,34,55,89, 144 seeds in a clockwise fashion and 34, 55,89,144,233 anti-clocwise. Rings a bell?

OLIVER WOW! They're ALL Fibonacci numbers!

MAN Right they are. But that's just the beginning. Fruit and Vegetables are no different, a banana when cut has 3 sections, an apple 5 and a pineapple's skin has spirals with sections in 5s, 8s and 13s.

NINA That's amazing! We eat this stuff everyday and I never noticed!

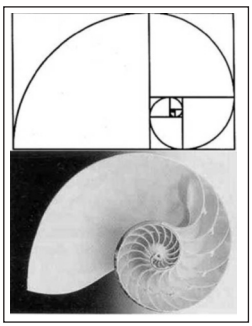
MAN Animals are no different either- did you know that when worked out a penguin's eyes, beak and wing display the Golden Ratio of its full height?

OLIVER Really?! That's mind-boggling!

MAN The Universe itself is based on the Golden Ratio as well as the structure of entire galaxies out there!

NINA That's amazing!

MAN Look at the Nautilus shell.... the radius of each section is always the length of one side of each rectangular section in such a way that it slowly creates the spiral, can you see? No matter how high the fibonacci number is the ratio always stays the same!



(Image reference: http://canibuscentral.ihiphop.com/forum/index.php?showtopic=46622)

MAN *(looks at Nina)* You like Art don't you?

NINA Love it!

MAN Well, that's another place you can find these mathematical wonders!

NINA Really?

MAN Sure. Ever heard of this? *(clicks fingers- an image of the Mona Lisa appears)*

NINA *(laughs)* HAVE I heard of this? I don't think there's anyone who hasn't! That's Da Vinci's Mona Lisa.

MAN Well the proportion of the woman's face and composition of the piece uses the golden ratio..... which is probably one of the reasons so many people are drawn to it.

NINA That's so cool!

MAN *(looks at Oliver)* And music is no different! Do you play the piano?

OLIVER A bit.

MAN How many keys in an octave?

OLIVER Erm... 13.

MAN White and black keys in that octave?

OLIVER *(counts mentally)* Erm... 8 white, 5 black.

MAN All-

OLIVER *(finishes his sentence)* Fibonacci numbers.

MAN They are everywhere! Art, music, poetry. Ever heard of an iambic pentametre?

NINA Shakespeare, right?

MAN Exactly and once again.... that's another place you find a Fibonacci number, along with limericks and the Haiku! We carry the Fibonacci sequence around with us all the time! *(looks at them mischievously)* And we carry them even around our very own person!

NINA *(looks around, on her person)* Where?

MAN Look at your hand. You have 8 fingers, 2 thumbs, 5 digits in each hand, 3 bones in every finger, 2 bones in each thumb, 1 thumb in each hand.

OLIVER Fibonacci numbers again!

MAN Yes. And guess what? If you work out the ration of each section from the top of your index finger all the way down to your wrist.... guess what the ratio always gets closer to?

NINA The Golden Ratio?

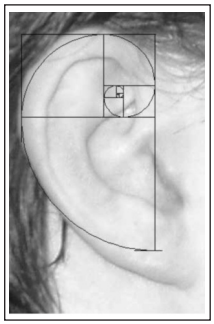
MAN Precisely!

OLIVER Awesome.

MAN And my favourite..... look at the ear....

Man points to the young man sitting next to Nina who is obliviously listening to his ipod. Man clicks his fingers and the young man's ear suddenly appears as an image on the screen.

MAN Have a look at this and tell me what it reminds you of....



(Image reference: http://grtemp.blogspot.com/2005/04/golden-ratio-ear.php)

OLIVER The Nautilus Shell!!!!

NINA How cool is that!

MAN Exactly! Nature is, as you can see... ALL about Math!

OLIVER I never knew numbers were this cool!

MAN I'm glad you think that! Number are so.... everywhere... in modern life that we often take them for granted and forget what amazing things these little figures here can shows us and remind us of.

The bus bell rings and SFX of a bus slowly coming to a halt. A few people stand to get off the bus. The images on the screen return to the street images rushing by.

MAN Ah, that will be my stop.

OLIVER *(disappointed)* Are you leaving?!

MAN Afraid so, the day awaits!

NINA I want to hear more of all this!

MAN You will. *(smiles)* Now that you are aware of all these wonders you will start looking for them... and finding them.....everywhere!It was lovely to meet you both.... and I do hope that next time you have a math test you'll remember our little conversation today and be a bit kinder to numbers.

OLIVER Sure will.

NINA Thank you!

MAN You are very welcome. But now I must really be off!

OLIVER Have a nice day!

MAN Thank you. A nice day to you too.

The Man stands and gets of the bus which slowly starts moving again.

OLIVER Oh look, he left the book behind him.

NINA Oh no, how are we going to give it back?

OLIVER *(who by now has opened the book to the first page)* Nina!

NINA What?

OLIVER *(wide-eyed)* Look at this!

NINA Look at what?

OLIVER Here.... on the first page.... there's something written.

NINA *(reads)* 'To Nina and Oliver, hoping that from now on numbers will become your 'cool' friends, as they are mine. With regards.'

OLIVER We never told him what our names are!

NINA *(Checks book again)* He didn't sign it.

The bus bell rings again and the bus slows down.

NINA This is our stop.

They walk to the door. But on the way out Oliver turns to the driver.

OLIVER Sir, you wouldn't know who that elderly gentleman sitting next to me was by any chance? He... erm... forgot his book....

DRIVER Oh that's old Leo, he catches the bus every now and then. Nice chap.... always goin' on about numbers.... of all things to speak about!

Oliver and Nina look at each other, their eyes about to pop out of their heads. On their way out the bus door lights slowly fade to BLACKOUT but not before the screen, for a split second, right before everything goes dark pulses with fading flourescent numbers that seem to show....1-1-2-3-5-8.....

Political Numbers

Writing by Spiros Kitsinelis from Greece

Roles

P - Prime Minister

M - Minister

U1- Union representative 1

U2- Union representative 2

U3- Union representative3

(In the prime minister's office the prime minister is a meeting with the finance minister)

M: Mister Prime Minister listen to me ....The debt is growing and we put the public sector in order. Something must be done immediately.

P: And what do you want me do my minister? Lay off more teachers? Shame! Our own teachers are watching us on TV.

M: God no .... teachers are useful ... but there are several useless organizations ... shut them down .... There are many who receive large salaries and do nothing ... reduce them. There 's people that abused the system…take back what they looted and fire them.

P: Well well .... everyone says all that…but you know how much bureaucracy we have to face….the state is a maze. ..even if one wants to do something useful he will be lost in its dark corners…

M: What dark corners Prime minister? Do you know how much the public electricity agency costs us? With what we spend we could illuminate the dark side of the moon.

P: My minister you 're good in math but not in astronomy .... we call it DARK not because it is dark but because we cannot see it from Earth ... The sunlight is getting there just fine.

M: Anyway .... I'm not here to talk about astronomy ... although I see little stars every time I look at the national debt .... I came here to discuss what to do ... before we go to to hell with geometric progression and the Chinese buy us off ...

P: Geometric progression you say? Well it is still progress ....we do not often have any sort of progression in this government so a geometric one towards hell is something ....

M: Prime minister do not joke! A geometric progression is not a success story ...it is a mathematical expressions which states that something could be rising fast ... much faster than linearly….

P: Yeah yeah, I know ... instead of going step by step to chaos .. we go two steps at a time ....

M: Prime Minister you have forgotten what geometric means... I wish it was two steps at a time .... geometric is much faster ....

P: Yes, I know ..... like every step being double of the previous one…it all starts fine and easy like 1, 2, 4, 8 and before you know it the numbers are incredibly high….

M: Like the legend of the Indian king, the chess inventor and the rice .... what do you want the king asked in return for this nice game .... a grain of rice in the first square and then doubling the grains for every square till all 64 squares are completed….Big deal says the king ... angry with such a paltry request ... but in the end the king gave him the kingdom ... cause the number of grains needed was phenomenal ...

P: Wait a minute….you just gave me a great idea ....

What time will the union representatives come to demand the withdrawal of the new austerity measures???

M: They ' ll be here in an hour…and they will be very angry ....

P: OK ..... Bring them in ... and whatever I tell them you just agree…no questions..just follow me ….

(New scene…Union representatives enter the office)

U1: Prime Minister enough is enough .... we have been paying taxes all our lives…now we demand that you don't touch our wages and pensions

P: Gentlemen how right you are ... I totally understand your complaints..I am on your side…the idea of new measures that will affect your life's work is unacceptable…I was just discussing this with the finance minister ….I assure you that nothing will change ....

(Union representatives look at each other puzzled…minister grabs his head in despair)

P: Gentlemen I repeat that I'm on your side ..... no new measures that will reduce wages and pensions will be taken ....

U2: Well admittedly, this is quite a surprise Prime Minister ..... what can we say ... We came here to negotiate and did not expect such an reaction from you ...

P: You should have expected this my good man ...You should have expected this because I am here to serve and protect the interests of the people that voted me in….and as a leader of the people my goal is to keep you happy and the state in order. ..

U3: Sure ... sure Prime Minister …exactly that ...

P: But I want your complete support my good men in order to get through this difficult period....

U1: What can we do to help prime minister? As long as we don't reduce wages and pension…lest not forget that

P: From you I want something small ... something symbolic I would say ... which however will make a big difference ... mostly psychological ... something to show our partners and the people that something is changing ...

U2: Please tell us.

P: I want you to give every week a small tax of 1 cent ... and this will last only for one year .... I promise you just for a year ... 52 lousy weeks ... and it will be only 1 cent that will increase weekly geometrically...

U3: What do you mean geometrically Prime Minister?

P: Oh, technical things that should not concern you .... each donation will be half of the next one .....

U1: Meaning???

P: Like I said technical stuff .... details .....

U2: Well do tell us those details in order to understand.

P: No big deal .... We begin with a donation of 1 cent and the second week this will be 2 cents .... the third week 4 cents …the fourth week 8 cents….then 16 cents…as you see this is a matter of lousy cents and it will be only for 52 weeks ....

U3: Well it does look trivial and symbolic…Ok you have our agreement !

(they shake hands and leave)

M: Prime minister do you have any idea what you agreed to?

P: Your idea my minister .... a thousand BRAVO ...

M: BRAVO my Prime Minister? Once they understand what they agreed to they will get in here with rakes ...

P: I just did my job …got the money for the state….but also left wages and pensions untouched….they agreed to a geometrically increasing contribution of one cent (laughs). Tell me ... you 're good with numbers ... how much will we get from each one?

M: Until the seventh week it will still be a few cents .... by the 17th it will be a few hundred Euros…and after the 27th …in the middle of the year that is…they will each owe us 1.5 million Euros….by the end of the 52 week period the total amount will be ...

P: Well this is not important….we don't have to get there…even the first few weeks are enough

M: But please let me tell you the number and laugh with this together…it will be the last time we laugh anyway….by the end of the 52 week period the total amount each will owe will be over 22 trillion Euros… hahaha ....

(They both laugh loudly ...)

P: And they wonder how we win the elections…all they want is promises and they can be easily manipulated….empty promises and you can then lead them to even worse disasters…

(The Minister still laughs)

P: Why are you still laughing? And why did you say earlier this will be the last time we laugh?

M: I am just picturing the scene....

P: What scene?

M: The judge telling you that you will only spend a minute in prison mister former prime minister ... a minute that will just increase geometrically every week for just 7 months….this will be your whole sentence…..a total of 134,217,728 minutes .....just a little over 255 years...

"distant.relations"

Writing by Oded Ben-Horin for Norway

"distant.relations" is a mathematical children's theater work, in one Act and three Scenes, inspired by the **Discover the Cosmos** eLearning portal and the book **"Learning Astronomy Through Inquiry and by Means of Self-Instruction"** (Spanos & Xenakis, 2013). Specifically, it seeks to teach the mathematical concept of ratio by embedding it in the context of a play about the distances of the Solar System planets known at Copernicus' time from the Sun. These are used as the basis for the play, in which emotional contents portray mathematical ones. The Solar System as it was known to Copernicus is thus presented as a society in which various characters have closer or more distant relations: The outer planets known at the time of Copernicus, Mars, Jupiter, and Saturn, are jealous of the Earth and the inner planets' close relationship to the Sun.

"distant.relations" is based upon artistic works which relate various mathematical or scientific concepts: **"Flatland, A Romance of Many Dimensions"** (Abbott, 1884) and **"The Planets"** (Holst, 1916).

Music: The planet Venus is chosen as the focal point for musical activity as its orbit round the sun was the starting point of the Copernican Heliocentric approach (Spanos & Xenakis, 2013). The play includes one original composition, "Venus", for soloist (Mezzosoprano or low Soprano), 4-part choir and piano (written in "chord changes" form). The composition is meant to be performed by high school pupils who specialize in music. In cases in which this setting is not available, the composition should be substituted by another song or poem about Venus or the Solar System *preferably in the original language of the country in which the play is being performed*. If available, bass and drums may be added. If needed, the piano part may be substituted by a guitar.

Optional: Should resources allow for it, musicians are encouraged to *improvise* music during Scene 2. A different style of music, or different instrument(s) should accompany each character, creating a series of short improvisations.

Staging: Some staging instructions are given. Staging should, to the extent possible, resemble a Solar System, especially with regard to physical distances between all characters except the Sun's Rays. How this is realized with regard to colors is dependent on the available lighting equipment, and the pupils' decisions.

Costumes: Costumes should refer to their respective planets color-wise in some way. The inner planets should differ visually from the outer planets. Any further details are dependent on the available materials, and the pupils' decisions.

Inquiry-based learning questions: The play should be learned and performed simultaneously with the learning of the mathematical concept of ratio, preferably also the study of the solar system. Following the performance, students should be asked to explain the following two issues presented in the play:

1. The mathematical key provided with the script
2. The reason for the reconciliation in Scene 3

Characters (gender is assigned according to the respective characters' mythological character):

The Sun (male)
3 Sun Rays (A Greek Chorus of 3 female actresses, always speaking in unison)
The Earth (female)

Inner Planets:
Mercury (male)
Venus (Female)

Outer planets which were known in Copernicus' time:
Mars (male)
Jupiter (male)
Saturn (male)

Mathematical key:

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn
Distance from Sun (ratio with Earth as reference=1)	0.387	0.723	1	1.52	5.20	9.58
Distance from Sun (millions of km)	57.9	108.2	149.6	227.9	778.3	1,427.0

Scene 1: The Sun and his Rays

Estimated time: 3 minutes

The Sun proudly enters the stage accompanied by the Sun's Rays and the Planets.

The Sun moves around the stage proudly, speaking to the Planets. The Rays approach the Planets and make movements aimed at them, thus physically delivering the Sun's message. The Planets sit down on the stage in an order physically conveying their distances from the Sun (see mathematical key).

The Sun:
Ending night,
To rip from darkness
Heat's energy, to feel and see

The Sun turns to the audience and gestures towards the Planets while speaking.

The Sun's Rays:
Ending night,
I rip you from darkness
Heat's energy, to feel and see

The Sun's Rays and the Planets begin moving around the stage, yet only the Rays are speaking

Dependent, forever present, celestial society
The planets, moons of my sky
Secrets unwinding as orbits near
Relations stretched as gravity weakens, here

Scene 2: Relationship Ratios

Estimated time: 10 minutes

There is no stage-shift. Everything continues as before.

Mercury, an inner planet:

The Sun's Rays circle very closely around Mercury for 10-20 seconds before he begins speaking.

Sun?

The Sun:

Moves close to Mercury, who circles quickly round the Sun.

Mercury.

Mercury:

Waits for some seconds before replying to the Sun.

Secrets?

The Sun:

Waits for some seconds before replying to Mercury.

None

Mercury:

Keeps orbiting, waiting 8-10 seconds

None

Venus:

Venus approaches center stage. All other characters form a choir. Performance of "Venus" (see Attachment 1)

Venus, we turned to the great big sky to see the strength of your light, Venus

Venus, for as far our naked eye could see far into the night, Venus
Couldn't you hear us? Screaming for love inside our dream?
Proceed to reveal us! We know we have every right to be…

Venus, we turned to the great big sky to feel the strength of your light
Venus, for as our naked eye could see far into the night
Why didn't you hear us crying throughout eternity?
So true to your light as only a God of love could be

The Earth:

The Earth is in the center of the stage. The Sun's Rays walk freely around the stage for several seconds before the Earth begins to speak.

Circling the sun,
One would dare become
Planet for the living

There would be a way
Time would surely let it

You'll find it here when
You hear
Know and wish and see and feel the waters flow
With life, seeing it grow
The only secret worth knowing,
This brand new story in the great unknown
Mars, Jupiter and Saturn, jealous outer planets:

The Sun and his Rays stand in center stage. The inner planets stand nearest to them, clearly uncomfortable, nervous, expressed by their facial expression and body language. The Earth stands slightly further out in the circle, between the inner and outer planets. The outer planets stand angrily around them, in a third, larger, circle, studying them. They are placed according to their distance from the Sun with Mars closest to them, then Jupiter, and lastly Saturn. The outer planets whisper among themselves while pointing at the inner planet, jealous of their closeness to the Sun.

Saturn:

Turning towards the audience, speaks with a mystical aura

Yellow gas, giant rings
Solid at the heart of things

Jupiter:

Turning towards the audience, speaks with gusto and bravado, a "large" aura

Planet of size
Spotting eyes

Mars:

Turning towards the audience, speaks with gusto and a "menacing" aura

"God of war", the human said
Outer planet, warring red

Pantomime: The inner planets turn to the Sun and his Rays for help. The Sun and his Rays try to console them, but the outer planets pester and provoke.

Scene 3: Reconciliation

Estimated time: 2 minutes

The Sun:

As a caring, consoling father

Ending night,
I rip you from darkness
Heat's energy

Cast eyes beyond to see
Starry eyes outshining me

Who can judge afar, of near
Skies of endless eyes appear

Pantomime: The outer planets begin changing their facial expressions and body languages, slowly at first, then more. As a reaction, the inner planets and the Earth gradually appear less intimidated. This reaction should be detailed, gradual. Not all planets should react at once. In the final scene, all planets sit down on the stage in an order physically conveying their distances from the Sun, reminiscent of the beginning of scene 1. All actors must freeze in this position, expressing positivity. Lights out if lighting is available.

The End.

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Noname

Writing by Luca Borosne Nagy from Hungary

Person:

Noname,
Little Bear,
Wise Owl,
BuzzyBuzz,
Queen,
Buzz soldiers

1. scene

Noname, Little Bear, Wise Owl

In the Vivid-field, in the indian camp.

Noname: How is it, that I Noname can make 2 belts a day of colourful leather pieces but my friend, Sedulous Hand can make twice as many. In 7 days together we can produce …. a lot of colourful belts, but a I need time, to calculate the exact number. Can you help me?

One morning Nevenics invited her friend Little Bear to accompany her to the old, wise indian's whigwham. Lttle Bear has always been a naugthy boy, this time he messed up the numbered stones along the path. On every stone there is written a number.

Noname: Little Bear, you have messed up the stones again! Although you swore not to! You naughty bear!

Little Bear: I'm sorry, it was such a good game! Let's sort them together!

39, 93, 3, 62, 10, 8, 29, 72, 56, 0, 2, 7

Can you help them with the ordering?

They arrived at the old wise's whigwham.

Noname: Welcome Wise Owl!I was sent to you with my question. Why am I called Noname? The others have got wonderful names! My friends have names like Sedulous Hand or Little Bear and I have just this name: Noname! It's not fair!

Wise Owl: Find tranguillity in your fiery heart and be calm! Everbody has got his/her own flower inside,with a word within. The name can't be given, it has to befound. You are to find the proper name for yourself.

Noname: But, how? How can I find the flower? How can I find the word in it?

Wise Owl: I send you off with peace, go! I give you this to take away: take 926 steps forward and you have reached half way, take 538 steps less too, then turn

to your heart and take 194 steps twice and you may find, what you are searching for.

Noname: Peace be with you, Wise Owl! (Noname took a bow.)

Little Bear: Have you got the answer you have longed for? Tell me everything!

Noname: Unfortunately I'm not so wise. I was told to find a flower with a word within and as help I've got a mathematical task too.

Little Bear: I'll help you! Let's solve the task together! You know, together is easier! Higher up at the waterfall there are lots of curious flowers, they could be the target of our journey.

Noname: Let's go… I haven't got a better idea… but… it won't be dangeoruos, will it? Sitting Bull warns always not to go far away from the camp where wild animals live… and…

Little Bear: Ok, I don't mind… your name should be Rabbity Rabbit or Shaky Legs …

Noname: That's ok, I'll go…

Little Bear: Look! The numbers led us here. Is it a blue flower? Wounderful! And so huge! I have never seen such a shiny blue flower before! Could the water have painted its petals?

Noname: Let's take a closer look… wow… I can see numbers on the petals: 10, 15, 20… What comes next? …Yes, of course: 25, 30, 35, 40… My flower, my flower, show me my name, show it and I'll find it! What is this? What is happening?

2. scene

Noname, Little Bear, BuzzyBuzz

The indian children are in the blue flower.

Noname: Wow! What a beautiful blue word we bumped into!

Little Bear: Where are we? What's this? Is here everything blue?

Noname: Look, somebody is coming… let's hide ourselves…

Buzzybuzz: zzzz….zzz… I heard something strange …. zzz…zzzz… I can't see anybody… may be my ears have whirred… zzz…zzz… I may only „bluemagined"… I will go, I will carry on… one bag, two bags… a lot of bags… one basket…

Little Bear: Atishoo!

Noname: Sssh! He could hear us!

Buzzybuzz: Who is this? Who are you? How did you get here?

Noname: This is Little Bear, I am Noname. Please, don't be afraid of us! We are from Vivid-field. We don't know what happened or how we got here! The flower did sucked us in…

Buzzybuzz: Zzz..zzz… I am Buzzybuzz. How do you look like? You seem to look so

strange! Your clothes and hair are full of colour! Zzz…zzz… Where did you get these colours from?

Little Bear: You know, we indians, we choose these colours ourselves. We paint the leather, we wear vivid chlotes, we sew moccasin for our feet to protect us from injury. We see and use lots of colours where we come from, that's why our filed name is Vivid-field. … Look at that vivid belt I made for Little Bear to cheer him up. This is very special, I worked on it, more then usual. It took me 52 hours and 27 minutes.Can you guess how often did the sun rise? (The children show the numbers with their fingers.)

Buzzybuzz: Ups, I can't count this way . (He was wondering, because he has never seen an other colour except for blue and he hasn't counted the blue sun rising before.)

Little Bear: I hope you could help us. It is believed, there is a word or name we are searching for here in this blue flower. Do you know about it?

Buzzybuzz: My colourful friend, I am afraid, I can't help you. Here in Blue-petal-flower we are just sweeping pollens, which will be taken into sacks and the striped Bees will come and collect them in a big basket . There is 500g pollen in one sack, there are 6 sacks in a basket. Can you count up, how many Kg-s come into a basket carried to their Queen?

Noname: Let's put our head together, please, help me Little Bear! (They count aloud.)

Buzzybuzz: zzz…zzz…Correct! Ok, I'll say it, althogh my heart begins to throb when I remember that the only one solution is to get out here with the Bees. They are dangeouros… zzz… zzz… they have got sharp stings!... I have to go now! zzz….zzz…. Have a smooth journey!

The children stood there helpless not knowing how to find the basket.

Little Bear: I've got an idea! Let's find the traces of the basket! You know as Sharp Eye taught us. Look at here, I've found something! We have to hide here, the basket will be brought here. Come on, I can hear them!

The indian children hid and when they spotted the basket and they jumped into it. A bit later Noname tried to stick out her head very carefully.

3. scene

Noname, Little Bear, Queen, Buzz soldiers

The basket and the children were carried into the hive.

The Bees worked with that chant:

Head, thorax, abdoman
work, work, like a man!
Antenna, wings, and legs
Buzz soldiers are like that.

Buzz, buzz, buzz soldiers,
Buzz soldiers are like that.

Head, thorax, abdoman
work, work, like a man!
Antenna, wings, and legs
Buzz soldiers are like that.
Buzz, buzz, buzz soldiers,
Buzz soldiers are like that.

Noname: Look at that,Little Bear, where we have been brought in! Are we in a hive? We only have seen such thing from outside.

Little Bear: Where are we? In a hive?

Noname: We are at the bee's home. You know, it is called: hive.

Little Bear: Wow, everything is shininy gold! But it's so empty. Does nobody live here? Did they move out?

Noname: No, not at all! Everybody is working! They are collecting pollens from flowers in the fields, as Buzzy Buzz mentioned. We have enough time to look around. Oh, oh, look! There is the Queen. She is coming here. What shall we do now?

