eTwinning

Co-funded by the Erasmus+ Programme of the European Union

TOTALLY MATHS Erasmus 2022

Totally Maths

We proudly present the Maths work in our Erasmus+ Project

Students taught Maths to peer students and then worked on the process of the creation of the lessons

IES Profesor Pablo del Saz

BERKENBOOM HUMANIORA

EUREKA Secondary School

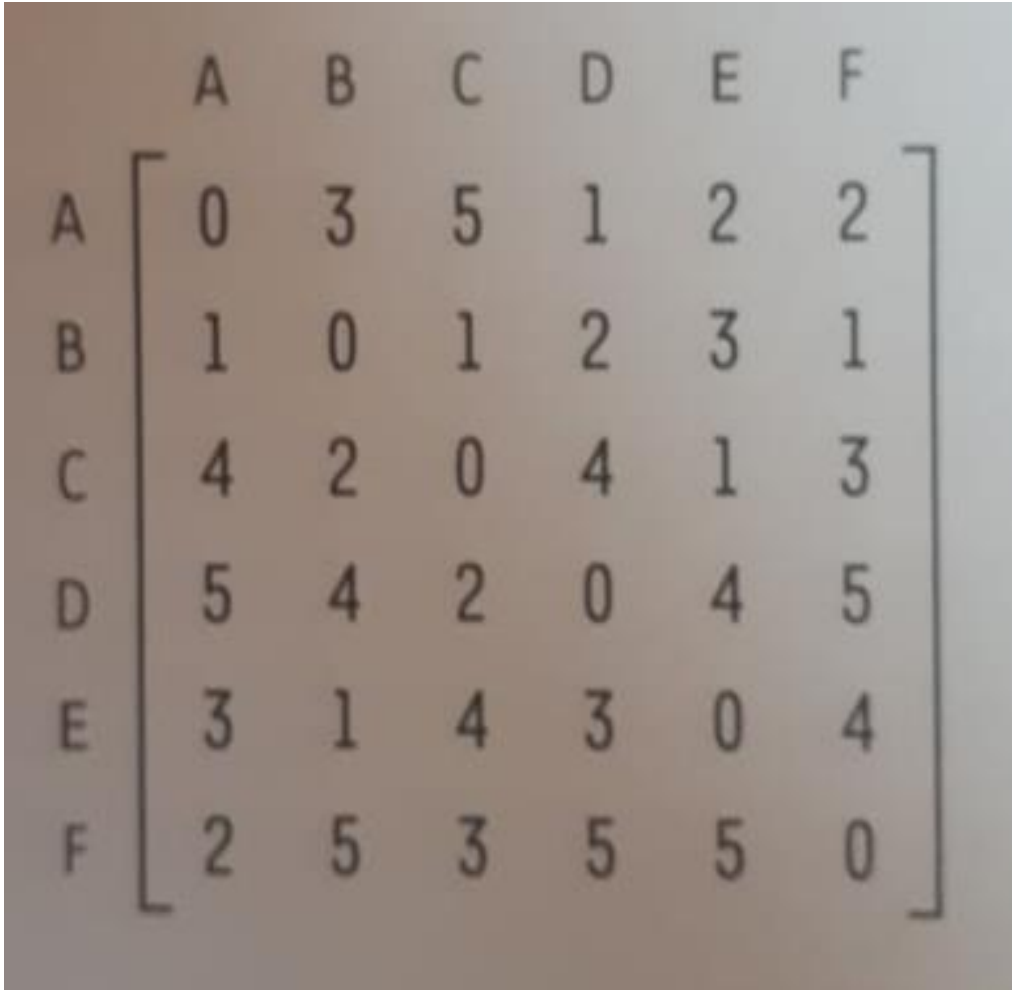
G. FRACASTORO VERONA

Math Class

Dries, Tibo, Gust and Kyara

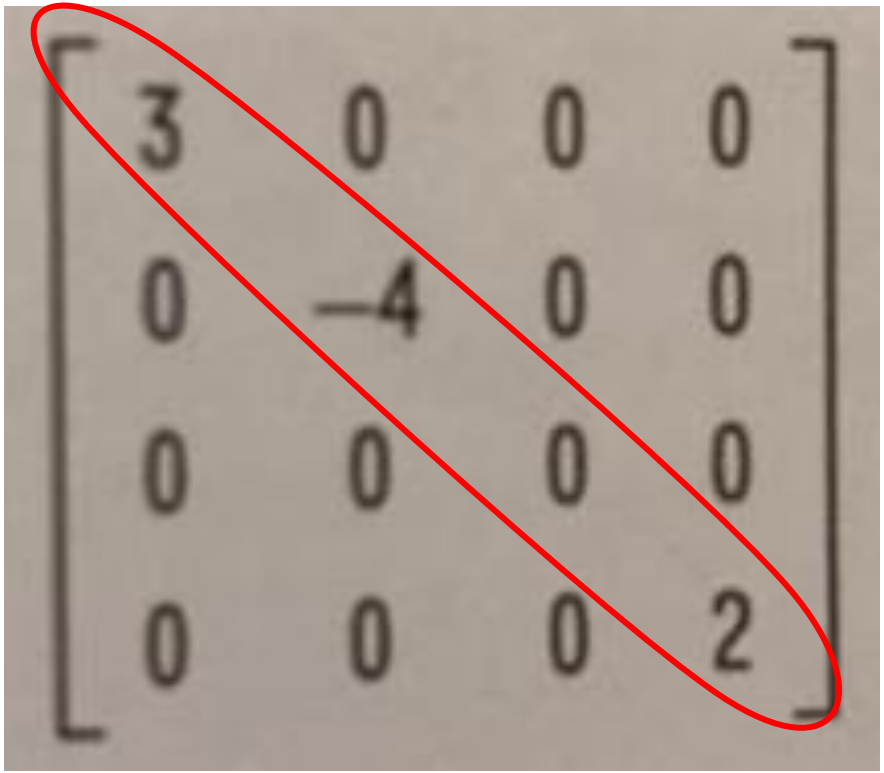
Logo contest!

First exercise + dimensions and elements