Queen: zzz…zzz… What's this? Is it a rebellion? Why are you not working? … Oh, you are strangers! Your chlothes are full of colours not just yellow-black. So, in this case, you have to solve a task, to get my permission to enter our realm of honey. So, here you are: there are twice as many buzz soldiers than baskets, because we need two soldiers to carry a basket. There are 315 yellow-black striped and 573 black-yellow striped Buzz soldiers. How many baskets are missing to be the half of the soldiers, when we have got 423 buzz-baskets?

Noname: Dear Mistress, pleas, give me one moment! So, there are … help me Little Bear! The indian girl whispered something into the Queens ear. Which number was it?

Queen: Excellent! What are your names, you colourful beings?

Noname: This is Little Bear, but I haven't got a name yet. We come with good intention. Vivid-field is our home. We were searching for a word in the Blue-petal-flower, which could have been my name, when the Bee soldiers came and put us into the basket too, not just the pollens… now, we are here…

Queen: So, this is your story. All right, look around! But you have to know, this is the realm of bees, it is not a flower. We are busy producing honey here. The hive will be filled by autumn. … There are 88 rooms in the hive. On one side of the corridor, there are even number, on the other the odd ones. Can you tell me the neighbours of room 66?

Little Bear sad the answer at once.

Queen: Correct! – sad the queen to Little Bear, who has given a rapid answer. What did he say?

Queen: Imagine, 1 Buzz soldier collects 2 baskets a day. Can you count how many baskets of pollen are collected in a year by 1 Buzz soldier?

After a bit of thinking, the indian children calculated how buzzy can be a Buzz soldier.

Queen: How talented you are in counting, you colourful beings! Congratulation!

Noname: I know! I know now!!! Dear Mistress, please help us to get out of here, I have found what I was searching for! I would like to go home!

Little Bear: What? Where have you found it? Which name is it?

Noname: You are impetuous, my friend, like a bear cub. No wonder, you have got the name Little Bear. I have found my name as well! Where? Here and in the Blue-petal-flower too, because it was everywhere with me, but I didn't notice it. I had to take this long jurney, to find it in myself. My name is Colourful!!!

Queen: Congratulations Colourful! The Buzz soldiers will come soon, they will bring you back to the Vivid-field, where you are come from. Have a good flight my friends!

The indian children got into the basket, with a strange feeling. They looked around. They were on the very spot where their journey began: next to the glorious blue flower at the waterfall. They rushed home to the Vivid-field singing, joyfully.

Beyond Infinity

Writing by Jaroslava Petrasova from Slovakia

Pupils sit in a small circle and have an energetic conversation.

TEACHER

What do you want to be when you grow up?

BOY

(yells)

I want to be a tow truck driver!

AVERY

(shyly)

I will be a...

BOY

(simultaneously)

Because my father took me to his work and I got to see so many interesting cars and he event let me play as if I was driving them. Some of them were pretty expensive!

GIRL

I want to be a cosmetician!

TEACHER

These are interesting choices! Avery, what did you say?

AVERY

Uhm, I wanted to say that I, I will be a scientist, a mathematician maybe.

Pupils start to laugh and Avery holds back her tears.

TEACHER

You will be? So, you have already decided to become a maths teacher, haven't you?

AVERY

Well, not exactly a teacher. I want to be a mathematician who solves problems!

TEACHER

What an uncommon career for a girl like you! I thought you hated it!

AVERY

My father says the same but he also says that I knew what a perfect number was before I could read! But you are right, I usually fail the exams.

TEACHER

But what draws you to Mathematics Avery?

AVERY

Well to me, it is something where all the answers to all the questions of the world are hidden. I mean, everything comes from science and without help from mathematics we couldn't describe and understand them at all.

The bell goes off and the pupils start to talk and pack when:

TEACHER

(having a loud, strict tone)

Ok kids! Pay attention to me just one more second! I want to talk about this matter tomorrow and I want you to prepare a short presentation about the job of your dreams. We didn't have enough time today so we will start tomorrow with you Avery. If it's okay you can go home now. Thank you. Avery? Do you have a second?

The teacher gives Avery some small paper but she doesn't read it right away and puts it into her pocket.

TEACHER (CONT'D)

Here, take this and don't be so nervous. They are only your classmates.

It is apparent that Avery goes home and then we can see her behind her desk and buried in books when her father enters the room.

FATHER

What's going on sweetie?

AVERY

It's nothing.

FATHER

Oh, come on, you know that you can't hide anything from me! And! Your facial expression is not helping you. So what's eating you?

AVERY

Dad, it's just some school stuff for tomorrow. Really. I need to work now.

FATHER

Oh. Okay. But still, I want to talk about it later.

Avery´s father is about to leave when:

AVERY

Dad?

FATHER

Wow. That was quick!

AVERY

(sadly)

Uhm, nothing.

FATHER

No. No! I'm sorry. I didn't mean it. I'm listening.

AVERY

Do you think I'm weird?

FATHER

(astonishingly)

Why would you think that?

AVERY

It's just that kids laughed at me when I said I wanted to be a mathematician.

FATHER

They are silly. You're not like them.

AVERY

But it makes me feel like I'm the one who's silly because I don't have good grades at school from Maths. It was a mistake when I said I wanted to be a mathematician. I'll never be good at it.

FATHER

That is not true and you already know that. Just don't think about it this way.

AVERY

I can't. I said that I would do a presentation on "What I want to be when I grow up"

FATHER

And may I help?

AVERY

Well, yes, I'm struggling right now. I don't know what to talk about. It's impossible to choose only one thing.

FATHER

Perfect numbers for example? You know I'm always saying...

AVERY

Yes! I know that dad! But no. It's not what I want to talk about. You know, the fact that there are different formulas, operations that apply to everyday problems is the thing that I'm really interested in.

FATHER

And where is the problem exactly?

AVERY

You know, the grades. I'm not good at it.

FATHER

Oh, come on! Where's my little girl curious about infinity, unsolved problems and with her own broad imagination?!

He comforts her, strokes her shoulder and then leaves. Avery is writing something when it looks like she has fallen asleep. A person appears.

AVERY

Who are you?

ADA

Don't you recognize me? I'm in your fantasy, I'm a product of your imagination and I'm also known as the "enchantress of numbers"!

AVERY

Oh, Ada! Ada Byron! Why are you here? I don't understand!

ADA

You needed help with your struggle that's why I'm here.

AVERY

But how? You are not alive anymore and how can you help me when I'm bad at school even though I understand what they teach us but when the test comes it's just not enough!

ADA

Maybe you are trying too hard.

AVERY

No, I'm not! I don't need advice like that! Go away!

ADA

You stay up late, cramming and hoping you'll pass the exam next morning...

AVERY

I said go away!

ADA

You're a smart girl Avery but you expect failure before you even try and that is your problem.

AVERY

I do not have any problem!

ADA

You sure? Why are you way better at Maths than anyone at your age but you don't have good grades then?

AVERY

(calmly)

I don't know.

ADA

Let me tell you something. Many people had underestimated me because I was a woman. But I had never given up.

AVERY

What did you do when you couldn't prove the truth in the notes you had written about the famous Analytical Engine?

ADA

I believed in my skills and in the complexity of Maths. But I'm not here to talk about myself.

AVERY

You know, the thing that fascinates me about you the most is the fact that you were working on the notes for a year and you basically created the...

ADA

Yes, I created the first computer program. That shows just how complex Maths is!

AVERY

You know, to me, infinity is the eighth wonder of the world!

ADA

Infinity is not big...

AVERY

...not huge...

ADA

...not excessively large...

AVERY

It's not even extremely enormous!

ADA

It is endless!

They both start to laugh

ADA (CONT'D)

Actually it is just the idea of something that has no end!

AVERY

Is it something like travelling on and on?

ADA

No, there is no such thing in our world.

AVERY

What is it then?

ADA

Let's say that infinity doesn't grow, it just is and it is fully formed and cannot be measured.

AVERY

But at school they say that a line is infinite!

ADA

And they are right, in Geometry a line is endless in both directions because it has an infinite number of points inside.

AVERY

It's not as easy as I thought...

ADA

Actually, it is easier in Maths because if something has an end you need information to define where the ends are exactly. A ray has only one end and a line segment has two ends.

AVERY

So, if there is no reason something should stop it is infinite.

ADA

As easy as that. Yes. For example the sequence of natural numbers never ends and is infinite.

AVERY

And adding one to a number?

ADA

Yes, another type. No matter how many times you add one to a number, you still can add one more. Someone can imagine it as the infinite amount of stars there is in the sky but still you can add one more star and have even more of them than you had before.

AVERY

So you are saying that some infinities can be bigger than others?

ADA

Yes, when you count 2 infinities together, you get another that is even bigger that the one you had before.

AVERY

And what happens when I subtract them?

ADA

That Avery is up to you to discover and define.

AVERY

So I guess I should start right now, huh?

ADA

(giggling)

Oh, yeah.

AVERY

Do you think I can be a mathematician when I grow up?

ADA

Of course! Even Einstein had this talk about bad grades and look what he achieved!

AVERY

Were you in his dreams too?

ADA

(laughing)

I wish! But oh, who knows!

I think our time is up Avery. Remember: You can be anyone you want but please don't expect it to be easy. It takes a great amount of devotion and time...

Avery wakes up and remembers the paper her teacher gave her. She reads it out loud:

AVERY

The only thing you have to do is to make your mother and father proud of you and you don't have to be famous to do so.

She smiles and says

AVERY (CONT'D)

Mathematics have some truly interesting things to talk about!

Math Homework

Writing by Diana-Elena Buruga from Romania

It is a beautiful summer day. The 5 colleagues Amalia, Roxana, Diana, Raluca and Emily met to discuss about their holiday homework.

DIANA: Hi girls! What do you think about my homework?

RALUCA: It's weird! Especially the Maths homework.

AMALIA: Yes, it's true. I mean what's A Δ B about?

EMILY: I have no idea. But that means I have to go to the Danube Delta to find out who A and B are.

RALUCA: Yes! Isn't it weird? This is a Geography homework, and A and B are Amalia and her sister Bianca.

AMALIA: And what do I have in common with the Danube Delta?

ROXANA: You ask? You know you are A.

DIANA: What about the next problem D+R1+A+E+R2=28 ⊠ R1=R2

AMALIA: It's easy!

EMILY: Yes, we have to find 28 people D, R1, E, A, R2.

RALUCA: Silly you! You have to make 28 drawings and on each one of them we have to draw R1 and R2 with red, A with blue, E with Emily's favourite colour and D with Diana's favourite colour.

AMALIA: You are both silly! It's obvious!

R1 = Raluca = 6 letters

R2 = Roxana = 6 letters

A = Amalia = 6 letters

E = Emily = 5 letters

D = Diana = 2 letters, together 28 letters.

DIANA: Good thinking! Amalia, you're so smart!

AMALIA: Right! I'm genius!

The girls were cheering Amalia without reading the rest of the equation.

ROXANA: Girls, do you have something for me to solve?

DIANA: Right away! Here: M={R| a2 <R<102}

ROXANA: You think I'm stupid?

DIANA: No. Do you know to solve it?

ROXANA: Yes. M = mom. I have to ask her how many girls she has whose names begin with R.

RALUCA: So you ask her?

ROXANA: No, I know the answer. One. Me. Only Roxana.

AMALIA: But how would the guy who wrote this problem know that?

DIANA: Good thinking!

The girls were confused. They didn't realize that it was a simple Maths problem with no connection with them.

RALUCA: At least we realized what Diana's homework is all about. Will you help me now with my homework?

AMALIA: Sure. What's it about?

RALUCA: It's a project with the title " The History of Mathematics".

ROXANA: Who assigned you this project?

RALUCA: Nobody. I want to write a project about people inventing such problems.

DIANA: Yes. We could send those guys e-mails to let them know what we think about Maths.

AMALIA: Right! I'll mention that are lagging behind technology. Nowadays you don't need homework assignments, you need computers.

EMILY: That's right. With a computer you can find anything you need to know on the Internet.

RALUCA: Stop it! Stop it! Stop it! Let me read you what I found about "The History of Mathematics".

Dear readers,

We would like to inform you that Mathematics appeared a long time ago. Difficult and interesting Maths problems have been discovered as belonging to the Romans. But maybe you want to know who discovered the mystery of numbers. Renowned mathematicians like Archimedes, Euclid, Pythagoras and others.

EMILY: OK. That's enough! We're going to Rome, to the Romans or to Romania. But we can do them both.

DIANA: Yes. And we ask them for their addresses.

ROXANA: Are you stupid?

RALUCA: These people lived a long time ago. It's no use going to Rome. This is what I propose to you: We make posters with "Mathematics forbidden" and maybe people will agree with us.

DIANA: You're right! Let's do it!

After two hours

AMALIA: I'm ready! 1999 posters!

RALUCA: Let me tell you something.

"A brilliant principle is "the box principle" or "Diriclet's principle". This famous mathematician stated that when we have n boxes and n+1 objects, one box will certainly contain one more object than the other boxes."

AMALIA: Hey! I brought 6 boxes. Are they enough?

ROXANA: Yes. But we will have to find out how many posters we will place in a box.

EMILY: I know how to find out. 1999 divided to 6 is …

DIANA: It's 333.

RALUCA: 333 and 1 rest.

ROXANA: And what do we do with I?

AMALIA: Raluca told us about a principle.

RALUCA: Oh, yes! I our case, n = 333 x 6 + 1 objects. That means that a box will contain one extra poster.

DIANA: But if we used Maths to solve this, we cannot create the "Mathematics forbidden" Club.

ROXANA: We worked 2 hours for nothing.

EMILY: No. It took us 2 hours to realize that we are pretty ignorant concerning Maths and that we were about to make a mistake.

The four guardians of the scared philosopher

Writing by Melpomeni Raptopoulou from Greece

In a theater, the first four numbers are trying to prove which of them is more important. The late Zero creates issue with the absence, until appears the unknown X.

TWO: Zero where are you? Come on my dear, get out, this is no time for playing!

ONE: You are still looking for him, even though he is late? How can it be possible for you to look for nothing, the non real, the not existing? You are wasting your time.

TWO: One stop now, you know that is not true!

ONE: What is not true? It's a number discovered in the 5th century A.D. Rightfully I call him late. Do you know when we were discovered? Thousands of years ago!

TWO: O! Believe me you may not consider him a natural number but certainly he is a real and integer number.

ONE: Zero, let's laugh ..... no content equals nothing. You are looking for nothing with such persistence!

TWO: Zero! If you do not present yourself right now, your place in the numerical system will be threatened. Don't you hear that they call you the absolute nothing? You could be ruined! You may be eliminated.

ONE: That lazy number! You see!? Just because he is the youngest amongst us, he thinks he can do whatever he likes! But things don't work that way mister! You hear me, you non-real?!

TWO: Hush. Don't irritate him! The show has to start and without him nothing will go on. He has a vital role in the play in mathematics, both as a number and as an arithmetic digit. Zero is very important for the distinction and presentation of other numbers. You do realize the importance of his existence?

ONE: This is what he hears all the time and his head got so big! Where is he now, your precious zero? We are all waiting for him to start and as always he is never on time! We are always late because of him. Ever since he was discovered in India our world turned upside down! Everything was just fine before he showed up!

TWO: I don't think you really believe what you're saying! Ever since he came our lives have order and sequence. A start was defined in Arithmetic! Perhaps… you are jealous and afraid to admit it?

ONE: What is there to be jealous of that round ball with a hole in his middle!? Do you know when he was discovered?

TWO: No.

ONE: Seriously Two? You will always be clueless and split.

TWO: I'm clueless simply because I'm a number full of understanding with a special perception of the world around me. Now really tell me, when was zero discovered?

ONE: Zero was used for the first time when humans had to write down astronomical data –you see the Indians thought that mathematics were a branch of astronomy- and they wanted to express the blank space. For example 3 years, 0 months, 12 days. Do you understand now why zero is the number that equals nothing? How can you measure something that doesn't exist? Let alone that I believe he has 0 friends, because he absorbs all of them. (Laughs wickedly)

TWO: Now that you mention it, doesn't it strike you that most of the time he is accompanied by words in plural? Zero friends, zero points… On the other hand it is a number that comes before you.

ONE: That's what annoys me the most. I stopped being the first number in line and I've lost my sleep over it!

ZERO: About your sleep I can't make any promises, but you are going to remain just a number for sure, besides you can't be anything else. For example you can't be a prime number, because you aren't bigger than yourself, whereas Two is a prime number, because she can be divided by you and himself. And what a prime number! The only even prime number; she is the structural unit of the even numbers. In a few words she is so much better than you'll ever be and still she remains modest! A real diamond number!

ONE: Now, now! Let's not forget that 1+1 equals 2 for the last thousands of years and if my memory serves me well –which it does- 0+0 always equals ZERO! Well look at that! I am the number of singularity, while you represent blank space! I am the source of all numbers. I am always on time whereas you are always late and never punctual in your appointments!

ZERO: I may not always be on time, but I am always at the beginning of the numbers, on the front line. In the start there is zero and let's not forget the start is the most important thing! It is the top half of everything!

ONE: You are useless, you are a ZERO!

ZERO: Are you sure dear? Maybe you should reconsider.

ONE: I have nothing to reconsider about! For me things are very clear. Full stop! You can't be anything else than nothing!

ZERO: No my friend, I won't get mad. It's my pride and joy to be Zero! Do you know how many things have been defined because of my existence? How many limitations I have presented or nullified? My existence set free the boundaries of language and imagination, which means that I have influenced the knowledge of the people. The world spins with more speed because of me!

TWO: Well done zero! What a nice speech. Don't lose your temper though, stay neutral.

ONE: Two why don't you just shoot me? That's why you are torn one minute you are on my side and next thing I know you are defending the dumpy!

ZERO: You are right Two; I must remain neutral, since I can be neither positive nor negative as I don't have a (mathematics) sign. And you know, I don't need the symbol (+or-), that defines the diversity because it is enough for me to exist even though I' m the smallest non negative integer number that insists on seeing

things always positively.

ONE: But diversity has been defined from the moment you showed up. Anything that comes after you is considered positive and what comes before you, is considered negative, before you no one- and I mean no-one was interested in plus and minus.

ZERO: You see that I was right about the enlargement of the limits? It seems that by disagreeing you learn at the same time. Do you know One that in order for you to become ten and for Two to become twenty me, the least important Zero, as you like to call me, always have to stand on your right, in my own good will and give you a value ten times more than yours, a value that could not be written with numbers if I hadn't be discovered? And yet you refuse to accept the necessity of my existence.

ONE: How very funny! From the minute you appeared, the temperature in the room has dropped to 0 degrees with what are you saying.

TWO: That's enough! You keep quarrelling every time you see each other. How immature of both of you! Who can take you seriously when you quarrel for such unimportant reasons? Nobody cares about which number comes first or second, as long as you do your job properly. The reason and the laws of right thinking have put you in that order and that is how you will remain!

ONE: You should tell all these things to Three and Four.

ZERO: Just a minute, I'll call them and we'll see what they have to tell us. Three, Four come here for a moment!

THREE: Why do you mess up the tranquility of the perfect number, the first lucky number?

ONE: As you can see, Two, Three has great aspirations. And then you say that I am immature.

TWO: Just wait and you'll see… he hasn't even started yet. Now we will hear about the three evils of our destiny.

ZERO: Happiness cannot be divided in three, but in our case there is no other way.

THREE: After all these unfortunate comments I keep saying, that I am the first odd number of primes. And to make your life easier I say that a natural number is exactly divisible by 3 if the sum of the digits is a multiple of 3. A triangle has three sides, three peaks. I'm telling you I'm highly sought after. Present, past and future, meaning you understand the time because of me. The seasons.....

FOUR: My friend, if you want us to remain good and dear neighbors let the girls in peace. The seasons are my friends, they belong to my group.

THREE: Without my existence you cannot realize the dimensions of space - length, width, height, states of matter-liquid, solid, gas. How is it possible to ignore the maximum of my greatness? Just me with my own sake, can bestow excessive with prefix trillion. In other words I'm ineffably happy, pretty and triangular because3= 2+1.

ZERO: I'm sure that if you keep up with this wretched monologue all of us are going to get up to leave.

FOYR: Just a moment, when will I speak? You have to let me speak! Two take a side because as the smallest composite number, because 4 = 2x2, or 2+2 = 4, or 3 +1 = 4 and the smallest square number because 22 = 4 I need a supporter.

TWO: As you see no one interrupts you my multiple, therefore continued we are listening with great interest.

FOUR: Multiples of 4 are all numbers whose last two digits are divided by 4, and only them. Leap years are all divisible by 4. There are four corners of a square. There are four seasons and four cardinal points. I am the number of fairness and stability, grace and perfection.

ONE: Just now I realize why you are trying to square the circle. Do you hear Zero, Four are trying to make you just like him, although from what I know it is prevented by straightness and stability, elements that I have redundantly in my posture and my spirit.

Appears the unknown X dressed like a spy

TWO: Sorry sir who are you? Hey, wait where are you going?

X: Why do you care? Why are you interested to know?

THREE: What rudeness! What provocation!

X: Who are you?

FOUR: We are the four guardians of the sacred philosophy. Let us introduce ourselves; here is One, Two, Three, and Four.....

X: And that pumpkin, who is he?

ONE: Did you hear how he called you Zero? Pumpkin! Not even I could think of a better nickname. He does not belong to the guardians. He is simply the Zero.

X: And what do you want from me?

TWO: Maybe nothing, we saw you wandering alone and so we asked you, out of interest!

ZERO: You're completely unknown to us and you look somewhat suspicious.

X: You are very close to the truth.You see loneliness makes me antisocial. Sorry let me introduce myself; I am the Unknown X, as well known as variable. And as unknown or variable number, I remain cautious. You understand now, I never know what they might ask me.

FOUR: They say that a stranger is difficult to approach.

X: That in my case is not valid.

TWO: But we are ready to learn everything about you.

X: But I want my peace. But I want to be left alone.

THREE: Don't worry we will protect you. Don't forget we are guardians of sacred secrets. You think we can't protect you?

X: No one can protect me. Everyone wants to find out who I am. They say that I am charming; I beget curiosity and stand as a challenge. And then begins the actual chase. The relentless pursuit. There is not a moment of peace.

ONE: Well what they do to you?

X: I hear them say: Get it out of here, take it there, swamp it next to this one, next to that one, lifted up the squared, add it to, remove it, multiply it, split it. Ah, this division if you knew how much suffering, constantly separates me from my mates' coefficients.

FOUR: And why do they do all this?

X: I wish I knew! Whenever they don't know something they use me. They use huge machines to discover my roots and whatever else is unknown to them.

THREE: Now that said, the root of two is white, likes coloring.

TWO: From the moment you appeared you have only said bad jocks. My root is not white. It is an irrational number, the first discovered. The irrational numbers have an infinite number of decimal digits not repeated periodically. Let me tell you already that Ippasos one of Pythagoras's students was killed because of this discovery; they say that he was murdered, they say he was drowned.

THREE: Tell us something we don't know! My root is an irrational number as well, so why do you think you're better than me?

ONE: Cease both of you, my root is me myself. Do you realize now what stability means? I don't confuse anyone, I'm the friendliest number.

ZERO: Rather indifferent I would say.

FOUR: In comparison to all of you, I have a perfect root. My root is two, because if you multiply two by itself, it gives me the brilliant four.

ZERO: X how it is possible to move in the area of mathematics without identity. They all know us as Zero, One, Two, Three, and Four. We all have identity while you are unknown.

ONEX: If you want to get an identity should become glued to Zero, because $0 \times X = 0$ and so you're mathematically identical with infinite solutions.

X: I know the absorptive capacity of zero. God bless the Equation that many times allows me to feel equivalent and relieves the anxiety I have because I don't know who I am. I cease to be unknown and become one of you.

Three: One of us? Well, then why do they call you unknown?

X: Because by that time they do not know who I am. For example there is the equation $x-3 = 2$, there is the separation of known from unknowns, 2 and 3 separated from the unknown me, and the equation is written $X = 2+ 3 = 5$ so $X = 5$ and then I know that I'm 5. I said five. Really where is the remaining numbers? Why they are not with you?

ONE: Who needs them when there are the first four numbers....?

ZERO: Five...

ONE: Stop talking, you are confusing us all. All other numbers come from us. 1+1 = 2, 2 + 1 = 3, 3 + 1 = 4, 4 + 1 = 5, 3 + 2 = 5, 3+ 3 = 6 and so on. Now my friend X if you add 1 + 2+ 3 + 4 = what does it equal to?

X: Equals ten. Magic!

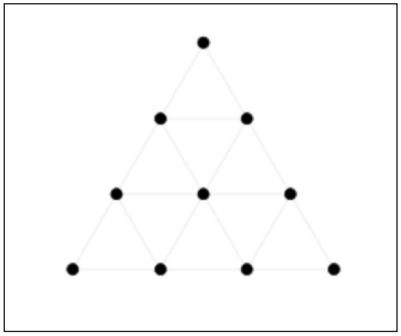
ONE: And how do you spell ten?

X: Numeral 10 is written with the digits 1 +0 ….

ONE: ….. That if you add equals 1. Now do you understand what I mean? One is the beginning of everything. May God rest his soul of Pythagoras? He discovered this famous relationship of the first four numbers and called us holy quartet Tetraktys. And since then we are the four guardians of Tetraktyos. Come on guys let's show him what we mean?

ALL TOGETHER:
One for all and all for Wisdom and Knowledge.

X: Fantastic, perfect!



The Chronicles of Catherine Cloud

Writing by Krishnan Manoharan from India

ACT I

Scene 1

Background- the setting is in geometry class, with the most boring teacher in the whole school, Mr. Haren. Catherine is near the back of the class, watching Mr. Haren write shape after shape on the board.

Bell rings

MR. HAREN

So today in class, we are going to learn about shapes. Get your notebooks out and be prepared to take notes!

CATHERINE

Not this again.

MR. HAREN

Do you have anything to say, Ms. Cloud?

CATHERINE

Nothing, Mr. Haren.

(Rolls eyes)

MR. HAREN

As I was saying, the circumference of the circle can be calculated by multiplying the radius by 2 and then multiplying by pi. Now, open your books to page 230, and start working on the practice problems.

CATHERINE

I'm too tired to do this work. I should stop watching all of those informative documentaries. I'll give it a try.

(Proceeds to try to do the work, but falls asleep)

Mr. Haren Exits. Mysterious person appears.

MYSTERIOUS PERSON

Catherine, Catherine...

CATHERINE

Who was that?

MYSTERIOUS PERSON

Follow my voice Catherine, we need your help.

CATHERINE

Why do I feel so weak?

MYSTERIOUS PERSON

Just relax, and I will lead you.

CATHERINE

Uhhuhhuhuh

Catherine enters a dream world looks much like the real world, except for the trees, and the wildlife looks strangely similar to shapes. She finds herself in a wide meadow, on a road.

CATHERINE

Wha... Where am I?

MYSTERIOUS PERSON

You are where you think you are.

CATHERINE

Does that mean...

MYSTERIOUS PERSON

That is beside the point, we need your help.

CATHERINE

I don't know what is happening, but I guess I can try my best.

MYSTERIOUS PERSON

Go where you feel needed, and you will find the correct way

points in a direction, Catherine turns

CATHERINE

But what about...

Catherine turns around, the unknown man has disappeared

Scene 2

Blue lights flash, and Catherine appears on a busy, medieval looking street market

CATHERINE

Wow! Where am I? This doesn't look like anywhere I know....look at all these strange people!

She goes up to a stall, and begins to listen to the discussion occurring there. A woman appears to be purchasing a bag of apples

LADY

How much are these?

STALL-OWNER

I want some eggs for the apples.

LADY

Here you are. What about that?(pointing at huge box of rice)

STALL-OWNER

Give me a few chickens.

CATHERINE (to herself)

How strange! They aren't using any numbers! I wonder why...

She continues, coming upon a group of children. They are kicking a bundle of cloth around- reminiscent of a soccer game.

CHILD 1

I scored! Woo hoo!

CHILD 2

I scored too, though!

CHILD 1

I scored more!

CHILD 2

Says who?

Catherine steps forward to prevent a fight

CATHERINE

Well, how many points do you each have?

CHILD 1

I have many points.

CHILD 2

I also have a lot of points.

CATHERINE

Like, 10, maybe? That's a lot.

Children appear confused.

CHILD 1

Teh-ehn? Is that another game?

Catherine laughs

CATHERINE

What? Don't you know numbers?

CHILD 2

Num...bers? What's that?

CATHERINE *(to herself)*

This place is so strange...it's like they haven't heard of numbers

Catherine looks around the market

CATHERINE

It all looks so ancient.....maybe I'm in the past! That's so weird. I must be sometime before math was invented! Whoa! How do they get anything done?

She continues walking forward, and a man stops her

MAN

Excuse me, could you perhaps help me? You look like a scholar...

CATHERINE

Haha! Me, a scholar? I don't know about that-but sure, I'll help.

MAN

See, I want to build a building. Normally, we build them out of mud-but it keeps falling down in the rain-I want to try building one out of stones.

CATHERINE

Of course! So what's wrong?

MAN

Well-I want it to be a very big building-but I can't get it to balance properly. I put a lot of stones on this side, many stones on this side, and more stones on this side. But it's never the same amount! IT keeps collapsing. Can you help me keep track of them?

CATHERINE *(to herself)*

How can I help him? He doesn't know any numbers!

CATHERINE

I see your problem. How can we figure this out?

She looks around, picking up a stone

CATHERINE

How many stones can you carry at once?

The man picks up a few stones

MAN

This many!

CATHERINE

Well, how about, for each side, you go back to the stone pile the same amount of times? If all your armfuls are equal, your sides will balance!

The man begins to carry stacks of rocks, and Catherine helps him soon, the foundation is built

MAN

Wow! You're right, it worked! You're not a scholar, you're a magician!

CATHERINE

Haha! Glad I could help.

She keeps walking, looking worried.

CATHERINE

I've got to get out of here. This place is scary. I didn't realize how much I used numbers....I'll never be able to stay here.

She walks faster, leaving the market square-just as she's past the people, the blue light appears, and she disappears

Scene 3

Mystery of Numbers

Catherine appears in District 3. A District where people are brainwashed to only know up to the number 20. The government of this District has organized the society to believe that the world contains only 20 numbers. Catherine watches the scene unfold.

In the government the King is talking to his governors

KING

From today, everyone in my nation will be brainwashed to believe that only 20 numbers exist in the world. Rebels will be executed in front of the citizens. Is this understood?

GOVERNORS

Yes, understood.

KING

I would like to meet the knight Esther.

Governors exit to find Ester. Ester enters.

KING

I have an important order for you; we have 2 Betrayers who increase the chaos in our world. They know too much about the mystery numbers, your task is to kill or seize them. If you succeed, I will teach you about the numbers higher than 18 and I guarantee your family's life.

KNIGHT ESTHER

If they know more numbers than we do, why are they using this knowledge to ruin our world?

KING

There is cryptic power in each number. So, if they know too many numbers at once, they will get confused and end up being crazy for more power.

KNIGHT ESTHER

Oh, that is the problem. Ok, Sir I will complete my task.

The King exits and Esther begins searching for the Betrayers. Enters an old village.

KNIGHT ESTHER

I am so excited to learn more numbers than I know!!!! I will succeed in this mission!!!!

Esther finds a map that says that the old village is where the Betrayers are hiding.

ESTHER

Aha! This map tells me I'm on the right track. That house looks so weird..

Esther looks in the house

um... nobody is living here,...

A loud cracking sound, and a person (Betrayer 1) falls out of the house.

BETRAYER 1

We should attack District 3!!! And teach people the power of numbers!!!!!

ESTHER

Oh god...! Stop! I have come to arrest Betrayers!!!!

Esther pulls out a sword threatening the Betrayer, and chases him. Then Betrayer 2 comes out of the house.

BETRAYER 2

Run away!!!!

Betrayer 2 runs away exiting the stage. As Betrayer 1 tries to follow Esther hits him in the stomach with his sword.

ESTHER

Stop!!!!!!

You have been arrested!!! And soon your friends will be too. So now tell me your cruel plan!

BETRAYER 1

(almost dying) Haha.... guess what? numbers are infinite!!!

Betrayer 1 dies.

ESTHER

What?! numbers are infinite??? I should not listen to the Betrayer.... I know only seventeen numbers, and there are more??? And endless??

A loud cracking sound and Esther falls down he has passed out. The stage goes a blinding white.Esther wakes up to find he is bound with ropes

ESTHER

What is this old room? Oh.. what is this... I can't move!

BETRAYER 2

You! You killed my friend!!!! We were going to save the world!!! And you ruined our plan!!!!!!!

ESTHER

No!!! You are the Betrayers of our kingdom!!!! I am going to kill you now!!!!!!

Esther tries to get out of the ropes but fails

BETRAYER 2

Calm down!!!! Stop acting like a child!!!! You are the same as us. You got an order from king to kill Betrayers? You were tricked by the KING!!!! I also once got an order to kill my friend, and guess what? my friend told me the secret of numbers!!!

The Betrayer shows the secret of numbers

ESTHER

What is this??? Is this real???? Wow.... what are these numbers!... they are so strong and amazing... numbers are infinite!!! I should let the people know they have been tricked by the KING!!! They have been brainwashed to learn only 20 numbers...

Betrayer 2 tears the rope binding Esther

BETRAYER 2

Now you see? come and follow me

Esther and the Betrayer exit.

CATHERINE

I hope they are successful in their mission to destroy the KING!

Blue flashing light

Scene 4

Shapes vs Shapes

Catherine's dream takes her to a place outside; she watches the play on the sidelines

SQUARE

I am a square! I have four sides and all of them are equal, what could be better than me?

TRIANGLE

Me of course. You're nothing special. You're just part of a bigger group called rectangles. I can be scalene, equilateral or isosceles.

SQUARE

Bah! I have four right angles. I am equal all over. That's perfection.

CIRCLE

(Was listening into the conversation. Then suddenly barges in) Perfect?! You have those rough edges, while look at me; I'm all smooth and round.

TRIANGLE

I'm clearly better than the both of you. You square! There is nothing special about you. The only remotely unique thing about you is that all your sides are equal. And as for you, the round thing, all you can do is roll around.

CIRCLE

Excuse me! My set of formulas and theorems are the best. Many of my formulas involve pi. Do any of you shapes have that? (1 second of silence) I thought not!

SQUARE

Hmph! It will take other shapes to decide who is the best out of the three of us.

CIRCLE and TRIANGLE simultaneously

Agreed!

The three shapes find a hexagon; Catherine follows

TRIANGLE

Hey, you with the six sides. Come over here!

The Hexagon walks cautiously to the group

TRIANGLE

Which out of the four of us-and you can't pick yourself!-is the best shape?

HEXAGON

Thinks for a few seconds.
Hmmmm. Hard to say.

Thinks some more

I can't pick any of you (Says it with exasperation).

CIRCLE

Oh noooooo-

cut off by the Hexagon

HEXAGON

But what I can decide, is that I am the best.

SQUARE

Oh please! You surely cannot be the best. Besides you can't pick yourself.

HEXAGON

Well if I could, I would.

TRIANGLE

And why might I ask?

HEXAGON

(Clears his/her throat; goes on slowly)

Well we can take interior angles as an example. The sum of the angles of a triangle is 180 degrees right?

TRIANGLE

(sharply cuts of Hexagon)

Yes. So what?

HEXAGON

Now don't cut me off.

(continues speech in a slow way, as if teaching a boring history lesson)

Where was I... Right so the sum of the angles of a triangle is 180 degrees. Well since I contain 6 of you, 120 degrees from each triangle equal one of my interior angles. I contain 6 of you.

Points to the triangle

TRIANGLE

(impatient tone of voice)

So what?

HEXAGON

That means I am worth six of you.

TRIANGLE

No it does not!

HEXAGON

Yes it does.

TRIANGLE

No it doesn't.

CIRCLE

Great we heard a half-hour lesson just to get into a fight again. Pathetic.

TRIANGLE

You know what's pathetic?! You!

CIRCLE

Now wait a minute, lets argue mathematically here shall we.

TRIANGLE

Yes lets.

CIRCLE

When a circle-which is me- is rotated through any angle about its center its orientation remains the same. That's like amazingly cool. But wait for this. Because of my unique classification through tangents, secants chords, arcs sectors and segments, I have a beautiful set of proofs and properties that revolve around these six things. And-

SQUARE

(Quickly cuts Circle off)

Alright! Now to me. Since all my sides are equal, that governs the basic properties I have. What is cooler than being all equal!

CIRCLE

Me!

HEXAGON

No me!

Everyone starts arguing and shouting

CATHERINE

NOW HOLD ON A SECOND!!! What is all this about? Why are all you guys arguing and fighting?

SQUARE

Oh my god..... it is the fabled geometry student.

All the shapes get on their knees stunned

TRIANGLE

Please.... choose the best shape out of all of us, then our quarrel will be solved.

Catherine surveys the set of shapes

CATHERINE

None of you

CIRCLE

(Wails) Oh noooo! Not again!

CATHERINE

What I mean to say is that all of you are special. You all contribute to geometry in a unique way. What you have to understand is none of you is better than the rest, but rather you are all key parts of an interesting and complex subject. Without you there would be no Geometry.

Silence

HEXAGON

That makes sense.

CIRCLE

(shushed voice) Yes it does.

Suddenly everyone starts hi-fiving and clapping; some shapes yell "we're equal!"

SQUARE

Hey guys! I'm still right. I said equality was the best!

Everyone bursts out laughing and the shapes exit the stage. Blue light flashes.

Scene 5

Mysterious man enters and sneaks up on Catherine from behind

MYSTERIOUS PERSON

Thank you for helping us

CATHERINE

So that is where you went (turning around)

MYSTERIOUS PERSON

You brought this world back to order

CATHERINE

Well, I should thank you. I never knew how fun math could be.

MYSTERIOUS PERSON

It is time for you to go now.

CATHERINE

But I want to stay.

MYSTERIOUS PERSON

Farewell Catherine, and good luck.

CATHERINE

How did you know my name..?

Stage goes black. Lights come up on Mr. Haren's geometry class. Catherine is asleep at her desk

MR. HAREN

Ms. Cloud, will you please not sleep in my class.

Catherine looks around the class

Go to detention

CATHERINE

But Mr. Har...

MR. HAREN

I said go!

Catherine gets up and exits to go to detention.

Honarable Mention

The trial of numbers

Writing by Georgios Gkalanakis from Greece

Persons:

President Judge…1

Public Prosecutor…3

Advocacy…2

Witness…x

Jury: 1789… (Date of French revolution)

1905… (Date when Einstein publishes the article On the Electrodynamics of Moving Bodies where he reveals his theory of special relativity.

876… (Date of the first appearance of the number zero in an Indian manuscript)

Defendant…7/9 (double face)

Invader …√2

…Court room…

Public Prosecutor, advocacy, jury and defendant are in their places onto parallelepiped rectangles. There is absolute silence. Enters the president, walking slowly. He sits on a cube higher than the others. Above his head there is the symbol of infinity (∞).

It all takes place in the universe of numbers.

President:

I, the unit, ancestor of all the integer numbers.

I, the unit, the one who represents everything.

I, the unit, with the power of zero and the illumination of infinity, I declare the beginning of this trial. *(Pause)*

Mister Prosecutor, please proclaim the indictment.

Public prosecutor:

Defendant. (Pause) You have violated a fundamental and unbreakable law of operation, until today. Allow me to be more specific. In our universe, the universe of integer numbers, there is absolute freedom as far as the functions of addition, subtraction and multiplication are concerned among our citizens. Only in the function of division which is the most important since it is related with love, there is one restriction. The divisible must be a multiple of the divisor to ensure that the division will be exact and the result of this relation, an integer number. (more strictly) You have violated the law, since 7 is not a multiple of 9 (more haughtily) so this numberoid that emerged is something we can't even name!

Defendant:

Seven ninths. *(Voices of the audience are heard.)*

President:

Silence. The court hasn't granted permission for the defendant to speak. You may continue Mister Prosecutor.

Public prosecutor:

You two, seven and nine, descendants of two families with great history. With your inadmissible relationship you have created a negative standard that must be stamped out without mercy.

President:

The witness may enter. For safety reason he will be wearing the code x.

(Enters x, wearing a mask)

President:

Do you swear to speak the truth and only the truth?

Witness:

I swear to infinity to speak nothing but the truth since this is the only way to have my consciousness at ease.

President:

Please tell us, what do you know about the case?

Witness:

Like I always used to, I decided that day to exit my hermitage at a time when there was no crowd in the streets. I was walking for a long time when I found myself at the building block between zero and one, when I realized that I was into a time deceleration field. That meant that there were lovers around. I moved towards where they seemed to be and I waited to view the usual spectacle of flying regular polyhedra that take form every time lovers come together. When I approached, though, I remained speechless. In front of my eyes seven and nine were making love and above their heads there were colorful spheres flying! All these accompanied by music played by a floating vibrating string. I have to confess that for a moment I stood stunned. Although, I realized quickly that this can be none other than the work of negative infinity and I did not got carried away. As soon as I came to my senses I ran to the police of order and morality, as I ought to do, and they proceeded with the arrest.

President:

Mister Prosecutor.

Public prosecutor:

I have no questions. I would just like to praise the witness for his immediate action. The Hesychasts were always on the side of justice.

President:

The advocacy may speak.

(The advocate is pacing in front of the witness)

Advocacy:

(abruptly) Witness… *(Pause)* Have you ever fallen in love?

Public prosecutor:

Objection mister president! The question is irrelevant to the case and it concerns sensitive personal information.

President:

I think you are overreacting mister prosecutor. Witness you may answer the question.

Witness:

No. I have never fallen in love. I have completely devoted myself to positive infinity.

Advocacy:

(satisfied expression) I see… Thank you.

President:

Witness you may step down. (Pause) Defendant you may speak.

Defendant: *(both faces talk, first 9 then 7)*

9: In this universe, love is worshiped by everybody and it is also considered sacred. But today it is love that is being persecuted. We have violated a law following our own emotions. We excluded the sense of the legislator in securing a supposed purity from our relationship. You may find the result bizarre but it is beautiful because it was born of love and we call on you to regard it as such.

7: You have never considered that somebody would have the dilemma or even pose a question regarding choice in love. Adapting to the rules was already a basic goal of the legislator. But even in this case? A case that is naturally mystical, magical and a source of happiness and ecstasy? How is it possible for someone to function logically when a sole meeting with the person one loves makes one feel like time is slowing down or like one is losing oneself, falling into a sweet void, holding each other's hand?

President:

The advocacy may speak.

Advocacy:

Absolute truths and certainties are many times hidden behind the law. I think that these are expressions of arrogance. Maybe it is another one of the characteristics that thinking beings possess, judging from the universe of humans that we have the capacity to observe. (Ironically) Their arrogance reaches the point where they believe our universe is their creation. (Pause) Let today's trial become the motive to reconsider some basic element of our existence. (Pause) Today we are not just judging seven ninths. (Louder) We are judging the right to differ. (Pause) May I remind Mister Prosecutor that once he didn't have the right to be in this position. Once he was considered inferior for being an odd number. I am referring of course

to the times of discrimination that are thankfully long gone. (Pause) Our universe has a vast variety of even, odd, exact, triangular, tetragonal, prime, complex negative and positive numbers and now the possibility is rising for the universe to be more diverse. I think that the monotony of uniformity is something really boring. (Pause) (More intense) Seven ninths is a number. It belongs among us. The thing that does not belong here is prejudice and racism. (Pause) (Going towards the jury) You are taking part in a historic trial that will be remembered, I hope, in the future, (more intense) like a trial that has honored the right to diversity, a trial that has honored the right to freedom. *(He sits back to his place)*

President:

Mister Prosecutor, what do you have to propose?

Public prosecutor:

This inadmissible relationship (intensely) is a bomb planted at the foundations of our universe, at the foundations of the morality and purity of our race. A bomb that we must disarm before it explodes. (Pause) (More intense) Our society must be protected from arbitrariness. Our society must be relieved of this negative standard. Our society must not be polluted. Our society must remain integral and pure. (Pause) What I suggest is… Capital Punishment! Multiplication with zero for the total elimination of the defendant.

President:

The jury can now withdraw in order to make a decision. (The jury exits. Small pause and they return)

President:

What is the decision?

1905: Guilty.

1789: Innocent.

876: Guilty.

President:

The defendant is found guilty and…

(√2 enters the court room holding a black cube)

√2: Everybody remain still. With the help of this cube I can create a black hole that will devour you all. I myself am a number whose name cannot be uttered. (Proudly) I am an irrational number! I live for years hidden along with other irrational numbers since your society cannot accept us yet. You should know that we will fight in every possible way so that we will earn the right to exist with you as equals in this universe. (He turns toward the defendant) Let's go…

(They exit leaving the cube in the middle of the room. The prosecutor approaches the cube hesitantly opens it and says)

Public prosecutor:

Void!

"Conditions, Conditions"

Writing by Christina Zourna from Greece

CONDITIONS, CONDITIONS…

Two friends (A and B) meet at a café. B is very tall and skinny. B looks anxious and rather disappointed. A is trying to give B courage.

A: Hey. What happened at the agency earlier this morning?

B: I don't want to talk about it, OK? Please. Just change the subject, will you?

A: They didn't give you any hope for that job, did they?

B: *(nods NO)*

A: Don't lose hope. Let's go through the list of requirements one more time. This will make you feel better – and much more confident.

B: Oh no, not again! We've done this a hundred times till now. It's pointless.

A: Just to be sure. Trust me. I know what I am saying. (At this point he takes a piece of paper/newspaper out of his pocket and reads out loud) The announcement is quite clear: "You'll get this job, if you are qualified". See? IF you are qualified, you GET the job. (enthusiastically) Elementary, my dear Watson. Simple Logic. Aristotle, fourth century BC. IF YOU are qualified, YOU GET the job. Piece of cake!

B: *(disappointed)* Yeah, right!

A: *(not paying attention to B's attitude, not losing hope, still enthusiastic, reads on, emphasizing some words)* "The applicant for the job…

(At this point a third character C appears on the other side of the stage carrying a backpack/light suitcase with him. C obviously contradicts the external appearance of B. C is both short and fat. C stands away from the table where the two friends sit and talk, and faces the audience. A and B haven't noticed him at all. A reads on)

A: … should meet at least ONE of the requirements listed below…

B: *(nodding YES, OK, we've been through this before but to no avail)*

A: … is taller than one meter seventy…

B: *(stands up to allow the audience to observe his sufficient height)*

C: *(almost simultaneously counts his body with his palms and clearly shows he knows he is much shorter than that)*

A: … weighs less than 70 kilograms…

B: *(waves OK with his hand)*

C: *(caresses his belly with tenderness)*

A: … owns a black karate belt…

B: *(shows his black belt to the audience)*

C: *(takes out of his suitcase a bunch of colorful belts - none of which is black - and shows them to the audience)*

A: … has got a GPA of at least 18 out of 20…

B: *(holds up in the air a piece of paper for the audience to observe a number 19.7 written on it in very large digits)*

C: *(holds up a similar piece of paper with a 16.3 written on it)*

A: … has got a driver's license …

B: *(nods OK)*

C: *(moves his shoulders upwards in bewilderment)*

A: Well done! All checked! Not just ONE of the requirements; on the contrary, my dear friend, you satisfy ALL OF THEM.

B: *(looks even sadder and even more disappointed)*

A: *(teasing B)* Come on, don't hold back! Spit it out! You GOT the job, didn't you?

B: Nope! No, I didn't.

A: *(looks totally surprised and shocked)* WHAT? And WHO did?

B: *(points at C, weeping)* HE did.

C: *(plays the winner)*

A: WHAT? But, but, but…

B: No buts! HE GOT the job! Definitely.

A: Are you sure?

B: *(nods in despair and points at C again)*

C: *(shows the CONTRACT)*

A: Wait a minute! The advertisement is perfectly clear: "you'll get this job IF you are qualified" (turns to C) Therefore, since YOU got the job, then YOU MUST have been qualified, haven't you?

C: *(ironically)* Do I look like I was qualified?

A: *(still in shock)* Then… how… what… huh? (turns to B) How come HE got the job, then?

B: Simply because…

C: …I knew the manager who hired personnel for that company. He is married to my sister! Simple logic, like YOU said. Piece of cake!

A: But… but… logic says…

B: Ancient logic may, but MODERN logic says otherwise. Let ME explain. The announcement said "YOU GET the job, IF you are qualified", right? It didn't say: "You get the job IF AND ONLY IF you are qualified", did it? It didn't clearly say "IF AND ONLY IF"; isn't that right, my dear master of logic?

A unique ride

Writing by Panagiotis Statharos from Greece

The particular scenario aims to help the pupils of D class of primary school to comprehend through a theatrical play, the concept of "reduction per unit "which is a chapter of the curriculum of mathematics for class D.The play is divided into 3 scenes – phases where children by using usual games in the amusement park of their neighborhood are troubled , investigate and in an amusing but also mathematical way come to conclusions compatible with those that every educator wants to reach in his classroom while teaching such mathematical concepts.

The questions which are made during the play are of such kind so as to trouble not only our protagonists but also the pupils who will watch it.In a way we could argue that they guide the thought of the pupils in the same way that a teacher would do while teaching.However, the procedure due to the theatrical structure is becoming much more amusing and experimental since the children themselves are able to be not only the spectators but also the protagonists of the play, exchanging for instance the roles of the play in each of the scenes.

Protagonists:

-Anne

-Victor

-Alexander

-Sophia

-Stelios

Duration of the play 7' – 9'

Scene 1

Our little friends start their adventure on a Saturday afternoon , when they leave for the amusement park of their neighborhood.There they will find out by facing certain difficulties that Math can be useful in their daily life as well as entertaining.

(The children enter the amusement park discussing).

-Anne: Your idea to come here tonight was absolutely perfect!

-Victor: It's cool that it's Saturday and we don't have to go to school.

-Sophia: Look! How many different games there are! What about getting into one of these instead of just standing here talking?

-All: Deal!

-Stelios: Look carefully at that sign! "For every four fares you pay sixteen euros."

-Sophia: A riddle isn't it?

-Victor: *(Disappointed without having understood correctly)*. We can't get in all

together. We are five. Somebody will stay out. What a pity!

-Anne: Let's try our luck somewhere else, so as we can play all together!

-Sophia: Calm down and don't be in such a hurry. The sign tells the price of the fare but in a different way!

-Victor: Aren't we paying sixteen euros?

-Alexander: Don't hurry Victor! We have to think a little more, to find the price of our ticket!

-Stelios: If we were four persons, things would definitely be easier and we wouldn't need to worry so much!

-Sophia: Something tells me that all five of us can enter.

-Anne: *(Angrily)* Oh! I'm so confused with all these! Can you just tell me how much my own ticket cost?

-Alexander: Well done! Anne. You are thinking in the right way.

-Anne: *(All of a sudden)*. But, I didn't…

-Alexander: *(Interrupting her)*. What you have just said is the most significant step to solve our problem about the entrance fee.

-Sophia: Alexander is right! We cannot calculate how much we are going to pay, if we haven't previously found what is the price of the ticket per person.

(Victor is troubled and cannot quite understand what his friends are saying)

-Victor: Yes but how are we going to find this? Let me think a little. It's not so hard! We will multiply sixteen euros on five since this is our number. But how is it possible?

8 0 euros? It's too much just for one game.

-Stelios: Victor when we know the total amount and we need to know the one unit's price is multiplication the correct calculation?

-Anne: You have just given it a way! It's division of course!

-Stelios: If the four tickets cost 16 euros, then how much is it per person?

(They are thinking a little bit)

-Sophia: *(Mumbling)* 16 / 4 (16 divided by 4) per person…I found…! 4 euros!!

-Alexander: Perfect! Now, that we know the price of the ticket , what is left is to calculate how much money we are going to need as a total!

-Anne: This doesn't sound easy! We will add 5 times 4.

-Sophia: Although you are completely right, there is a sooner way to find out! (She winks to Anne)

-Stelios: I multiply 4 for 5is equal to 20 euros.

-Alexander: Perfect!

The children collect the money and are satisfied that they managed to calculate correctly , they give the money to the cashier and enjoy the entertaining ride with their favorite game.

(After a few minutes…)

Scene 2

-Stelios: Wasn't it amazing up there?

-Victor: Yes from the one side the ballerina and on the other so much thinking with math, I'm dizzy! I want to eat something to feel better!

-Sophia: *(Excited)* Look, in front of us! A canteen with candies! There are plenty of them there!

Once they gathered all of the children in the canteen they made a queue to buy candies. After a few minutes, Anne came holding candies in her hands since she was the first in the line.

-Anne: I've just bought 20 candies for 6 euros. There are five kinds of sweets and I bought four of each kind. They all cost the same.

-Alexander: They will ruin your teeth with so much sugar! At least help me to see how many candies we are going to buy, when our turn comes.

-Victor: I want one candy of each category, which means since there are five categories 5 candies. I hope I have all the money I need.

-Sophia: We can know that at once.

-Alexander: Victor, do you remember how we think when we have the information for a quantity and want to find the same information for another quantity?

-Victor: First we find the many! *(the rest of them stare at him a little nervously after the answer he gave)*

-Victor: Oh! I wanted to say the one. We first try to find out the price per unit.

-Sophia: Well done! You have just made a step closer to the candies of Victor.(She smiles to him)

-Stelios: And not to forget! Which is the right operation to find how much does one candy cost?

-All: Division.

-Victor: Ok then , there is nothing else to do but to calculate! Hmm…

(After a little thinking) We divide 6 euros by 20. But just a minute! I don't know how to do that sort of division *(with disappointment)*.

-Alexander: Don't give up so easily , I'm sure that you know… Well I am going to tell you something first to help you! The 6 euros is equal to 600 cents and have precisely the same value, it's simply easier for us. How about one more effort?

-Victor: Of course! Why haven't I thought it before? By dividing 600 by 20 we find 30. This means , that each candy costs 30 cents.

-Sophia: And what if we want to transact it to euros?

-Stelios: Zero point thirty (0.30) this was easy.

-Anne: Our teacher would be proud of us if he saw the way we are thinking today.

-Alexander: That's true. So, what's left is to see how much Victor will pay for 5 candies! His turn is now.

-Sophia: Not only Victor. Now that we have found the price of the one candy, we are able to calculate any quantity we wish! The procedure is simple and known now. We multiply the price of the unit on the number we want! (Victor goes to the cashier)

-Victor: *(Talking to the cashier)*. I would like one candy of each kind. I have already calculated their value. It's 5 candies for 30cents each which means 150 cents or 1.50 euro.

-Cashier: Exactly! Well done! You are very good in math from what i see!

-Alexander: I realize when we cooperate with each other we can do everything! We all know now how from a quantity we find information for any quantity we like!

-Stelios: So, the steps are pretty simple!

-Anne: Any quantity they give me , I will look for the information that interests me , with the per unit price.

-Victor: By doing division of course!...

-Sophia: And then by multiplying I'm able to find the same piece of information for any quantity I wish! Some , a few , or too many…

-Alexander: If I am not mistaken these rules are written in a similar way in the next chapter of Mathematics! This chapter is called "Reduction per unit" which means that I seek for the information I wish after I have found this particular information for the per unit price.

-Stelios: This is exactly what we have done up to now! Amazing!

-Victor: *(Eating his candies whith his mouth full)* I couldn't have known that the fun park could make me love more Mathematics!

Scene 3

-Anne: And the candies as well!

(We hear laughs) And the children move slowly to the next game!

-Alexander: We have rested enough I think. It's time for a little action.

-Stelios: Who has the best targeting skills? In the game, which is before us we can win beautiful presents if we can manage!

-Anne: Come on then! Let's try…

-Victor: The prices are very appealing…Whoever collects more than 300 points wins a teddy bear , more than 150 points an ice-cream and more than 100 points a ball.

-Stelios: After this I suppose that everybody wants to make an effort.

-Sophia: *(looking the sing with the rules of the game)* According to the rules that I read here we are able to use 20 balls and within 2' we must hit the most possible teddy bears targets against the opposite wall.

-Anne: It sounds easy!

-Alexander: There is nothing left but to try. (After a few minutes , Anne tries first and then it's Alexander's turn)

-Anne: *(Returning a little sad)* I didn't manage to win anything… I shot only 3 targets and I hardly collected 75 points…

-Alexander: On the other hand I won an ice-cream. Hmm… I shot half of the targets which are ten and collected 250 points.

(It's Sophia's turn , however se is reluctant to go)

-Sophia: Before I play I would like to focus a little bit. I would very much like to win the teddy bear… How many targets should I at least hit to manage this?

-Victor: Come on guys let's think a little and help Sophia to get the present she wants!

-Stelios: We don't need to think so much! We already have the information (that is the points that the children collected) for a quantity we want to find out , the same piece of information for a different quantity. What do you think?

-All: "Reduction for per Unit"!

-Anne: Particularly we have to calculate how many points we get from any target we succeed to hit!

-Alexander: I agree with Anne!

Sophia: I remembered that Anne , collected 75 points with 3 successful shots! Aa result if we divide 75 by 3 we find 25.This is the number of the points per target!

-Alexander: I found it easier to calculate the value of each target by the points I collected myself. 250 is divided very easily into ten and gives us a quick result of 25 points again!

-Stelios: Either of the two ways of thinking is correct! What is left is to calculate how many successful shots does Sophia need to win the teddy bear she likes.

-Anne: She has to collect 300 or more points.

-Victor: What about if we add 25 as many times we need until we reach 300? The times we need to reach 300 this is the number of the least successful "shots", do you agree?

-Alexander: You are thinking in the right way Victor! However I believe that there is a quicker calculation which will lead us straight to the result we are looking for…That is the calculation that shows us how many times 300 contains 25!

-All: Division of course!

-Sophia: So, to win this beautiful teddy bear I need 300 by 25 = 12 successful shots! I will do my best to manage it. (After a while Sophia returns hugging the teddy bear she just won).

-Sophia: I did it guys! This adorable teddy bear is now mine.

-Victor: It's my turn now and what present would be better than this delicious ice-cream? However, I have to be prepared in the suitable way like Sophia to manage! How many targets should I at least hit?

-Stelios: I would like to remind you that Sophia needed 12 successful shots to collect 300 points…

-Anne: What a coincidence! You need precisely half of the points! Just 150!

-Victor: This means half of the successful shots! With 6 accurate shots the ice-cream will be mine!

-Stelios: If I will be the last who will try I wouldn't like to lose the multicolored ball. I will need 100 points definitely!

-Alexander: You are seeking for the easiest present! What do you have to do to win the multicolored ball?

-Stelios: I have given much thought while you were talking and I need 4 successful shots! I found it dividing 100 by 25.

-Alexander: Thank god your present is easy…If you wanted the teddy bear you would need the triple of the points! (300 instead of 100) So triple successful shots. (12 instead of 4).

(Having completed all of their efforts in the particular game , they hold in their hands the presents and they are getting ready to go).

-Victor: Why should we live right now? We have such a good time!

-Anne: We would all like to stay more… We had fun by using our knowledge and coming to new conclusions!

-Sophia: I'm looking forward to telling our classmates about today!

-Stelios: They will sure have a lot to learn…

(laughing is heard, the children leave...)

Elf Numbers

Writing by Marilena Viocu from Romania

A child's room.
Characters: Andrew - a 9 years old student

Elf numbers

an Egyptian, a Roman,a Greek, an Indian

(Andrew is sitting at his desk and he's doing his homework)

Andrew: - Phew! I'm tired! Only numbers and calculations during all day...Who invented these damned numbers?

Elf: - Hello, Andrew! Why are you upset?

Andrew: - This is my bussiness! Who are you and what are you looking for in my room?

Elf: - I'm Elf numbers and when a child is asking himself who had invented the numbers ,I appear immediately.

Andrew: - An Elf ? There is no such things, and especially an Elf of numbers.

Elf: - Yes! Touch me and you'll see that I am real!

(The child touches amazed.)

Elf: - The Matematical Fairy send me constantly helping children who have trouble with the numbers. I need to tell them a story that will make them to love the numbers. Are you ready to listen ?

Andrew: - A story ?! Hmmm...I love the stories.

Elf: - Listen to me ! The history of numbers is far more than you could imagine. Do you know what are the figures ?

Andrew: - Yes! The figures are signs written of numbers.

Elf: - Very well ! Thousands of years ago, people used other signs and rules different of what you learned.

Andrew: - About what people do you tell me ?

Elf: - About Indians, Egyptians, Greeks, Romans...Have you heard about them?

Andrew: - Yes, we have learned about them at History.

(Suddenly it appear an Egyptian, an Indian, a Roman and a Greek. The child is amazed. The Egyptian comes in front of them and he bows to them. He has a Papyrus. He unwraps it and he shows the signs to the child.)

The Egyptian:

- I am scribe Sesh. I am from Egypt. I brought to you a Papyrus with the figures used by us thousands of years ago.

Andrew: - What strange signs! Look! A flower!

The Egyptian:

- It's a lotus flower. It is sign for 1,000.

Andrew: - A finger, a frog...

The Egyptian:

- The index finger represents ten thousand and the frog represents a hundred thousand...

Andrew: - It's fascinting!

(The Egyptian gave the Papyrus, bowed to him and went away)

Elf: - Let's go ahead!

(The Roman approaches, he bows to them and he shows a papyrus, too.)

The Roman:

- My name is Octavius, and these are the figures used by the Roman people.

Andrew: - Jami...I know them! I've met through out books. The chapters are noted by them. Evan the door of my class - the III A. It looks like letters.

Elf: - Be patient and listen to their story!

The Roman:

- The kids is right. I it is a vertically stick and it represents 1, X-two sticks crossed and represents 10, C is initial word centrum which is 100, M the initial word mille is 1,000.

Andrew: - What a simple thing!

The Roman:

- It's not even that simple. There are some rules of writing. If you don't know, you won't be able to write correctly!

Andrew: - Which are these rules?

The Roman:

- Rule No.1: any sign placed to the right to another gives a bigger value or equal to it, it gathers.

Andrew: - Two X put one next to other is 10+10?

The Roman: - Exactly. I see that you understand.

-Rule No.2 :

any sign placed to the left to another with bigger value than, it decreases.

Andrew: - IX = 10-1= 9 ?

The Roman:

- You're a smart kid. I want to keep in mind the following: The Roman numerals are very difficult to use, especially large numbers in writing.

(He goes awayafter gave the Papyrus.The Greek approaches.he has a Papyrus, too.)

The Greek:

- My name is Thales. The Greek numbers are varied. You have to know that some Greeks used alphabetic system :1 alpha (A), 2 was beta (B), 3 was gamma (G) and if you look carefully you'll discover the other signs.

Andrew: - What strange!

The Greek :

- You're right. You must know that Greek matematics is known with Thales and Pythagoras.

Andrew: - I heard about this Pythagoras at my brother. It has to do something with the triangle but I don't know what is ,exactly.

The Greek

-That's right. You will learn when you will be bigger.

(The Greek goes away after he's offered the Papyrus.)

Andrew: - Until now I've found a lot of interesting things. I know we are using Arabic numbers and I've never heard anything about them, yet.

(Elf makes a sign and an Indian is approaching.)

Andrew: - It seems to be an Indian after the way he's dressed.

Elf: - You're right. Meet him!

The Indian: - I'm Pingala. Arabic numerals that you've learned, actually come from India. Arabs have taken from use. Have you heard of angels?

Andrew: -Yes. I've learned about them but very little.

The Indian: - The figures you know and use, appeared in a very simple way: the numbers of symbols' angles represents the icon.

(He shows the numbers and corresponding angles)

The Indian: - The Arabs had taken from us and they had spread all over the world. There is a legend which says that in Baghdad, the city of 1001 nights...

Andrew: - I know the stories, I've read about Aladin....

The Indian: - Yes, I see you have read the „1001 nights" but now listen to me and do not intrerrupt me...So...in Baghdad was a very rich Emir, a learned and very fair man. Evan if he was very rich and learned he calculated using the fingers..

Andrew: - Ha, ha, ha...and I'd calculated using my fingers when I was very small....

The Indian: - I asked you not to intrerrupt me. He'd calculated using fingers because he didn't know of the existence of the figures. Suddenly the Emir received a visit that changed world history. In Baghdad, an Indian Ambassador came. The Ambassador was also a wise man. Walking through the Empire to Baghdad, he noticed how they struggled to reckon on the fingers. So he gave him a priceless work domain...the figures. He had written on a parchment and he gave it to him. Arabs have brought them later, in Europe.

Andrew: - What a story...something like in „1001 nights"...

(Indian goes away after he gave the Papyrus.)

Elf: - You liked it?

Andrew: - Wonderfull! I learned some special things and I just wait to go tomorrow to school to tell them to my colleagues. But believe me?...These stories have sparked my curiosity to find out more. Help me out?

Elf: - Of course, but for today is enough. Do not forget that you have not done your homework. I promise that we will continue the journey into the realm of Fairy Mathematics.

Andrew: -Thank you. I can't wait to see you! Goodbye, my dear Elf!

Elf: - Goodbye, my dear!

.....

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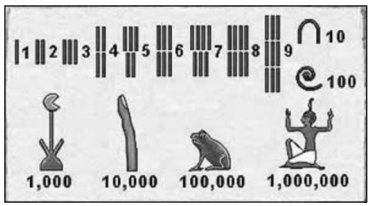
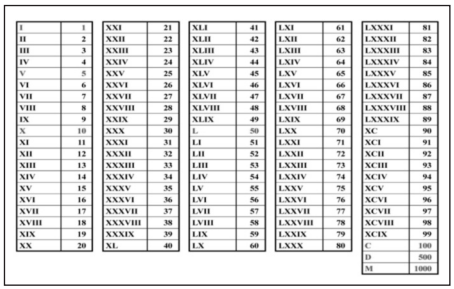
BUZAU
ROMANIA

Egyptian papyrus

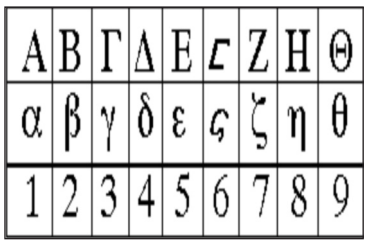


Roman papyrus

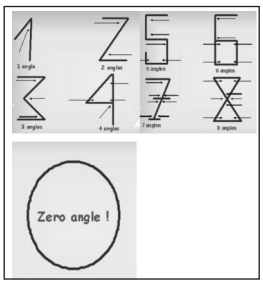


I	1	XXI	21	XLI	41	LXI	61	LXXXI	81
II	2	XXII	22	XLII	42	LXII	62	LXXXII	82
III	3	XXIII	23	XLIII	43	LXIII	63	LXXXIII	83
IV	4	XXIV	24	XLIV	44	LXIV	64	LXXXIV	84
V	5	XXV	25	XLV	45	LXV	65	LXXXV	85
VI	6	XXVI	26	XLVI	46	LXVI	66	LXXXVI	86
VII	7	XXVII	27	XLVII	47	LXVII	67	LXXXVII	87
VIII	8	XXVIII	28	XLVIII	48	LXVIII	68	LXXXVIII	88
IX	9	XXIX	29	XLIX	49	LXIX	69	LXXXIX	89
X	10	XXX	30	L	50	LXX	70	XC	90
XI	11	XXXI	31	LI	51	LXXI	71	XCI	91
XII	12	XXXII	32	LII	52	LXXII	72	XCII	92
XIII	13	XXXIII	33	LIII	53	LXXIII	73	XCIII	93
XIV	14	XXXIV	34	LIV	54	LXXIV	74	XCIV	94
XV	15	XXXV	35	LV	55	LXXV	75	XCV	95
XVI	16	XXXVI	36	LVI	56	LXXVI	76	XCVI	96
XVII	17	XXXVII	37	LVII	57	LXXVII	77	XCVII	97
XVIII	18	XXXVIII	38	LVIII	58	LXXVIII	78	XCVIII	98
XIX	19	XXXIX	39	LIX	59	LXXIX	79	XCIX	99
XX	20	XL	40	LX	60	LXXX	80	C	100
								D	500
								M	1000

Greek papyrus



Indian papyrus



Honorable Mention

The Fastest proof of everything

Writing by Andrej Ferko from Slovakia

The play is dedicated to 2600th anniversary.

propositio
expositio
terminatio
constructio
demonstratio
conclusio
six parts of a mathematic proof
Eucleides, Stoicheia
mythos
ethe
dianois
lexis
melopoiis
opsis
six parts of the systhasis of tragedy
Aristotle, Poetica

CAST HOME - REAL DECORATIONS MAN Fertile age.

Her husband. WOMAN Fertile age, pregnant. His wife. MOTHER Woman's mother. Beyond fertility, immobile, childish.

DRAMA - EMPTY STAGE - PHANTOM ILLUSION CHORUS

(7 actors/students/pupils) having no text, except „HM..." SETTING

A home in a typical European country, a kitchen or a living room. There is an old-fashioned rotating armchair with high nontransparent back in the scene center. The immobile old lady uses rotations of her chair to express her emotions.

It is recommended to use for the scene changes the painted decorations introduced to Greek theatre by Sophocles1. The true drama of ideas happens in gnomic space and time, with phantom illusion (shadow theatre or a projection screen or a blackboard with a white chalk) and silents chorus. Light change switches among the real and virtual spaces.

TIME NOWADAYS, PRESENT

The very beginning of 21th century. The end of classical values, like highly respected teachers and very cheap textbooks for high quality education.

1 Sophocles (~497 – ~405 BC)

PROLOGUE PHANTOM ILLUSION

The empty scene.

Seven students enter slowly, each of them is hiding some small thing in her/his hands.

The first one shows that it is a sand-clock and turns it upside-down. (This semiotic signal indicates the start in European culture.)

PLAYBACK

Set of noises: rock music, explosions, flying bombers, cry of a child, applause, barking of a dog, woman voices in quarrel... silence.

AT HOME (Woman, Man, Mother) REAL DECORATIONS

LIGHT change.

WOMAN Why should be the mistake with me if it can be with you! MAN Nice idea. WOMAN Why do we speak American English? We are Europeans! It is strange for me! MAN You know why. Because of your mother!!! She is the total prying person. She tracks everything here. Including our sexual life. I will not speak with you any language understandable for her. MOTHER What is the time? MAN Fifteen minutes before Your spoon of honey.

WOMAN Each fame lasts for fifteen minutes2, maximally. She speaks again! What a good news. MAN Your mother speaks English! What a bad news... MOTHER Once upon a time I proved the following theorem. When you erect squares at the outer border of a triangle with two bordersides perpendicular, the area of two smaller squares has to be exactly the same as the area of the biggest square. WOMAN Your mother in law speaks Mathematics!

2 Andy Warhol, pop artist, (1928 –1987).

INTERLUDE PHANTOM ILLUSION

The first student shows that the sand is (pause) over. (This semiotic signal indicates the end of the first minute in European culture.)

The first one leaves the stage.

The second one shows that the small thing in her/his hands is a sand-clock, again, and turns it upside-down. (This semiotic signal indicates the start of the second minute in European culture.)

From now on, this interlude happens each minute, eventually in parallel to real life in real space and real time.

The silent choir can say HM... at suitable moments from now on.

(Another form of interlude can move a white table tennis ball in the space and three other students indicating its coordinates by visible rulers and markers, man-made animation/game, as we are in gnomic space here, once during the performance they can show, that the time stops here, visualizing this fact by fake sand clocks with glued sand, which they should have hidden somewhere in their clothes, afterwards, when linked to real time, they should use the working sand clocks again...)

((If it is true that AH, AHA, or HAHA indicate that there was something interesting before, the HM is a behavioral embryo, indicating, that there will be maybe the AH, AHA, or HAHA reaction in near future. - - - The silent choir can for younger audience use the opposite/negative HM, intonated with a question mark.))

AT HOME (Woman, Man, Mother) REAL DECORATIONS

LIGHT change.

MOTHER When you erect squares at the outer border of a triangle with two bordersides perpendicular, the area of two smaller squares has to be exactly the same as the area of the biggest square. MAN What is your proof? WOMAN My mother speaks Mathematics! MOTHER I was very happy. You know the feeling of discovery. An original discovery. WOMAN Yes, this is caused by endorphins. MAN What was your proof? MOTHER I was so happy and I run to share the discovery with our teacher. WOMAN Biochemically the happiness is casued by endorphins, but their release is caused by AHA reaction, neurologically. MOTHER Unfortunately, the teacher killed my happy... my first creative joy. „That is only Pytagorean theorem... we will deal with it in five weeks! Why did you no homework again???" MAN Your proof!!! MOTHER Fortunately, I forgot it. MAN Unfortunately! Maybe it was an original one, differing from hundreds of proofs of this famous theorem.

WOMAN Arthur Koestler means that there are three such bridging bisociations3, AH in art, AHA in science, and HAHA in comic creation. MAN Stop, please! Maybe there is at least one common interest among your mother and me. Stop distracting us! WOMAN Mathematics! Gosh! (She does not say: We, neurologists, do the true science.) Do you need a proof? Denote by capital P, that the theorem holds and by lowercase p the opposite. And each idiot sees immediately, that p<P. Quod erat demonstrandum. The proof is ready. MAN (has no words)

3 KOESTLER, A. The Act of Creation. New York 1964.

MOTHER My proof ... was different. MAN I firmly hope so. WOMAN You have the proof. Be happy. MAN I am so happy. This is no proof. WOMAN Are you sure that the Pytagorean theorem does not hold? MAN It pays, but with record number of another correct proofs. WOMAN Is math a science or a paranoia? Why one proof is not enough? Let me experiment. Touch your ear to my ear... so... and slowly rotate our faces against each other... (when the lips are in contact, she kisses him). Kiss = Keep It Simple, Stupid. MOTHER I saw it! MAN Experiment... WOMAN There is nothing like a single isolated point in space, nor in time, no zero error. Your science is based on nothing real. MOTHER I saw it!

MAN You did not see anything. Both of you. Do you remember the formula (a+b) squared equals a squared plus b squared plus twice a times b? You should see-see-SEE three squares and two equal area rectangles there. (He sees it4 and the audience sees it at the projection screen in the gnomic space and time.) 4 a2 + 2ab + b2 = 2ab + c2 , this proof is credited to Pythagoras of Samos (~570 – ~495 BC), see e.g. GIAQUINTO, M. Visual Thinking in Mathematics... Oxford 2007.

WOMAN Even your a and b do not exist. MAN They denote numbers and some numbers are square numbers and some are rectangular ones. And if this does not exist, we all do not exist!!! WOMAN Wow... prove it, please.

MAN To think means to exaggerate5. WOMAN Are you sure, that a2 + 2ab + b2 = 2ab + c2? When are you sure that you are sure? I am absolutely sure only when I have no time. MAN Let me conclude partially. I am trying to link my profesional interest with the forgotten discovery of your mother. All we do is increasing the precision of our thinking in both symbolic and iconic dialects of mathematic languages. And some mathematic system is inborn as a fundament of universal grammar.

WOMAN That is just the hypothesis of Chomsky. We learn in three ways, to be exact, with pain or fear with amygdala asap, by boring multiple repeating with activization of thalamus and by creative discovery, activizing the whole orchestra of brain parts. Welcome to your brain6. Chomsky is probably relevant for the thalamus part only. My mother learned herself her own proof, without any pain and without stupid repetitions. MAN Inborn. WOMAN Exaggerate. MAN ...the whole orchestra of brain parts... just two, you said earlier... bridging two contexts by a bisociation... you damned neurologists... your evidences are contradictions of contradictions...

WOMAN But the two contexts are represented by information, which is the difference making a difference7, metadata and paradata, in MULTIPLE brain parts. MOTHER You ignore me! I am the chair of your session. MAN What an inspiration! (he rotates her armchair hiding her to audience, fixes the rotation, e.g. by a rubberband or a thin rope and he is obviously going to kiss again his wife the ear-to-ear plus rotation way). The chair is the key!

5 Blaise Pascal (1623 – 1662). 6 AAMODT, S. & WANG, S. Welcome to your brain. New York 2008. 7 Gregory Bateson (1904 – 1980).

WOMAN Do you allways need a proof? The fastest proof of everything? Denote by capital P the probability, that the theorem holds and by lowercase p the opposite. And each idiot sees immediately, that p<P. Quod erat demonstrandum. The proof is ready. (She puts her ear to his ear.) Yes, exactly this was our first kiss. MAN (after the rotational kiss) By the way, it is not true that p<P. It is no proof, just a joke. Honestly, each pi equals to 3.14 with given precision. MOTHER (is trying to rotate her fixed chair with no effect) You violated my human rights. To punish you, I tell the first European nationalist joke. I am a proud multicultural European nationalist! What is the difference between America and yougurt? In yougurt, there appears culture already in a few days.

MAN (kisses his wife, using two rotations, several times. Note, that coding of comic information is an open problem8) FADE OUT MAN I am happy she speaks again. WOMAN Are you sure? MOTHER Angels! My proof used angels? MAN Do you mean angles? WOMAN Is there any difference? MOTHER Angels? Or angles? Hm... WOMAN Why should be the mistake with me if it can be with you! MAN Nice idea.

8 ELIAS, P. et al. 2003. Bakhtinian Understanding to Web Graphics. Pp. 135 - 142 in Cyberworlds 2003. [online] http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=1253446&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D1253446

EPILOGUE PHANTOM ILLUSION

PLAYBACK Set of noises: rock music, explosions, flying bombers, cry of a child, applause, barking of a dog, woman voices in quarrel... all the noise of advertisement, SMS incoming signals, disharmony of noisy mobile phones...

Eventually, a silent chorus9 enters the scene behind. (This happens at the end of minute No. 15 or beyond, see next page). The chorus goes closer and closer to the audience. Now we see why the chorus is silent. All actors have tape-glued mouths. But they can say HM... (a halfway to AH, AHA, or HAHA signals of creative bisociation). CURTAIN.

Postscriptum: Acknowledgements Our Comenius University is named after the discoverer of modern teaching methodology and the very predecessor of multimedia presentations: Moravian bishop Jan Amos COMENIUS (1590-1670). Refer to his famous book Orbis Pictus for multimedia origins and his excellent book Schola Ludus for creative teaching and learning. From spring 1999, we dedicate the SCCG Welcome Video to his educational theatre tradition/spirit and a Patascientific seminar, April 1, annually to the vivid Schola Ludus tradition. This play (display) follows both living branches of Comenius traditions. A. F. The forgotten proof story happened to Dalibor Bosnak, the head of a student theatre Pegasnik at Cioenius University, and the illustration image comes from a poster of Katarina Zackova, a Comenius University student, supervised by Iveta Kohanova, a Comenius University teacher. The p<P pataproof belongs to laughter culture/folklore of Faculty of Mathematics, Physics and Informatics.

The true cognitive reason why we accept a real uncertain sketch for the exact proof in gnomic space (our inscape) is explained by Ladislav Kvasz in his book Patterns of Change, Fernando Gil Prize awarded research. The line segments visualize the numbers, but not a particular value, because they are prolongable. This way Euclid predicted the abstract numbers and the language rupture from geometry to algebra. See http://fernando-gil.org.pt/en/nominees/2010/winner/ This research work was supported by KEGA grant 094UK-4/2013, entitled E-matik+, Kontinuálne vzdelávanie učiteľov matematiky (Continual education of math teachers).

9 FERKO, A. 1999. " SOPHOCLES ? ". International Onassis Prizes (manuscript, not awarded). The fulltime stage play was dedicated to 2500th anniversary (Sophocles).

Le-MATH Project: Theatre Play writing competition on the theme of Mathematics

The play is dedicated to ~2600th anniversary.

Around 2600 years ago, Pythagoras of Samos (~570 – ~495 BC)

discovered the ideal world of synthetic geometry.

Although his theorem is much more popular, this discovery of an exact virtual world was crucial for European culture, science, and education.

As the repetition is nicknamed the mother of wisdom, the whole play (or the proofs only) should be now repeated again, to exhaust the allowed 15 minutes limit.

Honorable Mention

Mathsss…Puaghh…!!! What for??

Writing by Concepcion Martinez from Spain

Script for nine participants: the teacher and eight students.

The setting takes place in a regular class with smartboard.

The play

-The students gather together near one of the windows, minutes before the class starts. Some of them have their Math's books open and checking the content with lack of interest and dissatisfied faces-.

Student 1: Another year wasted.

Student 2: It's is such a useless subject. I do not understand the purpose of so many formulas.

Student 3: -Opening his brand new book randomly- Numbers, numbers, numbers… What a bummer!!!

Student 4: I heard we have a new teacher. Let's see.

Student 5: Nothing new. All of them are the same – miming the former Math teacher-: "Open your books on the first page. I am not going to review anything from last year. I assume you worked on the summer workbook I told you to get."

Students in general:

-Burst into laughter-

Student 6: Quiet!!! Someone is coming!!!

Students in general:

- Rapidly and loudly sit down at their own desks-

-The teacher enters in the room, starts the computer, search for some kind of information turns the lights off and the projection begins-.

-Tiles and the Courtyard of the Lyons from La Alhambra in Granada, The Pyramids, Temple of Artemis (reconstruction)….-

Student 1: What the heck?? Is this Math or Art class? Is my schedule mixed up?

Students in general:

Yeah!!

Teacher: Silence, please. Nothing is wrong.

-The projection continues with images of hives, the Giants Causeway basaltic formations in Ireland, Naica Giant Crystal Cave in Mexico…-

One student: Now, Science???

Students in general:

-Mumbling and expressing surprise with some photos-

Teacher: -Pauses, gazes around with a grin and presses the play button-

-… Low and high tides pictures, Periodical Cicadas insects…-

Student 7: Just like my younger sister: bugging me. Ha ha ha…

Teacher: Then your sister is extremely nice.

Student 7: What do you mean?

Teacher: Those insects emerge every thirteen cycle or seventeen years cycle depending on the specie. Therefore, she takes long brakes to bug you…

Student 1: Is that so? How come? Where do they live in the mean time? What makes them coming out? And prime numbers sequences… This is too weird.

Teacher: Ha, ha, ha… I am delighted you have so many questions. Let's move on.

-…. An old cover of Alice in Wonderland, an Emily Dickinson photo and works, works of Pollock, Kandinsky, Munch, Sliced Nautilus shell, Vitruvian Man and the Golden Ratio-.

Suddenly, notes from Gnossienne number 1 by Erik Satie.

-The students seem to relax and enjoy the music. The teacher turns down the volume and switch on the lights; scrutinizes their faces and smiles-.

Teacher: Well, ladies and gentlemen. Why did I show you these pictures and play that music?

-The whole class is in complete silence, just the music is heard-

Teacher: Anybody?

Students in general:

No idea.

Student 8: You want to drive us even crazier.

Student 9: Tell us!!

Teacher: Nobody knows what do they have in common?

Students at once:

NOOOOOOOOOOOOOOOO…….

Teacher: Beauty, harmony, balance…. due to numbers. All of them share the code: a mathematical world built for numbers. If we understand or, at least, grab the intuition of the essence of that code, you will change your mind about Math.

Student 6: But teacher, I do not see numbers on those paintings, the bees… except on the back of Pittsburg Steelers players.. –He appears satisfied with such a smart remark knowing he is the leader of the pack-.

Students in general:

Hahaha… You grabbed it!!!!

Teacher: Good one!! And good sense of humor. It will help.

Student 4: I love the drawing of the man with two pairs of limbs. It rings a bell. I saw it before.

Teacher: I am glad you named it. It was made by Leonardo da Vinci. Do you know who he was?

Students at once:

YESSSSSSSSSSSS!!!!

Teacher: We are on the right track. This drawing –showing the picture again- represents the Golden Ratio. It means the proportion between all the different parts of the body. See how Leonardo measured and established the body as a perfect geometrical combination of shapes.

Student 2: It is cool!!! Can we draw ourselves like that too?

Teacher: Of course!!! You will need to create a homemade compass for the circle, though it can be fun and interesting. Let's continue. Now, look at the Nautilus shell. What do you think?

Student 3: It is strange and beautiful. What are all those spaces for?

Student 2: It is the toilet. When it is full the animal looks for another clean shell.

Student 7: It is the pantry. When it runs out of food in the ocean.

Teacher: You are saying interesting and logical explanations; nevertheless, the reason of the compartments is to store oxygen when there is a lack of it down at the bottom of the ocean. But, what I want to point out is the perfect ratio between them when you measure the chambers. The numbers are already on this drawing –showing the photo with numbers on it- . Do you see anything peculiar?

Student 6: The numbers get bigger because the spaces are bigger.

Teacher: Perfect!!! Now, look closer.. closer… closer….

Student 5: Teacher, my eyes balls are out of the sockets and still don't see anything different.

Teacher: -Smiling- Look at the first three numbers. What relation do you see among them?

Student 4: Ahhhhhhhhhhh!!! I know it! I know it! –very excited and raising his hand-

Teacher: Tell us.

Student 4: The third one is obtained adding the two previous ones.

Teacher: Exactly… and the same with the rest. Try it.

Students in general:

Wowwww….

Teacher: Now, divide one with the next.

Students: Give us a minute.

Student 2: It is always the same number. Amazing!!!

Students at once:

Unbelievable!!!

Student 1: I am speechless…

-The bell rings indicating the class is over-

Students in general:

Already? It was fast. Awesome…

Teacher: Well, tomorrow, we will continue.

Student 5: No homework?

Students at once:

Shut up!!! Pet's teacher.

Teacher: Because we are working with numbers, Arabic numbers, I want you to search for the reason of their shape.

Student 6: What??

Teacher: Why they have that form. Why we write them that way and not other.

Students at once:

That's all??

Teacher: It is for tomorrow. Come on, you are going to be late for your next class. Have fun.

Students: Bye, teacher. See ya!! Have a good day.

-As the students disappear along the corridor, the teacher can perceive some comments: "It was cool". "I didn't expect it". "I didn't remember paying so much attention before"…. and, of course, laughs.

Circles, semicircles and math

Writing by Narcisa Catalina Codreanu from Romania

Characters:

Therapist (Suzanne)
Boy 1 (Archimedes)
Boy 2
Boy 3 (Pythagoras)
Boy 4
Girl 1 (Logarithm)
Girl 2

A large room. In the middle of the room, a single illuminated light bulb. Under the light bulb, a row of ten seats arranged in semicircle. The therapist's chair is slightly separated from the other chairs. The boys and girls are sitting nervously, looking uncomfortable and rather timid. To the semicircle's right there is a small blackboard with chalk and a dry sponge.

Therapist: Hello, my name is Suzanne and I'm glad to welcome you to the first sessionof the Mathematics Group Recovery. Since you are all new here, I will tell you a little bit about the procedure. Each and every one of you will share your story. First, you have to tell us your name; if you prefer not to, we may all use nicknames *(signs of approval from participants)*. Then, you tell us what is the problem, when did you first start to realize that something is not right and then give us every detail you feel necessary so I..well, we, can find a solution. I think we should start. From the right, please.

Boy 1: Hi, my name is…hmm…oh, you can call me Archimedes. What can I say? It first started a few months ago, at school. It was the math class and I had just woken up from some strange dream, when I heard the teacher saying something about some PI number or something. I was quite curious, but couldn't understand much. *(Archimedes goes to the blackboard and writes the symbol of PI and becomes quite excited)*. See? It looks fascinating. All I know is that PI is a mathematical constant that is the ratio of a circle's circumference to its diameter, and is approximately equal to 3.14. You know, the circumference of a circle is two, multiplied by PI, multiplied by the radius, and the area is PI multiplied by radius squared. *(While he talks, he is quickly writing the formulas on the blackboard)*. Crazy, isn't it? Simple you would say..yes., simple! But how, how on earth can you obtain something precise when PI is *(He instantly wipes the blackboard and starts writing as he says the number)* 3.14159 26535 89793 23846 26433 *(He does not have enough space to write, so he stops)*. Aaaaaaaaaaaaaand much more!! *(Screaming)*. There is PI here, PI there, PI everywhere. It's in my mind all the time! I know things about it; it probably knows things about me too,

since it's haunting me. That's all I know about it, but it's enough! *(Sits down, looking exhausted. The others sigh, showing him signs of understanding)*. I want to get rid if it!

Boy 3: You want to get rid of this PI thing? *(Suddenly stands up, nervous)*. Ohoo, let me tell how it is to want to get rid of something!

Therapist: Please, tell us your name.

Boy 3: I'm Pythagoras! And I mean it! If he wants to get rid of that thing, let me tell you how it is to eat, drink, sleep, run, sing, cry, dance, paint, shower with PYTHAGORAS theorem scratching on your brains!!! *(He goes to the blackboard and writes)*. The square of the hypotenuse is equal to the sum of the squares of the other two sides! *(While he says the theorem, he points at the blackboard)* Theeeee squaaaaaaare oooof theeeee hypooooootenuse iiiiis equaaaaal too the suuuuum of the squaaaaaares of the ooooother two sides! The square of the hypotenuse is equal to the sum of the squares of the other two sides! *(The last time, he says it quickly)*. What a nice theorem! So sweet, so cool, so…. theorem. But just like Mr. Archimedes over there, I have nightmares, horrible nightmares. *(He starts running around the semicircle)*. There are always three triangles chasing me, chasing me, chasing me…and theeeen! *(He stops,suddenly raising his hands. The others look terrified)* appears the giant head !! The head of PYTHAGORAS! Se starts saying it, torturing me with it *(He sits down, almost crying)*. The square of the hypotenuse is equal to the sum of the squares of the other two sides… The square of the hypotenuse is equal to the sum of the squares of the other two sides….

Therapist: Thank you Mr. Pythagoras! *(When Pythagoras hears his name, he winces)*. You *(Points at Girl 1)*. What can you tell us?

Girl 1: Well, to be truly honest, I know nothing about what these guys talked about. I mean, I've heard about those things, but my problem is quite different. You can call me Y, or X, or whatever, 'cause I don't really care. Or you may simply call me Logarithm. Yes! I love logarithms and I hate them at the same time. You know, you fall in love and then it's just like he left you at the altar and then you chase him because you want to tell him some things (She clenches her fists. Some laugh). But you know, you just CAN'T CATCH HIM! Pheu! *(She sighs)* Anyway, there is this thing called logarithm, and this logarithm is the exponent to which another fixed value, the base, must be raised to produce that number. For example, the logarithm of 1000 to base 10 is 3, because 1000 is 10 to the power 3 *(She writes 1000 = 10×10×10 = 103 on the blackboard)*. See? But you know what I thought one day? Does it really have to be about numbers? Wouldn't you agree that the logarithm of father to base mother is children? They may have 1, 2 ,3, as many as they want, or as many as they can! And it is the same with animals: logarithm of bull to base cow is calf! It sounds so great, so simple! And it can be applied to the whole universe! *(She becomes excited)* Buuut, but, when I tried to tell this to my math teacher, he said I am crazy! Why? Why do you have to be some great mathematician or something to have the right to express your opinion? *(She grows frustrated. Some applaud)*. Please tell me!

(She looks at the therapist). I do not understand! Logarithms are so wonderful and fascinating, and..I am not crazy. *(She sits down and looks at the others)*. Am I?

Therapist: No, no, no! You are not crazy at all! None of you is crazy, believe me! None of you has disorders. You have just misinterpreted things. Hmm. Let me tell you something about mathematics *(She goes to the blackboard, wipes it and draws a circle)*. Look, this is the circle of Natural numbers. *(She then draws another circle around the smaller one)*. This circle is the circle of Whole numbers. *(She proceeds to draw another three circles around the first two)*. This circle is the circle of Integers. This is the one of Rational numbers. And they are all surrounded by the circle of Real numbers. Here, somewhere, in the circle of Real numbers there is a small separate circle, the one of Irrational numbers. *(She draws it)* You see, this is the number system. When you think of mathematics, you should create you own reasoning system. Your problem is that you all take the circles separately, you do not interconnect them. Yes, logarithms and PI and Pythagoras's theorem have their own circle, well, their own dot, but they are all united under the great circle of mathematics. Why did you get stuck, you ask? Why do you seem crazy, you ask? Why are you here, you ask? You are all here because you have learned only particular things, while mathematics stands for something more, stands for learning thoroughly and comprehensively. If you want get over it, you must change your attitude towards the subject of mathematics. Mathematics on the whole is beautiful, but you must understand it in order to really appreciate it. It is the same as in life. We do not do things irrationally. We do not do only one thing, such as brushing our teeth or eating, do we? *(The others start laughing)* We do things because something motivates us, because we have understood. That's it with mathematics and life! Simple, isn't it? Anyone can do it! *(Everybody approves, and then they all stand up and start applauding. They grab their hands and then take a bow. Curtain closes.*

Around the circle

Writing by Gabriela Buse, Ionut Buse and Muntean Andreaa-Izabela from Romania

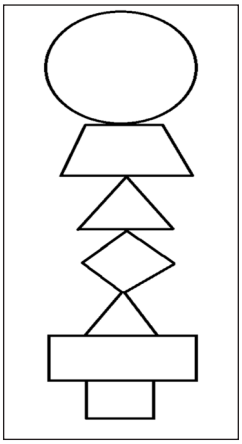
Characters:

Adriana (A), Bogdan (B), Carmen (C), Dan (D), Elena (E), Florin (F), Gabriel (G) ,14 years old students.

Henrieta (H), Irina (I), Ovidiu (O), 15 years old students.

Each student is wearing a white t-shirt with their name initial on.

The action takes place on the schools' basketball court during a spring day afternoon. A 3.6 meter diameter circle is marked at the center of the court. The circle also represents the last part of the hopscotch marking next to the square, rectangle, equilateral triangle, diamond, isosceles triangle and isosceles trapeze.



PART I

The first seven students enter the school yard together. Bogdan and Carmen are riding bicycles, while Dan is riding a tricycle. Adriana and Florin are each caring two 1.8 meter long jumping cords, Gabriel is carrying a basketball and Elena is carrying the hula-hoop circle.Once on the field, the students introduce themselves and start playing: riding the bicycles, tricycle, jumping the cord, bouncing the basketball and hula hooping.

Bogdan (riding his bicycle following the circle's circumference): I am Bogdan and I enjoy riding my bicycle.

Carmen (riding her bicycle):

I am Carmen and I also enjoy riding.

Adriana (jumping the cord):

My name is Adriana and I am a track runner

Florin (jumping the cord):

I am Florin and I am practicing judo.

Dan (following the circle's circumference on his tricycle):

I am Dan and I relax by riding my tricycle.

Elena (Hula-hooping on the circumference of the center circle):

I am Elena and I like gymnastics.

Gabriel (dribbling the basketball):

My name is Gabriel and I play basketball.

All students (together):

We exercise; we exercise

So we live a healthy life.

We do exercise a ton,

But math is also lots of fun.

(The students drop their objects on the side of the field.)

Adriana (excited and full of energy, dropping the jumping cord):

Guys, let's play hopscotch. Who wants to go first?

Carmen and Gabriel (at the same time):

Me!

Adriana (consulting the other students waiting for the game to start):

What do you guys think? Who should go first?

Bogdan:

Why not going in alphabetical order?

Florin:

Alphabetically is not a bad idea, but it is rather boring. Does anyone have another idea? (walking towards the other students that are becoming more anxious to start the game) Don't forget that besides the regular game rules, we also have to say the area and perimeter for each geometrical figure we jump into. Adriana you start.

Elena:

Looks like the first figure is a square. Who knows the formula for its' perimeter?

Adriana (singing a song while jumping through the figures, suddenly stops):

I am the one jumping; therefore I need to say it! The perimeter is the sum of all the sides, same as any polygon.

Gabriel:

But we will get bored if we have to wait for everyone to go through…

Dan (the most quiet among the students): That is true…

Florin:

They are right. Adriana, let us all repeat the formulas while standing on the side of the field!

Adriana:

Fine, fine… I am done anyways.

Carmen:

The area of the square it is the side multiply by the side.

Elena:

Bogdan, you are next!

Bogdan (finishing jumping the hopscotch):

The rectangles' perimeter is equal to two times the sum of the width and the height.

Elena:

I could say that the diamonds' perimeter, same as the squares' perimeter, is equal to four times the side.

Florin:

Carmen is next, after Bogdan.

Carmen (half way through the hopscotch):

I think this is the last formula I know. The diamonds' area is half product of the diagonals, or the base times the height, as for any parallelogram.

Dan (jumping):

Another figure is the equilateral triangle. Who knows the formula for the area?

Adriana:

The aria of the equilateral triangle is one half times the base times the corresponding height. There is also another formula using the length of the sides, but I don't quite remember it…

Elena (jumping):

Now let's see who knows the formula for the rectangle's area?

Dan:

That is easy: it is the width times the height.

Gabriel:

This game becomes kind of boring because everybody knows the formulas and I am the last to play. I think I will just leave…

Florin (jumping,worried that Gabriel is leaving):

Gabi, please stay. Look, you will be responsible for the last figure in the hopscotch.

Adriana:

But Florin, did you forget we do not learn the area of the circle and its' length?

Gabriel:

I will take the next figure then, the isosceles triangle. The perimeter is the sum of the three sides.

Elena:

Why don't you also tell us the triangles' area?

Gabriel (blushing):

I think it is …

Carmen:

He really doesn't know it…even though Adriana said it earlier.

Bogdan(smiling):

Gabriel, weren't you saying this game is boring?

Gabriel (frowning):

The area is the base times the corresponding height, everything divided by two.

Florin (being happy):

Good job Gabi!

Gabriel:

I am last to jump. Let's see what are the formulas for the trapeze?

Bogdan:

The area is quite complicated. It is the sum of the basis times the height, everything divided by two.

Gabriel(finished jumping):

I am so happy we are done…

Florin:

You mean done jumping, or done reviewing the formulas?

Gabriel:

Both.

Adriana:

That's not true. What are we going to do with the circle?

Elena (worried):

We have to find a method to measure the length and the area using the element that defines the circle's size: its' radius.

Gabriel (smiling):

Elena, I brought my basketball. You think it would be useful?

Elena:

And I brought my hula-hoop circle.

Adriana:

I think you are right, but for now let's go around the circle, holding hands…

Florin:

That's a good idea, but we will need more students to cover the whole circle.

Gabriel:

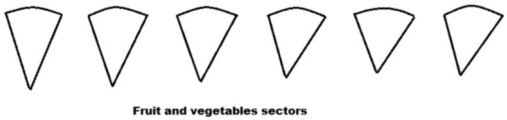
My older friends Henrieta, Irina and Ovidiu are coming soon.

Elena:

Let's spread around the circle!

PART II

To simplify the language, each student will be identified by their name initial, which is also on their t-shirts. Henrieta,Irina and Ovidiu are entering the court, each one having three circle sectors. Three sectors have drawings of fruits, three have drawings of vegetables, one has dairy, one has grains and the last one has drawings of lean meat. All these foods are necessary for a healthy nutrition. Each sector has a radius of 1.8 meters and a center angle of 40 degrees.



Fruit and vegetables sectors

Flour, meat, dairy sectors

H,I,O (dropping the circle sectors on the side):

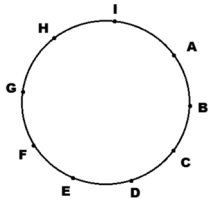
Greetings everyone! We went to the market to buy healthy food.

(O grabs the two jumping cords and heads to the center of the circle where he will be sitting.)

I & H (heading to the circle circumference where they will join the other seven students holding hands):

We understand that you guys need help with the perimeter and area of the circle. We will help you.

(All nine students around the circumference holding hands start dancing.)



O(who already got to the center of the circle):

PI's asking them to dance
Within its' mysterious roundness
To estimate the circle's circumference
As function of the radius.

A-I (dancing):

We'll estimate the circumference
As function of the radius.

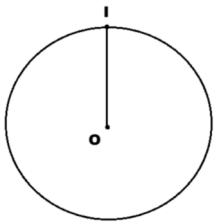
(The students stop dancing, holding their spots. O remains at the center of the circle.)

A: How could we do this?

O: (talking to I) Dear I, me and you will determine a circle radius using one of my cord.

B: Guys, I am really confused now…you mean the chord or the radius?

(O throws one end of the jumping cord to I)



O: We will use my jumping cord, fully tensioned by 'I' who stands on the circle. This is not a chord of the circle; it is a radius of the circle. We could use it as a unit to measure the circumference of the circle we are standing on.

B: Got it! Got it! Let's start measuring! In other words, let's see how many times we can fit the radius – our jumping cord – into the length of the circle.

H: Wait a second! I got a better idea that will save us some time. Let's measure the length of the circle using its' diameter.

D: We already have a diameter marked on the circle!

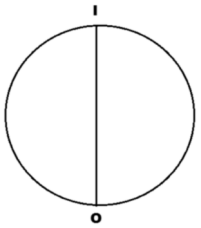
(O grabs the second jumping cord and ties it together with the first cord.)

E (talking to O):

Dear O, could you please move to the point that is diametrical opposite to I?

O: That's what I am going to do in order to determine a diameter of the circle using my two jumping cords.

(O is taking the proposed position holding the other end of the second cord)



O: Guys, we got the longest chord in the circle!

G: Let's start measuring the length of the circle using its' diameter!

H: In other words, let's find out how many times we can fit the diameter in the length of the circle.

(The ten students overlay the diameter formed by the two cords on top of the circumference, marking the starting point.)

All 10 students together (being excited):

Once!

Twice!

(repeating) Three times!

(repeating until they get close to the marked spot) And a little bit more!

H&I (together):

Almost one seventh of the diameter left!

O&I (showing on the cord):

That's right!

All ten students together:

The diameter fits in the length of the circle approximately 3.14 times!

O(talking to the rest of the students):

Thousands of years were necessary to discover the identity of this irrational number,named PI and labeled with the Greek symbol… PI's story is fascinating. Until you will read it, just remember that the length of any circle is equal to PI times the diameter, or two times PI times the radius.

A-I grab the circle sectors on the side and put them together covering the disc at the center of the field. This represents a circular diagram for a complete healthy nutrition. Each student will stay next to his or her sector. O stands outside the circle. Being older, he is coordinating the discussions.

All 6 (while carrying the sectors with the fruits and vegetables drawings):

Lots of fruits and veggies we eat

As we stay healthy and fit!

All 3 (while carrying the sectors with drawings of dairy, grains and meat):

Dairy, grains and meat we eat

As they keep us strong and fit!

O(after the sectors have been arranged):

Let's measure our health disc

Still using the radius !

Without taking any risk

Calculate the area.

G (anxious):

We want to learn how!

O: Over 2000 years ago, Archimedes proposed that the sectors would be rearranged in a different way. When the number of sectors grows to infinity, the surface they cover starts looking like a parallelogram or a trapeze.

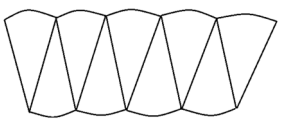
B: As we know how to calculate the area of a parallelogram and a trapeze, the problem is half solved.

O: How are you going to rearrange the sectors?

I (after debating with the rest of the students):

We know! We know!

(each student grabs his or her sector and places it as shown below, while O says:)



O: As there is no overlaying, the surface of the initial disc and this newly formed surface are equal. How should we name them?

B: We will call them equivalent surfaces.

O: It's good! What know figure does this surface look alike?

C: It looks like a trapeze to me.

D (following the contour with his hand) The sum of the basis lengths is the same as the circles' length, which is two times PI times the radius.

E (pointing across the height):

And the height is equal to the radius.

O: What are you going to get after a few substitutions and simplifications to the area formula?

F: We get that the area of the disc is equal to PI times the radius squared!

O: Very good!

G: But you also had mentioned something about a parallelogram…

O: Yes, I did. When would you get a figure that looks like a parallelogram?

H: Well, if we add another sector to the existing nine sectors either to the right or left.

O: Good job! In other words, if we had an even number of equal sectors and not an odd number as we did.

H: And then, the base will be as long as a semicircle, thus the base length will be PI times the radius.

I: And the height will be same as the radius, therefore the area will be PI times the radius times the radius. Either way we get the same result! We now solved everything we needed for our game.

A: I will play hopscotch using the rules you guys initially came up with and did not obey.

(Adriana jumps into each figure saying the area formula and then again saying the perimeter formula.)

All together:

Training the body also trains the mind - Mens sana in corpore sano.

Monkey Business

Writing by Bianca-Andrea Banica from Romania

List of characters:

The Nerd (boy)

The Football Bully (boy)

The Rock Star (boy)

The Clown (boy)

The Pretty Little Face (girl)

The Gossip-Girl (girl)

A highschool classroom with the desks put along the walls. In the middle of the room there is a large circle made of stones. A boy wearing glasses, a shirt tied up to his neck and some black trousers having no crease enters the classroom, followed by 6 youngsters (The Pretty Little Face, The Gossip Girl, The Football Bully, The Clown, The Rock Star) walking in line. They have their hands tied and also their eyes and mouths covered. They all try to scream.

THE NERD (very ironically):

Shut up and keep walking! I've already told you that we are not inside the school anymore, so there is nooooobody here that can save you. Come on, come on. There you go. Veeery good.

THE FOOTBALL BULLY (trying to speak through the scarf that is covering his mouth):

Where the fuck are we?

THE NERD (still ironically) :

We are under the school, in a secret hallway that will take us to a secret room where we will secretly talk in secret whisper.

THE FOOTBALL BULLY:

Yeah, right. Let us go, you're fucking bluffing.

THE NERD (ironically)

Oh, so you don't believe me…well...I don't care. As I said, (with a serious and rough voice) shut up and keep on walking!

The Nerd guides the 5 youngsters through the classroom, then out of it, then inside again. The process repeats three times. He makes them step inside the circle made of stones.

THE NERD:

Ok, now stop right there. Good. I'm going to uncover your mouths now, but you have to promise not to scream, or I will tie you again…forever!(he nearly laughs. everybody stops making sounds and he unties the scarves)

THE GOSSIP GIRL(screams at the top of her voice):

AAAAAAAAAAAAAAAAAAAAAAAAAAA!!!!!

THE ROCK STAR:

Shut up, you lunatic!

THE GOSSIP GIRL (keeps screaming):

Heeeeeeeeeeeeeeeeelp meeeeeee! Somebody help meeeeeeeeee!

The Rock Star and the Football Bully start pushing her with their shoulders.

THE Rock Star:

Shut up, you freak!

The Nerd puts the scarf back on the gossip girl. She keeps making some sounds.

THE NERD:

Ntz, ntz ntz. I guess you won't be participating in the chat. It's a shame, gossip-loly! Ok, now that we solved this problem and that the rest of you are so participative…You can sit down now, but be careful not to cover much space cause you happen to be, just like in the movies, in a circle made of rat traps and H2SO4. That's sulfuric acid, by the way. Oh, and it burns. (he steps away from the circle and sits on a chair, with a very satisfied face)

THE CLOWN:

We are not stupid, man, there's no circle, no acid, no nothing. You're bullshiting us badly!

THE NERD:

Oh, so you don't believe me…well, again, I don't care. Try to spread your legs and we'll see what happens.

THE CLOWN:

You, Bully, why don't you hit him in the head or something?

THE F.BULLY:

Why don't I hit you in the head so that you stop being stupid, huh?

THE ROCK STAR:

Why don't you both hit your heads and stop existing for once, huh? (the three of them start pushing each other with their shoulders)

THE NERD laughs loudly.

THE PRETTY LITTLE FACE (angry, towards the boys):

Hey! Hey! You're hurting us! Hey! Cut it off, you losers! (sweet, towards The Nerd) : Umm…look, I don't believe that we're surrounded by traps or acid either (she walks slowly and takes a step , gently trying to figure out if there is something there. She touches the stone and quickly drags her foot back) but we're certainly surrounded by something…and you are in control of that something…so, why won't you untie me and get me out so that we can talk some place more…private about your plan.

THE NERD:

Of course sweetie, some place away from these…losers?

THE PRETTY LITTLE FACE:

Yes, exactly.

Everybody else:

What? Hey, wait a minute. How can you say that? What are you, like saving your ass and that's all?

THE PRETTY LITTLE FACE:

Well, excuse me from being able to talk like a civilized person and not showing my muscles.

THE ROCK STAR:

The hell, civilized person. You're not going anyway!

THE NERD (ironically)

Ooook, calm down , nobody is going anywhere. Sorry, sweetie, you gotta work more on your little speech. Ain't fool me. But, you did say an important word. LOSERS. (serious tone) Remember when you used to shout that at me every morning when I was entering the school yard? "Looooser, looosy loooosy looosy! You like me , huh losy? " Bully, remember when you punched me in the face because you lost a game and I came to ask you if you want some water? Cause, of course, I was the water boy, what else could I ever be? Hey you, shiny rocker, remember how I begged you for singing something at my sister's birthday? Cause of course, she adores you and dreams about you, although I can play the guitar. Yeah, I can, and even better than you, but who fucking cares about the maths creep? Nobody. Oh, wait, except for when you, the funny guy, made sure to embarrass me in front of everybody in the toilet and then made sure that she (points towards The Gossip Girl) finds out about it and tells everyone in this universe what happened. You couldn't just leave me alone, you had to drag me inside your filthy little worlds where you rule and shine and walk over every…loser.(pause) Well, today, I'm gonna drag you into my world. (back to irony) Not because I'm looking for revenge or anything. No, no, no. It's just for showing you how I have fun.

THE GOSSIP GIRL:

mmmmmmm!!!!!!!!!!

THE CLOWN:

So you're gonna torture us or something cause we stole your candy when you were a baby? Come on, man, get over it, that's so Hollywood style!

THE NERD unties the Gossip girl's scarf.

THE GOSSIP GIRL:

Please don't hurt us, please!

THE F. Bully:

Oh, shut up!

THE ROCK STAR:

No, she's right. What if he has a gun or something?

THE GOSSIP GIRL:

Yes! Do you know Marie from class A? One day she was on the street, just walking home and then out of the blue comes a guy and then he pulls out a gun and then he…

THE F. BULLY:

SHUT UP!!!!!!!!!!!!!!!!!!!!!!!!!!!!He has nothing!

THE ROCK STAR:

He might have something! He managed to kidnap us already! That's something!

The CLOWN:

o, you idiot, we kidnapped ourselves for believing that stupid bullshit with the principle's experiment of trust between classmates. I can't believe we tied each other, that's how stupid we are!

The Nerd (imitating the principle's voice):

You were chosen to be part of the trust exercise that we do every year. You cannot talk to your classmates about this because only 6 are the lucky ones chosen and we don't want any other pupil to interfere with the exercise because of curiosity or ego. You ought to come to the highschool on Sunday at 5 p.m. and bring a scarf, and some strings. Thank you for your cooperation, you will be rewarded according to your performance in the exercise. Do your best. (laughing loudly)

THE Pretty Little Face:

We all remember the famous e-mail, thank you for performing it, you terrorist.

THE NERD (reverences):

Well, thank you, milady! Now, let's get back to business. You have to solve a riddle. Actually it's a maths thing. I will tell you the riddle once and only once, so listen carefully and try to memorize for the first time in your lives. Bully here, who I tied myself, doesn't have a string around his hands but a metal cable with a cipher. Once you have the answer to the riddle, he would be free and so he can untie the others and so you will be free…bla bla…you will come after me and destroy my whole life…bla bla.

THE ROCK STAR:

What if we refuse to play your little game?

THE NERD:

of course, of course, you refuse. Well, in that case, you will stay here until tomorrow morning when people come to classes.

The CLOWN (laughing):

That's all? Big deal. We'll stay.

THE NERD:

Giving the fact that Bully here has the big scholarship game at 6.30, Rocky-guitar has the dream concert at 7, Pretty Little Face has her debut modeling show at 9, Gossip-loly has the first date of her life at 8 and Clowny here who wants to show us his surviving under pressure skills has to return a biiiig amount of money to a very important violent person from this town at 1 a.m…….well taking all this into consideration, if I were you, I'd do the foolish riddle. But it's your call. I can leave…(pretends to be walking, but only lifts his feet to make the footsteps noise)

Everybody:

Wait !!!

THE NERD:

Yeah, I thought so. (he sits on the chair) Here it goes. Ten people land on a deserted island. There, they find lots of coconuts and a monkey. During their first day they gather coconuts and put them all together in a community pile. After working all day, they decide to sleep and divide the coconuts into ten equal piles the next morning. During the night, one castaway wakes up hungry and decides to take his share early. After dividing up the coconuts he finds he is one coconut short of ten equal piles. He also notices the monkey holding one more coconut. So, he tries to get the monkey's coconut, but the monkey conks him on the head with it and kills him. Later, another castaway wakes up hungry and decides to take his share early. On the way to the coconuts he finds the body of the first castaway, which pleases him because he will now be entitled to 1/9 of the total pile. After dividing the coconuts into 9 equal piles, he is again, one coconut short and tries to get the monkey's bloodied coconut. The monkey conks the second man on the head and kills him. One by one each of the remaining castaways goes through the same process until the 10th person to wake up gets the entire pile for himself. What is the smallest number of possible coconuts in the pile, not counting the monkeys'? (pause, complete silence, everyone is in trance) Good Luck!

THE F.BULLY:

You got to be kidding me!

THE NERD:

Nice huh? Do the maths boys…and girls. Byee! (he leaves the room)

THE PRETTY LITTLE FACE:

Hey, wait, hey! Don't we get any clues or something? Hey!

THE ROCK STAR:

Did he really leave? Man…hey! Nerdy!!!!

THE GOSSIP GIRL:

Stop calling him like that if you wanna get out of this alive!

THE ROCK STAR:

Yeah, right. Then tell me his name.

-silence-

THE PRETTY LITTLE FACE:

Roney? Robby?...something

-silence-

THE CLOWN:

So are we doing this or …

THE F.BULLY:

Man…I so need to get to the game…but he so lost me with the riddle…

THE ROCK STAR:

Let's concentrate a little. It's like the guitar, once you know how to reach all the notes in the right order, you just play……Gossip-loly, you have good memory, tell us the riddle again. Just the important things.

The Gossip Girl:

There were 10 castaways and a monkey.

The CLOWN:

Bully, remember that.

The F.Bully (whispering):

10 castaways, a monkey, 10, a monkey.

The Clown:

Go on.

The Gossip Girl:

They gathered coconuts all day and had enough to split them into 10 equal piles.

The F.Bully:

10 men, 10 piles, one monkey.

The Gossip Girl:

The monkey took one coconut, so the man who woke up first was one coconut short and couldn't divide everything equally. The monkey killed him cause he tried to take her coconut.

The F.Bully:

9 men, 10 piles, one monkey

The Clown:

So the total number is a number that can be divided by ten…minus one coconut.

The Pretty Little Face:

But then the next castaway tries to divide everything by 9 and is also one coconut short. That means that the total number can be divided by 10 and also by 9.

The Gossip-Girl:

Minus the coconut of the monkey.

The Rock Star:

yes.

The Gossip-Girl:

And it has to be the smallest number possible.

The Clown:

Right, so we have 90 minus 1

The Rock Star:

89. This is the smallest, right? Bully, keep counting!

The F.Bully:

9 men, 10 piles, one monkey, 89 coconuts.

The Pretty Little Face:

yeah, it's the smallest.

The Clown:

So let's try it. Bully, turn around.

The Clown tries the number on the cipher, gently trying not to put it wrong, he listens carefully to the cipher.

The Rock Star:

Well?

The Clown:

Nothing. It's wrong.

The Pretty Little Face: But why…it said 10 equal piles, then 9 equal piles, each time one short…because of the monkeys. I don't get it…

-silence-

The Rock Star:

Maybe the monkey killed the second castaway with another coconut.

The Gossip Girl:

No, he said that the second man tried to get the blooded coconut from the monkey so it was the same from the first murder.

The Clown:

So the monkey only had one, for sure.

The F. Bully:

8 men, 10 piles, one monkey

-silence-

The Pretty Little Face:

What else did Nerdy say? There's gotta be something else.

The F.Bully:

9 men, 10 piles, one monkey, no, no, 8 men, 10 piles, one monkey…8 men, that't it! There were 8 more!

The Rock Star:

So…

The F.Bully:

There were 8 more to wake up.

The Gossip Girl:

Yes, he's right, Nerdy said that every castaway got through the process until the last one woke up and got the whole pile.

The Pretty Little Face:

So each of them tried to divide the coconuts in equal piles and each of them was one coconut short because of the monkey.

The Clown:

So the total number can be divided by all the numbers from 1 to 10.

The Rock Star:

Yeah, way to go, Bully! We have this!

The F.Bully:

Wait…how are we gonna multiply the numbers without a computer? Or without a piece of paper?

The Gossip Girl:

Who's good at numbers?

The Pretty Little Face:

Nerdy is. This is his world, remember?

The Rock Star:

It's just a multiplication, it's not that hard. Look, it's 5 of us, I multiply out loud and you remember for me the numbers that I ask you to. It's like you're my piece of paper, but acoustic. Ok?

Everybody nods.

The Rock Star:

So from my left you are in this order: Bully, Pretty, Gossip-loly, Clowny, right?

The Gossip Girl:

No, I'm near Bully.

The Rock Star:

So Bully, Gossip-loly, Pretty, Clowny.

The Gossip-Girl:

yes.

The Rock Star:

2 X 3 =6 X 4= 24 X 5 = 120 X6 =720 OK, Gossip, you're 7, Pretty, you're 2, Clowny, you're 0. Multiplied by 7. Clowny 0, Pretty 4, Gossip 0, Bully 5. Multiplied by 8. Say the numbers, beginning with Clowny and I tell you what to remember.

Clowny:

0

The Rock Star:

0

Pretty:

4

Rock star(whispering):

2

Gossip:

0

Rock star (whispering):

3

Bully:

5

Rock Star:

40

Ok, so the number so long is:

Bully:

40

Gossip:

3

Pretty:

2

Clowny:

0

Rock Star:

40 320, good. Multiplied by 9…

Clowny:

0

Rock star:

0

Pretty:

2

Rock star: 8

Gossip:

3

Rock star:

8

Bully:

40

Rock star:

362. What's the number now?

Bully:

362

Gossip:

8

Pretty:

8

Clowny:

0

Rock Star:

362880. Multiplied by 10 it's 3628800. Minus the monkey's coconut it's 3628799. Right?

The Pretty Little Face (with enthusiasm):

Yes, yes! That's it!

The Gossip Girl:

Let's try it! Come on!

The Clown:

Bully, turn around!

He tries the number carefully. Everybody waits, breathing loudly.

The Clown:

No…it's wrong again.

The Gossip Girl:

How can it be wrong? Did we miss anything in the multiplication? Should we do it again?

The Rock Star:

I think we did it right…anyway..before doing it again, let's think about the riddle one more time.

The F. Bully:

10 men, one monkey, 10 equal piles minus 1, then 9 equal piles minus one, then 8 equal piles minus one, then 7, then 6…and so on.

The Clown:

So it's gotta be divisible by all of them.

The Pretty Little Face:

So we multiplied them all.

The Rock Star:

It's correct, the number is divisible by them all. And minus one…that's the answer. I don't get it…1 2 3 4 5 6 (whispers alone)

They all whisper alone.

The Gossip Girl:

The smallest! Is it the smallest?

The Rock Star: It's gotta be… 2 X 3 = 6 X 4 =

The Pretty Little Face:

That't it! You already have the 6, you don't have to multiply by 6 again. And that goes for 4. You just multiply by 2 cause you already have a 2.

The Clown:

Yes, that's it! We multiply the prime numbers and then the factors that we need for obtaining the others.

The Rock Star:

So it's 2 X 3 =6 X 5 =30 X 7 = 210

The F. Bully:

For 4 we need another 2.

The Rock Star:

420.

The Gossip Girl:

We already have 6 from 2 X 3, for 8 we need just another 2 cause we already have 2 X 2 which is 4.

The Rock Star:

840.

The Pretty Little Face:

9 it's 3X3 so we need another 3.

The Rock Star:

2520.

The Clown:

We already have the 10 cause it's 2 X5.

The Rock Star:

So, 2520 minus 1 and that's it.

The F.Bully:

2519. This is the answer! 2519!

The Clown:

Easy, Bully, we have to try it, we said this about the other two numbers and they turned out to be wrong. Come here, let's hope it's for the last time.

The boy tries the number rotating the cipher very slowly and carefully, listening to every click. Everybody else is in dead silence.

The Clown:

2…….5…..1…….and 9…….oh yeaaaaaaah! It's right! We solved it!!!!!!!!!!!!!!!!!!!!!!!!

Everybody:

Yeaaaaaaaaaaaaaaaaaah uhuuuuuuuuuuuuuuuuu!!!!!!!!

Bully unties himself quickly, he takes off the scarf and looks around.

The F. Bully:

Rat trap and acid, huh?! Smart bastard. He just made us doubt.

Bully hurries to untie everyone. They all hug, jump, and clap hands, applauding, the boys jump together in a circle, holding shoulders.

The Gossip Girl (staring at the floor):

It's Riley. (louder) It's Riley!

The boys stop jumping.

Pretty:

What?

The Gossip Girl:

It's Riley! I remembered. Nerdy's name is Riley.

-silence- (They all smile gently and stare at the floor.)

Pretty:

Johanna.

Clown:

Matt.

Bully:

Sam.

Rock Star:

Chris.

Gossip:

Mandy. Nice to meet you.

Honorable Mention

The Pythagoran Proposition

Writing by Dimitris Lyras from Greece

Hypothesis: A group of students who attend the third class of Gymnasium would like to create one big chessboard in the schoolyard. Nevertheless, they face a difficulty in drawing the right angles of the chessboard.

The goal: The present act aims to teach the Pythagorean Proposition and its reverse through a practical problem which raises. The goal of this act is to be teached the Pythagorean Proposition and its reverse through one practical problem. In this way, the experiential learning seems to be succeeded not only to the students who play the act (since the fact that they have solved the problem means/presupposes that they have understood deeply the meaning and application of the P.P.), but also to those who participate in an active way, by watching, listening, thinking, puzzling and looking for a solution to it.

Persons:

1) Dimitris (student)

2) Evangelia (student)

3) Panos (student)

4) Georgia (student)

5) Dimitris mother

6) Pythagoras

Duration: approximately ten minutes

SCENE 1

(Dimitris meet Evangelia in the morning at the schoolyard and she informs him of their new school project)

Evangelia:

Have you heard the news?

Dimitris:

No! Tell me all about it!

Evangelia:

Yesterday, when you were absent, the director visited our classroom.

Dimitris:

Oh, my! Are we in troubles again?

Evangelia:

No, thank God, this time he came for a good reason. He gave us the duty to help. He asked us to improve our schoolyard, since we are the elder students class of our school.

Dimitris:

Wonderful! We waited so many years for this to happen! What do we need to do, then?

Evangelia:

We discussed about it and decided to make groups with specific projects.

Dimitris:

Great job! Hopefully we are in the same group.

Evangelia:

Sure we are! And our project is so exciting!

Dimitris:

Who else will be in our group?

Evangelia :

Panos and Georgia.

Dimitris:

I wonder if our project has to do with chess, since we are all (four) very fond of it.

Evangelia:

Bravo, you got it! We will make a big chessboard at the corner of the schoolyard opposite of the olive trees.

Dimitris:

Awesome! But, will we make it? It seems quite difficult to me!

Evangelia:

Take it easy! All we need is some Geometry and someone who paints beautiful numbers.

Dimitris:

What do our classmates think about our project?

Evangelia :

They are excited!

Dimitris:

Good! So, when do we get started, then?

Evangelia:

Tomorrow we have our first meeting after school, by the water springs

Dimitris:

OK then! See you tomorrow! Have a good start!

Evangelia :

You too!

SCENE 2

(at the schoolyard, by the water-springs, at midday after the end of the lessons, the discussion for the work, difficulties and different ideas)

Georgia:

What a day! I'm dead!

Panos:

And what do you think about the new mathematics we learned today?

Evangelia :

Hey guys, let's just drop everything else and talk about our hot potato: our chess project.

Dimitris:

You're absolutely right. We're running out of time, anyway!

Evangelia :

So, we will make a big chessboard next to the olives.

Georgia:

What dimensions should it have?

Panos:

First of all, we are talking about a square. So, we will make a big square which will cover most of the schoolyard's surface.

Dimitris:

As a first estimation, its dimensions should be 5X5 meters.

Georgia:

Good! What else do we need to make this square?

Panos:

What exactly do you mean: in order to create it as a geometer shape or just to stamp it on the schoolyard?

Georgia:

For both reasons!

Evangelia:

Let start from the easy part. In order to stamp it on the schoolyard we need some black paint, a couple of brushes and a long board to design the lines of the square.

Dimitris:

That's very simple! My father has some paints and brushes in his storehouse. I will also bring a metre to take the right dimensions.

Panos:

As for me, I can bring a long board from a building next to my house.

Georgia:

Ok, we are done with the paints, the brushes and the board. Let's see now, how we will make the square.

Dimitris:

If I remember well from the Geometry class, each square has four right angles.

Georgia:

Correct, and four equal sides.

Panos:

OK, those are easy to be done. But, how can we make a huge right angle?

Evangelia :

If it was on the paper, we would use the set square.

Panos:

We know this alright! But there aren't any huge set square.

Georgia:

That's exactly our big problem.

Dimitris:

Hey, I've got an idea: what if we didn't use a set square?

Evangelia :

Hallo!!!! Can you even imagine how will the 'square' look without four right angles?

Dimitris:

I don't even want to think about it!

Evangelia :

That would not seem like a chessboard, but like a snake, instead!

Panos:

It won't even be a square, but a four-sided scheme!

Georgia:

Hey, I just came with an idea!

All together:

What are you waiting for? Tell us all about it NOW!

Georgia:

What if we took a big paper box or a wooden frame and used it to sketch the right angles?

Evangelia :

I find your idea too…naïve. We will end up with the same problems, as before. Just imagine this: the sides of the boxes you propose will be too small for our chessboard. So we will definitely lose the proper dimensions of our schema, by the minute we will try to extend the sides.

Dimitris:

No need to worry anymore! I just got the answer to our problem!

Evangelia :

We are all ears!

Dimitris:

We will take four stakes and will place each of them five meters away from the other. Then we will take a big rope and will place it around the stakes.

Panos:

Cool! Go on!

Dimitris:

This way we will have created the perimeter of the schema.

Evangelia :

But will it be a proper square?

Dimitris:

By moving the stakes properly, we will manage to create a schema rather close to a proper square.

Panos:

But again it won't be 100% a success.

Dimitris:

In this case we'll have to call for one of the ancient geometers to make it happen!

Georgia:

Guys, we've got a big problem! We must find a way to create the right angle.

Panos:

Ah, it's too late! I have to go because I have training.

Evangelia :

I suggest to end our discussion here. Let's give it some more thought and tomorrow we will continue at the same place, at the same time.

Georgia:

You're right! Have a nice afternoon!

All together:

Bye!

SCENE 3

(at home Dimitris discusses with his mother)

Mother:

Do you have lots of homework?

Dimitris:

No, mum. Tomorrow's schedule is easy, apart from Math's, of course.

Mother:

But you are very good at Mathematics. What makes you say it's difficult?

Dimitris:

Yesterday our Math's teacher introduced us a new proposition. I think it was something like… 'The Pythagorean Proposition'…Yes, that's it.

Mother:

So, what is it all about?

Dimitris:

I cite it from the book: "in every rectangular triangle if we add the squares of the two small sides the result is the same with the square of the big side".

Mother:

Could you make it simpler for me, please?

Dimitris:

I can't even learn it by heart, how could I possibly explain it to you? And as if it wasn't enough for us, our teacher taught as together with this proposition its reverse, at the same time!

Mother:

And what's this 'reverse proposition' anyway?

Dimitris:

The reverse preposition of the Pythagorean proposition says that "if in one triangle the square of the bigger side is equal with the sum of the square of the other two sides then the triangle is rectangular".

Mother:

Why don't you look it up in an Encyclopedia?

Dimitris:

You are right. I will.

Pythagoras from Samos (570-500 B.C.: famous mathematician of the antiquity. He traveled to Minor Asia, Egypt and Babylon. Later he moved to South Italia where he established a School. His students had special skills and interests in Mathematics. It is said that he or one of his students invented the Pythagorean Proposition. One of the School's interests was to study the relationships both among the numbers themselves, as well as between them and the physical environment; you see, they used to say that

'everything is. Much of of their teaching has been lost as the members of the School have swored to keep their lips sealed and not to reveal any of the teachings".

Just a minute! As I can now see, the proposition refers to the rectangular triangles. But so does our school project: we need to create a right angle. Should the PT be the answer to our problem? Hopefully!

SCENE 4

(Dimitris is asleep and Pythagoras comes to his dream)

Pythagoras:

My young boy what is bothering you and you can't sleep?

Dimitris:

Great Master Pythagoras, we have a problem!

Pythagoras:

Share it with me. Perhaps I can help you.

Dimitris:

We want to make a big right angle in the schoolyard but we don't know how.

Pythagoras:

I see. If you wanted to draw it in your notebook which geometrical instrument would you use?

Dimitris:

The gnomon, of course.

Pythagoras:

So, you need a big gnomon.

Dimitris:

Exactly!

Pythagoras:

To make it simpler, you need a big rectangular triangle.

Dimitris:

This will give us the solution.

Pythagoras:

And why don't you create it?

Dimitris:

How?

Pythagoras:

Remember what my proposition says. Doesn't it refer to rectangular triangles?

Dimitris:

Of course, it does. It precisely says that "in every rectangular triangle if we add the squares of the two small sides the result is the same with the square of the big side".

Pythagoras:

Very good!

Dimitris:

Ok, but the proposition refers to a rectangular which already exists. In our case we need to create one.

Pythagoras:

I agree. Try to read the proposition from the end to the beginning.

"The square of the bigger side is equal to the sum of the squares of the other two sides in every rectangular triangle".

Pythagoras:

Doesn't it ring any bells to you?

Dimitris:

If I am not mistaken, this is the reverse of your proposition.

Pythagoras:

Bravo! You got it! And how can the reverse proposition help you in your case?

Dimitris:

If I could find a schema which would have the proper dimensions according to the proposition, then this schema should be a rectangular triangle.

Pythagoras:

Well done! So, you can make a rectangular triangle.

Dimitris:

Yes, but first I need to find three sides with the proper dimensions.

Pythagoras:

So, try!

Dimitris:

Let's take the numbers 1,2 and 3. 32 isn't equal with 12 + 22. No, they don't give us the solution. I shall take the numbers 2,3 and 4. Nothing again, because 42 isn't equal with 22 + 32. I continue with the numbers 3,4 and 5. I found it! 52 = 32 + 42 because 25=9 + 16. So, if I take the dimensions of the sides 3,4,5, then the triangle which will be made is defenatelly a rectangular!

Pythagoras:

You see how easy it was?

Dimitris:

Master Pythagoras, thank you very much for your help!

Pythagoras:

You are welcome! I am always happy to help students with Math's.

SCENE 5

(in the morning, at the schoolyard Dimitris reveals the solution to the team)

Dimitris:

Guys, guys, I have something big to tell you!

Panos:

OK, first of all tell us 'good morning' and then go on.

Evangelia:

What's up, then?

Dimitris:

I found the solution to our problem!

Georgia:

Are you sure? Personally, I have given up. I tried a whole day to find the answer to our problem, but I came up with nothing at all.

Panos:

I asked my uncle, who is a mechanic, but he confused me much more.

Evangelia:

So, tell us! What solution did you find?

Dimitris:

You won't believe it but the solution came to my sleep!

Georgia:

No way! Did you even see a dream?

Dimitris:

Exactly! Pythagoras himself came to my dream and revealed everything to me!

Panos:

Very good! It's very rare for a Pythagorean to reveal any ideas. They usually keep them secret.

Dimitris:

Don't you think that it is a big secret or anything like that. As a matter of fact, we learned it all yesterday. It's all in our book of Mathematics.

Evangelia :

What do you mean?

Dimitris:

The reverse of the Pythagorean Proposition will give us the solution.

Georgia:

In which way?

Evangelia:

What does the reverse say?

Panos:

Let me cite the proposition. It took me an hour to learn it by heart, anyway! So: "if in one triangle the square of the bigger side is equal with the sum of the square of the other two sides then the triangle is rectangular".

Dimitris:

Very good! This will help as make a rectangular triangle.

Panos:

Yes, but we don't know the dimensions for the three sides in order to make the triangle rectangular.

Dimitris:

It's very simple! We make trials until we find three numbers which will eventually satisfy our relation.

Georgia:

Which numbers?

Dimitris:

3,4 and 5. The bigger side will be five meters long and the other sides will be 3 and 4 meters long.

Evangelia :

Excellent, Dimitris! Truly, these numbers confirm the proposition.

Georgia:

But how will we build it in practice?

Panos:

I've got it now. We will place a stable stake (number one). We will measure a distance of 4 meters and there we will place another stable stake (number two). From this stake, we will measure a distance of 3 meters and we will put a third movable stake. Then we will fasten a rope from the first stake via the second stake to the third stake. Finally, we will move the third stake until we find a point that has exactly 5 meters distance from the first stake. This is the exact point we need and where we will place the third stake permanently. The angle which will be opposite the bigger side of the triangle shall be of ninety degrees.

Evangelia :

Amazing! Unbelievable!

Georgia:

Such a great construction!

Dimitris:

And to avoid repeating the same procedure from the beginning, since we will have made the rectangular triangle, we could take two canes and make a form of the rectangular triangle. This way, every time we need to make the rectangular triangle, we will just have to place the form of the angle on the field and draw the sides.

Georgia:

Genius!

Panos:

Hurry up! Let's go quickly! I can't wait!

Dimitris:

Take it easy, don't panic! First of all, let me buy you a pizza. We need a lot of energy to make it happen!

All togetherí:

OK, let's!

A mathematician's Apology

Writing by Edit Kormos from Hungary

Characters

Charles Percy Snow	author, scientist, Hardy's friend
Geoffrey Harold Hardy	mathematician
Lynn Hardy	Hardy's sister

Hellenic Scientists

Actor

Painters

Poets

Puzzles

Numbers

Physicist

Act 1

(In front of curtain)

(Snow enters. Lynn, Hardy's sister, welcomes him.)

Snow How are you?

Lynn … Thank you for coming, Mr. Snow. Harold is… very ill…

S The depression…

L You ought to know that Harold has tried to kill himself.

S Oh, God! Thank goodness that…

L *(Takes Snow's coat and hat)* It was a pity the attempt had failed. Harold is a creative man. Life on those terms he would not endure: there was nothing in it. He had made a completely deliberate choice… Please, this way!

Act 2

(Curtains up)

(The interior of a room, Harold lies in bed.)

Snow Good evening!

Hardy …

S I'm glad to see you!

S I hope that… I am not disturbing you…

H *(emotionless)* As you ought to be able to notice, the answer to that is that you are.

S …

H *(smiles in a tired way)* … Still, I'm usually glad to see you. Had anyone ever made a bigger mess?

S … I don't think anyone would be bothered by your lucky…

H …unlucky escape.

S ???

H *(in a tired way)* I have, my friend, messed up the last act. I'm a loser… a clumsy idiot…

S If you just allow me to make a remark. You are not the first one…

H Pardon?

S What about the German generals in the last war? Beck, Stulpnagel…?

H *(lively)* Yes?

S They had been remarkably incompetent at it – like you.

H *(smiles)* I still find pleasure in your company. Honestly, I am glad that you have come! We don't have to wait a lot anymore…

Act 3

(Lynn brings in some tea then leaves.)

S ???

H Charles, would you be so kind as to pass me the tea?

S Here you are. Who have you mentioned you are waiting for?

S Oh, yes, yes. I haven't said it yet. Well, the end. The great finale… May I ask you to pour me some milk, please?

S Pardon? And you? Afraid?

H What was there to fear in nothingness?

S You believe in the rational to an extent that I thought irrational.

H *(laughs then suddenly begings to caugh)* By the way, what's the reason of your coming?

(Lynn appears at the door and, by moving her head, tells Snow not to reveal the real reason of his coming)

S Uhmmm… well, to congratulate! I mean, to congratulate you to be appreciated… the Copley Medal… Well? You didn't even know about it…?!

H Now I know that I must be pretty near the end. When people hurry up to give you honorific things there is exactly one conclusion to be drawn.

S Do not say anything like this, please! It is evident for the Royal Society, too, that you are the greatest mathematician of our times…

H *(Moves his cup towards Snow who takes it)* Oh, come on, Charles! At my best, I was for a short time the fifth best pure mathematician in the world. I still say to myself when I am depressed and find myself forced to listen to pompous and tiresome people, "Well, I have done one thing you could never have done, and that is to have collaborated with Littlewood and Ramanujan on something like equal terms.

S Your famous Mephistophelian grin! I am glad it has returned…

H Charles, when a creative man has lost the power or desire to create — So it is a pity but in that case he does not matter a great deal anyway, and it would be silly to bother about him. *(turns towards the wall)*

Act 4

(Lynn enters and arranges the bed.)

S I have read Graham Greene's criticism of your book. He wrote that along with Henry James's notebooks, the „Mathematician's Apology" was the best account of what it was like to be a creative artist.

H It is a melancholy experience for a professional mathematician to find himself writing about mathematics.

S Why?

H Exposition, criticism, appreciation, is work for second-rate minds.

S …

H If then I find myself writing, not mathematics but 'about' mathematics, it is a confession of weakness. I write about mathematics because, I have no longer the freshness of mind, the energy, or the patience to carry on effectively with my proper job.

S I am convinced that your work still continues to be useful…

H *(in a threatening voice)* USEFUL??? Have you said 'useful'?

S *(shy)* Well, that's the expression I have used, yes.

H The work of a mathematician cannot be 'useful'.

S Why is that?

H Because mathematics itself is not useful, either…

(Lynn leaves)

Act 5

(Hardy sits up in bed.)

S And what about the mass of mathematical truth? It's obvious and imposing! Its practical applications, the bridges, steamengines…

H Some mathematics is certainly useful in this way; the engineers could not do their job without a fair working knowledge of mathematics, and mathematics is beginning to find applications even in physiology…

S You see! That's what I am talking about…

(Hardy gets out of bed, steps to the table, gets a bottle of wine and pours himself a glass)

H The most 'useful' subjects are quite commonly just those which are most useless for most of us to learn.

S You are stating that…

H Yes. So little practical value scientific knowledge has for ordinary men…

S And what about Mathematics? Chemistry? Physics?

H It is useful to be tolerably quick at common arithmetic. But a little chemistry, physics, or physiology has no value at all in ordinary life…

(Hardy lights a cigar.)

S ???

H We know that the gas will burn without knowing its constitution; when our cars break down we take them to a garage; when our stomach is out of order, we go to a doctor or a drugstore.

(Lynn enters and takes Hardy's glass.)

S Just „tolerably quick at common arithmetic"??? That's all?

H No, you are right. Mathematics can be entertaing, as well…

S Indeed…

H The public wants a little intellectual 'kick'…

(Lynn takes Hardy's cigar, as well, and leaves.)

H …and nothing else has quite the kick of mathematics.

Act 6

(At the background appear some characters symbolizing different puzzles.)

S Ahh! You are thinking of the puzzles…

H Yes. And who knows of what other games…

(Characters of digital games appear next to the puzzles.)

(Says in a condemning way, turning towards the back) Yes, that is, too, one kind of mathematics, my dear friend…

S You don't think much of puzzles…

(The characters leave bowing their heads in a sad way.)

Right. But what do you think of chess?

(Chess characters arrive in a confident way.)

H True: every chess-player can recognize and appreciate a 'beautiful' game or problem.

S So do you surrender?

H Chess problems are the hymntunes of mathematics.

S *(smiles)* Surrendered.

H Nevertheless: a chess problem is genuine mathematics, but it is in some way ' trivial ' mathematics. Chess problems are unimportant. The best mathematics is serious as well as beautiful.

(The chess characters leave, ashamed.)

Act 7

S Beautiful? Mathematics is not esthetic…

H Well, of course, it is…

S I don't understand…

H Fine… just pay a little attention. Come with me, please.

(A vision – with the elements of black theatre. All the theories and thoughts are shown like a dream-like vision similar to 'Alice in Wonderland'.)

What we do may be small, but it has a certain character of permanence; and to have produced anything, whether it be a copy of verses or a geometrical theorem, is to have done something utterly beyond the powers of the vast majority of men.

As history proves abundantiy, mathematical achievement is the most enduring of all.

But of course the crucial case is that of the Greeks. The Greeks were the first mathematicians who are still 'real' to us today.

(Hellenic scientists appear.)

Greek mathematics is 'permanent', more permanent even than Greek literature. Archimedes will be remembered when Aeschylus is forgotten, because languages die and mathematical ideas do not.

(The scientists disintegrate.)

A mathematician, like a painter or a poet, is a maker of patterns. If his patterns are more permanent than theirs, it is because they are made with ideas. A painter makes patterns with shapes and colours, a poet with words. A painting may embody an 'idea', but the idea is usually commonplace and unimportant. In poetry, ideas count for a good deal more; but the importance of ideas in poetry is habitually exaggerated: poetry is not the thing said but a way of saying.

(An actor enters.)

Not all the water in the rough rude sea

Can wash the balm from an anointed King.

Could lines be better, and could ideas be at once more trite and more false? The poverty of the ideas seems hardly to affect the beauty of the verbal pattern.

(The actor leaves.)

A mathematician has no material to work with but ideas, and so his patterns are likely to last longer, since ideas wear less with time than words.

The mathematician's patterns, like the painter's or the poet's, must be beautiful.

It may be very hard to define mathematical beauty.

But it will be clear by now that, if we are to have any chance of making progress, I must produce examples of 'real' mathematical theorems, theorems which every mathematician will admit to be first-rate.

I can hardly do better than go back to the Greeks.

The first is Euclid's proof of the existence of an infinity of prime numbers.

(The theorem appears like a vision.)

The prime numbers or primes are the numbers (A) 2,3,5,7, 11, 13, 17, 19,23,29, ... which cannot be resolved into smaller factors. Thus 37 and 317 are prime. The primes are the material out of which all numbers are built up by multiplication: thus 666 = 2X3X3X37. Every number which is not prime itself is divisible by at least one prime (usually, of course, by several). We have to prove that there are infinitely many primes, i.e. that the series (A) never comes to an end.

Let us suppose that it does, and that

2, 3, 5, •••> P

is the complete series (so that P is the largest prime); and let us, on this hypothesis, consider the number

Q=(2X3X5X …P) + 1.

It is plain that Q is not divisible by any of 2, 3, 5, •••> P for leaves the remainder 1 when divided by any one of these numbers. But, if not itself prime, it is divisible by some prime, and therefore there is a prime (which may be Q itself) greater than any of them. This contradicts our hypothesis, that there is no prime greater than P; and therefore this hypothesis is false. The proof is by reductio ad absurdum, and reductio ad absurdum, which Euclid loved so much, is one of a mathematician's finest weapons. It is a far finer gambit than any chess gambit: a chess player may offer the sacrifice of a pawn or even a piece, but a mathematician offers the game.

Beauty and seriousness – these are the criteria by which the mathematical patterns should be judged. I can hardly believe that anyone who has understood this theorem will dispute that it pass these tests. If we compare it with Dudeney's most ingenious puzzles, or the finest chess problems: there is an unmistakable difference of class.

Thus Euclid's theorem is vital for the whole structure of arithmetic. The primes are the raw material out of which we have to build arithmetic, and Euclid's theorem assures us

that we have plenty of material for the task.

But a significant mathematical idea, a serious mathematical theorem, should be 'general' in the same time.

'Generality' is an ambiguous and rather dangerous word, and we must be careful not to allow it to dominate our discussion too much.

When we assert that 2 + 3 = 5, we are asserting a relation between three groups of ' things'; and these ' things ' are not apples or pennies, or things of any one particular sort or another, but just things, 'any old things'. The meaning of the statement is entirely independent of the individualities of the members of the groups. All mathematical 'objects' or 'entities' or 'relations', such as ' 2 ', ' 3 ', ' 5 ', ' + ', or ' = ', and all mathematical propositions in which they occur, are completely general in the sense of being completely abstract.

Quite common, for example, for an astronomer or a physicist to claim that he has found a 'mathematical proof that the physical universe must behave in a particular way. All such claims, if interpreted literally, are strictly nonsense. It cannot be possible to prove mathematically that there will be an eclipse tomorrow, because eclipses, and other physical phenomena, do not form part of the abstract world of mathematics; and this, I suppose, all astronomers would admit when pressed, however many eclipses they may have predicted correctly.

In the first place, I shall speak of ' physical reality', and here again I shall be using the word in the ordinary sense. By physical reality I mean the material world, the world of day and night, earthquakes and eclipses, the world which physical science tries to describe.

For me, and I suppose for most mathematicians, there is another reality, which I will call 'mathematical reality'.

I believe that mathematical reality lies outside us, that our function is to discover or observe it, and that the theorems which we prove, and which we describe grandiloquently as our 'creations', are simply our notes of our observations.

The contrast between pure and applied mathematics stands out most clearly, perhaps, in geometry. But the point which is important to us now is this, that there is one thing at any rate of which pure geometries are not pictures, and that is the spatio-temporal reality of the physical world.

This may sound a little paradoxical to an outsider, but…

Let us suppose that I am giving a lecture on some system of geometry, such as ordinary Euclidean geometry, and that I draw figures on the blackboard to stimulate the imagination of my audience, rough drawings of straight lines or circles or ellipses. It is plain, first, that the truth of the theorems which I prove is in no way affected by the quality of my drawings. Their function is merely to bring home my meaning to my hearers.

Now let us go a stage further. The room in which I am lecturing is part of the physical world, and has itself a certain pattern. The study of that pattern, and of the general pattern of physical reality, is a science in itself, which we may call ' physical geometry'.

Suppose now that a violent dynamo, or a massive gravitating body, is introduced into the room. Then the physicists tell us that the geometry of the room is changed, its whole physical pattern slightly but definitely distorted. Do the theorems which I have proved become false? Surely it would be nonsense to suppose that the proofs of them which I have given are affected in any way. It would be like supposing that a play of Shakespeare is changed when a reader spills his tea over a page.

This is the point of view of a pure mathematician. Applied mathematicians, mathematical physicists, naturally take a different view, since they are preoccupied with the physical world itself, which also has its structure or pattern.

I think that there is probably less difference between the positions of a mathematician and of a physicist than is generally supposed, and that the most important seems to me to be this, that the mathematician is in much more direct contact with reality. This may seem a paradox, since it is the physicist who deals with the subject-matter usually described as 'real' ; but a very little reflection is enough to show that the physicist's reality, whatever it may be, has few or none of the attributes which common sense ascribes in- stinctively to reality. A chair may be a collection of whirling electrons, or an idea in the mind of God: each of these accounts of it may have its merits, but neither conforms at all closely to the suggestions of common sense.

I went on to say that neither physicists nor philosophers have ever given any convincing account of what ' physical reality ' is, or of how the physicist passes, from the confused mass of fact or sensation with which he starts, to the construction of the objects which he calls 'real'. It is plain that he is trying to correlate the incoherent body of crude fact confronting him with some definite and orderly scheme of abstract relations, the kind of scheme which he can borrow only from mathematics.

Mathematical objects are so much more what they seem. A chair or a star is not in the least like what it seems to be ; the more we think of it, the fuzzier its outlines become in the haze of sensation which surrounds it; but '2' or '317' has nothing to do with sensation, and its properties stand out the more clearly the more closely we scrutinize it.

317 is a prime, not because we think so, or because our minds are shaped in one way rather than another, but because it is so, because mathematical reality is built that way.

There are then two mathematics. There is the real mathematics of the real mathematicians, and there is what I will call the ' trivial ' mathematics, for want of a better word. The trivial mathematics may be justified by arguments, but there is no such defence for the real mathematics, which must be justified as art if it can be justified at all.

I have never done anything 'useful'. No discovery of mine has made, or is likely to make, directiy or indirectly, for good or ill, the least difference to the amenity of the world.

Judged by all practical standards, the value of my mathematical life is nil; and outside mathematics it is trivial anyhow. I have just one chance of escaping a verdict of complete triviality, that I may be judged to have created something worth creating.

The case for my life is this: I have added something to knowledge, and helped others to add more… And maybe I have left some kind of memorial behind me…

(The vision comes to an end. Hardy stays alone in the emptied black space. Hardy in the spotlight.)

H: Charles! Where are you, my friend? At last…. (finally realizes that he is already in nothingness)

(Darkness)

Act 8

(Curtains down.)

Lynn: Thank you for staying beside him.

S: Don't even mention it. God bless you, Lynn. Take good care…

L God bless you…

(Snow leaves for the door.)

L Charles! Please. And your last adventure together? What was it like?

S (smiles) Useful. Oh, I'm sorry, Harold… beautiful. Yes, beautiful.

Operation: Equation

Writing by Rosalind Flynn from USA

Operation:

Characters:
Emcee (1)
Equation Reader (2)
Judges (3) (4)
First Team of Mathletes—(5) (7)
Second Team of Mathletes—(6) (8)

Audience
Staging: The actors should be arranged onstage as if they are on the set of a TV game show. The Emcee (1) and Equation Reader (2) at center; the Judges (3 and 4) on the left; the Teams of Mathletes (5, 6, 7, 8) on the right. The audience should be facing the actors as if they are the studio audience.

1:	Ladies and Gentlemen, Boys and Girls! Welcome to tonight's show—
Audience:	Operation: Equation! [sound effect]
1:	Yes, the show that requires "Mathletes" to solve equations—
2:	—also known as number sentences—
1:	...quickly and correctly! I am your host, Quo Tient, here with our equation reader, C. Quence.
2:	And you all know it's just about time to—
Audience:	Solve that equation! [gesture] [sound effect]
1:	Correct. But first, who are tonight's judges, C. Quence?
2:	Please welcome Al Gebra and Geo Metry!
Audience:	[Applauds]
3:	Thanks, Quo. Thanks, C.
4:	It's always great to be here on...
Audience:	Operation: Equation! [sound effect]
1:	So, let's get solving! Team 1—are you ready?
Operation:	Equation by Dr. Rosalind M. Flynn 2
5 and 7:	Ready!
1:	Team 2—are you ready?
6 and 8:	Ready!

1: C. Quence—please read the equation.

2: 6 x (2 +1) + 42

Audience: Solve that equation! [gesture] [sound effect]

[Each pair of team members confers and then presses the buzzer or bell.]

1: Team 1, your solution?

5: 6 x 3 = 18 + 4 = 22

7: 22 squared = 484

5 and 7: The answer is 484.

1: Judges?

3 and 4: [sound effect—wrong answer] Incorrect!

5 and 7: [sound effect—Gasp!]

Audience: Awwww.

1: Over to you, Team 2. C. Quence—please read the equation again.

2: 6 x (2 +1) + 42

Audience: Solve that equation! [gesture] [sound effect]

1: Team 2, your solution?

6: 6 x 3 + 4 = 6 x 7 which equals 42.

8: 42 squared = 1764.

6 and 8: The answer is 1764.

1: Judges?

3 and 4: [sound effect—wrong answer] Incorrect!

6 and 8: [sound effect—Gasp!]

Audience: Awwww.

2: Both teams got wrong answers?

Audience: Then what's the right answer?

Operation: Equation by Dr. Rosalind M. Flynn

3:

5, 6, 7, 8: And how do we figure it out?

1: Judges?

3 and 4: You need to know The Order of Operations!

Audience: The Order of Operations!

5, 6, 7, 8: What's that? [gesture]

3: Well, in Mathematics, "Operations" means add, subtract, multiply, divide, square, etc.

4: There's an "order" that states which operations you perform first, second, third, and so forth...

3 and 4: ...so that mathematicians everywhere will get the same correct answer.

5, 6, 7, 8: What is The Order of Operations?

3 and 4: We were hoping you'd ask!

3: Quo and C., will you kindly help us out?

1 and 2: Of course! That's what we're here for on—

Audience: Operation: Equation! [sound effect]

3 and 4: The Order of Operations:

1: First, find the operations in parentheses

2: or brackets.

Audience: Parentheses or brackets, parentheses or brackets.

3: Solve those operations first—

Audience: Compute, compute!

4: Then search for exponents.

5: Exponents?

4: Exponents—little numbers to the right—

2: —and just above—

4: a number or a symbol.

6: Like squared or cubed?

3 and 4: Like squared or cubed!

Audience: Give power to that root! Give power to that root!

Operation: Equation by Dr. Rosalind M. Flynn 4

3: After all that, there's another step—

Look at your equation and start on the left.

4: Divide or multiply.

Audience: Divide or multiply.

3 and 4: Divide or multiply from left to right.

1: After all that, there's one last step—Go back to your equation and start on the left.

2: Add or subtract.

Audience: Add or subtract.

1 and 2: Add or subtract from left to right. Complete this execution and there's your solution!

Audience: Complete this execution and there's your solution!

5, 6, 7, 8: The Order of Operations. Hmmmm.

1: Mathletes, now that you know The Order of Operations, would you like another chance to...

Audience: Solve that equation! [gesture] [sound effect]

5, 6, 7, 8: Yes!

1: C. Quence—please read the equation once again.

2: 6 x (2 +1) + 42

[The Audience whispers each step of The Order of Operations as each team performs the operation and speaks in a stage whisper—as if the other team cannot hear them.]

Audience: [whispered] First, find the operations in parentheses or brackets. Parentheses or brackets, parentheses or brackets.

5, 6, 7, 8: Two plus 1 equals 3. Six times 3 plus four squared.

Audience: Then search for exponents and—Give power to that root! Give power to that root!

5, 6, 7, 8: Four squared equals sixteen. Six times three plus sixteen.

Audience: Now look at your equation and start on the left. Divide or multiply from left to right.

Operation: Equation by Dr. Rosalind M. Flynn

5

5, 6, 7, 8: Six times three equals eighteen. Eighteen plus sixteen.

Audience: One last step! One last step— Go back to your equation and start on the left. Add or subtract from left to right. Complete this execution and there's your solution!

5, 6, 7, 8: Eighteen plus sixteen equals thirty-four.

[Each pair of team members presses the buzzer or bell simultaneously.]

1: Teams, your solution?

5, 6, 7, 8: The answer is 34.

1: Judges?

3 and 4: [sound effect—correct answer] Correct!

Audience: [Applauds and cheers wildly.]

1: Ladies and Gentlemen, Boys and Girls! We have a tie here on—

Audience: Operation: Equation! [sound effect]

1: Yes, tonight's Mathletes solved the equation—

2: —also known as a number sentence—

1: ...quickly and correctly!

1: I am your host, Quo Tient, here with our equation reader, C. Quence.

2: And our judges, Al Gebra and Geo Metry.

1: Please join us again tomorrow night here on...

Audience: Operation: Equation! [sound effect]

2: Tonight's show was brought to you by The Order of Operations!

[The following can be performed as a chant, signaling the end of the show. Add some choreographed moves, if you like!]

3: First, find the operations in parentheses or brackets.

All: Parentheses or brackets, parentheses or brackets.

4: Then search for exponents and—

All: Give power to that root! Give power to that root!

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1: Now look at your equation and start on the left.

All: Divide or multiply from left to right.

2: One last step!

All: One last step!

3: Go back to your equation and start on the left.

All: Add or subtract from left to right.
Complete this execution and there's your solution!

Honorable Mention

The happiness scale and the history of imaginary numbers

Writing by Eleni Koutrouli from Greece

Time: summer, the school year has finished

Characters:

1. John (a 13th years old pupil who has just finished the first grade of highschool)
2. Uncle George(a mathematician who has visited George)
3. Cheating assistant
4. Mathematician
5. Tartaglia
6. Gardano

Description of the scene:

The scene is divided in two parts. In the first part of the scene (e.g. the left part) John and his uncle George are sitting at a table in a house. Uncle George is drinking a freddo coffee and John is holding a comic. A blackboard surface is right next to them, containing a shopping list from the super market. They are discussing.

In the second part of the scene (e.g. the right part) there is a big table with many chairs around it. The furniture is of an antique styl, so as to resemble the 16th century).

Dialogues:

Uncle George:

How did you find maths in the first grade of high school? I think you entered new fields in the world of numbers. I keep hearing from pupils like you that they either love them or hate them.

John: Well, these numbers have completely confused me. What is the need for all these categories? In the elementary school we start by learning the natural numbers and how to operate on them. Then the decimal numbers come by and we learn again how to operate on them and not to be confused with the decimal sign. By the end of the elementary school we believe that all numbers are greater than or equal to zero, in order to be meaningful. And by the time we say these are the numbers and let's learn now how to solve difficult problems, the negative numbers appear and almost drive us crazy. Can you tell me what is the meaning of a number which is lower than 0? Can we have negative number of pencils or a negative amount of money? I tend to believe that they are a caprice of mathematicians for tormenting us with strange operations!

Uncle George:

I can show to you that negative numbers have indeed their meaning and that adding and subtracting with negative numbers makes sense. We can never hold

a negative number of things but we can understand them with several examples. Such an example, which I was taught once and I really like is the happiness scale. [Uncle George makes a line on the blackboard, after erasing the sopping list, as a scale from -10 to +10].

John: and what is this happiness scale?

Uncle George:

In this scale we can rate how happy we are; when we are unhappy we are at -10 and when we are very happy we are at +10. Let us now think that someone gives us something positive which makes us more happy or gives us something negative which reduces our happiness.

John: OK…

Uncle George:

Let's think that you start with a medium happiness which is at rate 2. (pointing to number line) Someone gives you 4 chocolates, and each chocolate gives you a single point in the happiness scale. You are moving then from +2 to rate +6. Then someone gives you punishment corresponds to a negative point and reduces your happiness by 1. So your rate becomes 5. What will then happen if they take 7 chocolates from you? How will you feel? Less happy?

John: Yes, I will go down 7 and will be at rate -2.

Uncle George:

What will happen if they take 3 punishments from you?

John: Well, I will be happier by 3 and will go to +1. Well, you are right. In the happiness scale we can go to negative rates of happiness. We can also add or subtract negative numbers if make the correspondence of something negative to a negative number. I think I have understood the negative numbers quite well. Have we now finished with numbers and can we start looking at the problems?

Uncle George:

Well, slow down! I cannot imagine what you will say when you hear about imaginary numbers and also the complex numbers.

John: Imaginary and complex numbers? Are you kidding?

Uncle George:

Well these numbers have been discovered in order to solve very difficult and for many years unsolved problems.

John: And who has discovered the imaginary numbers, the aliens?

Uncle George:

They have been discovered not by aliens but by the mathematicians of 18th century. The history of their discovery has to do with human passions, intrigues, fencing and the customs of that era!

John: So, in order to understand them are you going to give me an example with swords and intrigues?

Uncle George:

Well, I would rather tell you the story of the events that led to their discovery. I think you will better understand them through this story!

John: Hm, a story of the 16th century about intrigues and about numbers… I' d definitely like to hear it, but I am not sure which part I will like more!

Uncle George:

Well, we will see. In Europe of the 16th century, one of the greatest problems which the mathematicians were trying to solve was to formally find the solution of the cubic equation.

[Uncle George writes in the blackboard after erasing the previously drawn scale:

$ax^3 + bx^2 + cx + d = 0$.]

One of the first people who claimed to have found the solution was a Polish mathematician who did not publish it. Only when he got very ill, he commended the solution to its assistant who then started to present himself in the mathematic society as the great mathematician who found the solution of the cubic equation.

[In the right part of the scene some mathematicians are entering the scene and are sitting around the antique table. They have a mathematicians meeting. One of them is the Cheating assistant]

Cheating assistant:

Yes, it's me who solved the cubic equation!

Uncle George:

At that time, mathematicians meetings were secret and the reason was not only the value of the knowledge but also the value of the prize was given for the solution of very difficult problems.

Other mathematician:

This is a historic invention! Whoever doubts this solution has to confront this man in a scientific duel!

[Tartaglia is entering the meeting room and is sitting opposite to the cheating assistant.]

Uncle George:

After a secret mathematic duel between the cheating assistant and the Italian Tartaglia, Tartaglia wined his opponent by showing mistakes in his method and by finding a shortest way to the solution of the cubic equation.

Tartaglia:

Your method has mistakes and cannot be considered as a solution of the cubic equation. I have found a much more efficient method!

[Other mathematicians are leaving the scene. Only Tartaglia is staying.]

Uncle George:

Tartaglia did not himself publish his method. And then devious Italian Gerolamo Gardano managed to become a friend of Tartaglia and to learn the method of solving the cubic equation from him.

[Gardano is entering the scene and is walking with Tartaglia, smiling at him and talking to him].

Gardano:

You can trust me with the solutions you have found. They will be safe with be and they will remain secret. Please reveal them to me. I just want just to understand them!

[Tartaglia is giving Gardano his papers. They are both leaving the scene.]

Uncle George:

In 1545 Gardano wrote a famous book, Ars Magna, where he presented Tartaglia's method as his own. However, this method had problems too and did not give all solutions of the cubic equation. There were real solutions which when used in Tartaglia's formula resulted in the root of a negative number. Gardano referred to these solutions as fictitious numbers. Mathematicians confronted a dilemma, either to reject the whole method or to accept that the root of negative numbers exist. Despite the first disapproval, the new numbers included in Gardano's method could not be neglected and soon became known everywhere.

These new numbers which were the square root of negative numbers became know as imaginary numbers and their combination with real numbers gave the complex numbers. A complex number can be expressed as $\alpha+\beta i$ [Uncle George is writing on the blackboard: $\alpha+\beta i$] , where i is the square root of -1.

[Uncle George is writing on the blackboard:].

The next big step was done by Rafael Bombelli who first set down the rules for multiplication of complex numbers in 1572.

Imaginary and complex numbers are today widely used in Computer Science and Electricity, like the quantum mechanics and help scientists to explore the world and make great inventions.

John: Even though, I do not understand them completely, I can see that numbers have a great history.

Uncle George:

Isn't it also fantastic how numbers help us understand the simple and the complex things of our life?

John: Yes, I see, we can use numbers to better understand ourselves, our lives and our world. I cannot imagine how more wise we could be if we were more cooperative with each other and were not fighting the success of the others like they did in the 16th century!

Uncle George:

And can you imagine how many more numbers we could have discovered?

John: Oh, no more numbers…

On the set of the movie "How to become a Pythagorean"

Writing by Eleftheria Kelekidou from Greece

Director's notes:

Interior: a studio. All involved in the filming are on set. The director's chair is on the upper right corner. In front of him stand the actors and the technical crew. The following people are present: director, Pythagorean 1, Pythagorean candidate, technicians 1&2, clapperboard man. The director is dressed in an artsy-fartsy style, the crew and the clapperboard man are dressed casually while the Pythagoreans are dressed in Ancient Greek costumes.

Director: Ok guys. We'll be starting in 5'. Take heed: We are set in Crotone, the southernmost point of Italy. We are now shooting Scene 1, which illustrates the initiation procedure for a Pythagorean. Ok. All set? Lights? Sound? That's nice. Camera, go! (He speaks in French accent and is uttering these last few words in a loud decisive way.)

Technician 1: Ready!

Technician 2: Ready!

Director: Clapperboard! Action!

Clapperboard Man:

Act 1! Scene 1! Take 1!

Pythagorean Candidate:

Rejoice! (addressing Pythagorean 1 in a flat, breathless voice). I am here to join your famous club. I request you to accept me.

Pythagorean 1: Who are you who longs to be taught by our wise master? (in an austere manner).

Pythagorean Candidate:

I am all ready to face…

Director: Cut! You've got to be kidding! For God's sake Ilias! You request to be accepted in a club in which number 1 was first invented, as well as the term "philosophy", the word "world", the irrational numbers, the theory that the Earth is not the centre of the Universe, the Mechanics in practice and the Pythagorean theorem!!! And you've been speaking in a flat, breathless voice as if you are dying! Let's take another go in a bit more upbeat manner please! Clapperboard! Action! (pompously and in a slightly ironic tone)

Clapperboard Man:

Act 1, Scene 1, Take 2.

Pythagorean Candidate:

Rejoice! I am here to jo…

Director: Cut! Come on now! How can't you realize the gravity of this situation? Haven't you been taught Maths back in school?

Pythagorean Candidate:

Ha, big deal! I wonder if anybody studied Maths at school. No single person ever offered to help me after all. (Starts in an ironic tone which then shifts to resentment).

Director: Either way, listen up what I want from you: I don't need you to act as a Pythagorean, I want you to become one. Be proud and ambitious. If necessary, take off your wig and wear your hair down (first pompously, then half joking).

Pythagorean Candidate:

Ha! That was a funny one!

Director: Funny or not, we have another scene to finish off today. Get down to it!

Clapperboard Man:

Act 1. Scene 1. Take 3.

Pythagorean Candidate:

Rejoice! I am here to join your famous club. I request you to accept me.

Pythagorean 1: Who are you who longs to be taught by our wise master? What is your true calling and skills?

Pythagorean Candidate:

I am all ready to face all the challenges with patience and perseverance.

Pythagorean 1: You should probably be aware that you will undergo a 5-year trial in order to get familiar with the ways our club functions as well as its fundamental principle, that is, strict confidentiality.

Pythagorean Candidate:

No obstacle shall change my mind whatsoever.

Pythagorean 1: (Exiting for a while only to appear shortly after). Tell me your name and the place you come from.

Pythagorean Candidate:

I'm Philolaus from Athens.

Pythagorean 1: So, listen up Philolaus from Athens. You will hereafter be accepted in our club as a listener, having the right only to listen to our master but not see his face. Moreover, until the day of your initiation you will be able to understand only a portion of what you'll be hearing. When this trial ends, you will either be eligible to become a full member of our club, having the privilege to see and take in our master's words, or you will be dismissed from the club altogether. Do you accept these terms?

Pythagorean Candidate:

I do!

Clapperboard Man:

Cut!

Director: Brilliant! You are both tailor-made for your roles! Let's take a break before coming back for the fifth scene.

(Lights go out & the narrator's voice is heard)

Narrator: The initiation process' sole purpose had been to single out a Pythagorean's ability to conceal all that he hears. The secrets of the club were withheld from the rest of the world, so during the early years a Pythagorean's ability to speak was considered significantly less important than his ability to remain silent. Perhaps a few might even wonder why the next scene to be shot is the fifth. You shall be informed, thus, that the scenes of a movie are not shot in a sequence. The sequencing guidelines vary but what is most important is the setting.

(Lights go on again and all people involved (director, Pythagoreans 1 & 2, technicians 1&2, Pythagorean candidate, clapperboard man, Pythagoras) go back to their seats)

Director: Ok guys. We've got to start now. I hope you have learnt everything off by heart by now because it would be nice if we filmed the fifth scene today. So, we are in the room where the trial takes place, which is divided into two separate spaces. Pythagoras along with the other two Pythagoreans are in the first one, while Philolaus is in the second one. There is a conversation going on among them while Philolaus remains silent. Is everything ok? Lights? Sound? Perfect! Camera!

Technician 1: Ready!

Technician 2: Ready!

Director: Clapperboard! Action!

Clapperboard Man:

Act 2. Scene 5. Take 1.

Pythagorean 1: Pythagoras, you shall teach us your last theorem today.

Pythagoras: If the square of the length of the longest side of the triangle is equal to the sum of the squares of the other two sides, then the triangle is a right triangle.

Pythagorean 2: That is truly great Pyth…

Pythagorean Candidate:

Cut!

Director: Who is screaming "cut" so loud and why is that?

Pythagorean Candidate:

This is unacceptable! The lighting is so dazzling that my eyes hurt so badly that I can hardly keep them open. Not to mention the make-up.

Director: Come on now! Why don't you try moving a bit on the left? Let's get that finished! Clapperboard! Action!

Clapperboard Man:

Act 2. Scene 5. Take 2.

Pythagorean 1: Pythagoras, you shall tea… achoo! (sneezing)

Director: Cut! I guess it's not meant to be! Let's resume, shall we? Camera! Clapperboard! Action!

Clapperboard Man:

Act 2. Scene 5. Take 3.

Pythagorean 1: Pythagoras, you shall teach us your last theorem today.

Pythagoras: If the sum of the squares…

Director: Cut! What are you talking about? You must be joking!

Pythagoras: My brain is fried from the endless jumping back and forth. (irritated).

Director: You have got a point there. Let's call it a day. You are all dismissed for today. (flatly and lacking spirit)

(Everybody exits except for the director himself)

Director: I have made up my mind! I am abandoning this life to go to my village and start cultivating my grandfather's land. Plants don't talk and they certainly don't shout. And last but not least: they keep their complaining all to themselves!

Who is the better?

Writing by Vivien Mascay from Hungary

NARRATOR Once upon a time two good friends entered to a café on a warm day in August. They have known each other for a long time. They often meet, as they have points of intersection at x= π/4 , x=5 π /4 , x= 9 π /4 and we can continue the line until the infinity. Really. Both of them are famous, and they are used throughout science for example to describe harmonic motion or rotary motion. They are important in geometry and engineering too.

WAITER What can I get for you Sirs?

SINE I ask for a cup of black coffee without sugar, please.

WAITER And for you Sir?

COSINE I would rather ask for a cup of tea. Do you have green tea?

WAITER Of course, Sir.

COSINE So I ask for black tea.

(Waiter goes back to the bar.)

SINE Just imagine my friend! More and more people recognize me on the street. I have already felt several times that they know, who I am, but nowadays I have this feeling more. On the top of that they draw me. They draw me not only their exercise book but their computer. And you can read a lot of information about me on the Internet.

COSINE I understand what you mean. I have the same experience.

SINE Well, but you have to admit that I am more famous than you.

(Waiter comes back to their table.)

Dear Sir, do you know, who I am, don't you ?

WAITER Of course, you are the sine function, Sir.

COSINE And do you know who I am too?

WAITER You are the cosine function Sir.

(Waiter goes back to the bar.)

SINE It means nothing. Even our names show who is the better. I am the sine function and you are only the coSINE function. I have a value at (0,0), you don't have. At x = π/2 my y-value is one. And your? Your y-value is zero there.

COSINE Your justification is ridiculous. It is true that where my x-value is π/2, my y-value is zero. But you also said, that where your x-value was zero, your y-value was zero. My y-value is one there! And both of us know that you aren't symmetric about the y-axis.

SINE (He stands up angrily.)

But I am symmetric about the origin. ABSOLUTE VALUE FUNCTION Excuse me Sirs, but we have heard with my girlfriend what about you are arguing.

You know, rivalism is not a nice characteristic. Both of us are important function with my girlfriend but we have never rivalized.

COSINE (He stands up petulantly.) Who are you?

ABSOLUTE VALUE FUNCTION

She is the Squaring Function and I am the Absolute Value Function.

SQUARING FUNCTION

As certainly both of you know , Absolute Value Function and me are symmetric about y-axis. On the top of that our ranges are from 0 to infinity and yours are only from -1 to 1. You are bounded above and bounded below. We are the better functions.

SINE Dear Lady, you forget that you have a big defect. Neither of you have negative y-value.

(Two ladies stand up from their table and they connect in conversation.)

1/X FUNCTION

Well, you can't bring these arguments up against me. I am the 1/x Function. I have negative y-values, my domain and range are from negative infinity to infinity. On the top of that I am symmetric about origin.

COSINE But Squaring Function, Sine Function, Absolute Value Function and me are continous functions. You are a discontinous function, Lady. You have a discontinuity where x=0.

1/X FUNCTION

How dare you bring it up against me? A gentleman has never said such a thing. (She leaves café angrily .)

SQUARE ROOT FUNCTION

You know, it is true, that 1/x Function is not continuos function. But she is a monotonically decreasing function. Which of you are monotonically decreasing? Neither of you are. (She leaves café.)

SINE She didn't introduced herself.

SQUARING FUNCTION

We have met her before. You know Sir, 1/x Function, Absolute Value Function and me have a point of intersection at x=1, y=1. So does she.

COSINE Who is she?

SQUARING FUNCTION

Her name is Square Root Function. She does not have negative y-values, her domain is from 0 to infinity. But she is very proud of herself because she is a monotonically increasing function.

SINE Really. I have just remembered that we met at x=0, y=0.

ABSOLUTE VALUE FUNCTION

You have neither recognized us, inspite of the fact that Squaring Function and me have a point there too.

SINE You are right, Sir. However, I know Cosine Function very well at least. Both of us are periodic function and we repeat over intervals of length 2π radians, and we have no end of points of intersection.

ABSOLUTE VALUE FUNCTION

Inspite of the fact you are arguing.

SINE Not any more. Can you forgive me?

COSINE I would like to apologize too. You are my best friend. Shall you watch basketball on TV with me tomorrow? We may invite Tangent and Cotangent too.

SINE That's a good idea. (They shake hands with Absolute Value Function and kiss hand of Squaring Function, than leave the café.)

ABSOLUTE VALUE FUNCTION

It is time we left too. I will be the most important function in your life forever, won't I ? (He helps her put on her cardigan.)

SQUARING FUNCTION

Of course my honey. You look like letter V. V for victory.

(They leave the café.)

(Narrator goes to the bar.)

NARRATOR It was an interesting dispute. Have you ever seen such a thing? So many famous functions has been at the same place.

WAITER You know, I just work here as a relaxation. I have already met much more functions. I have met them too. But they didn't recognize me as a waiter.

NARRATOR Who are you?

WAITER I am the Cartesian Coordinate System…

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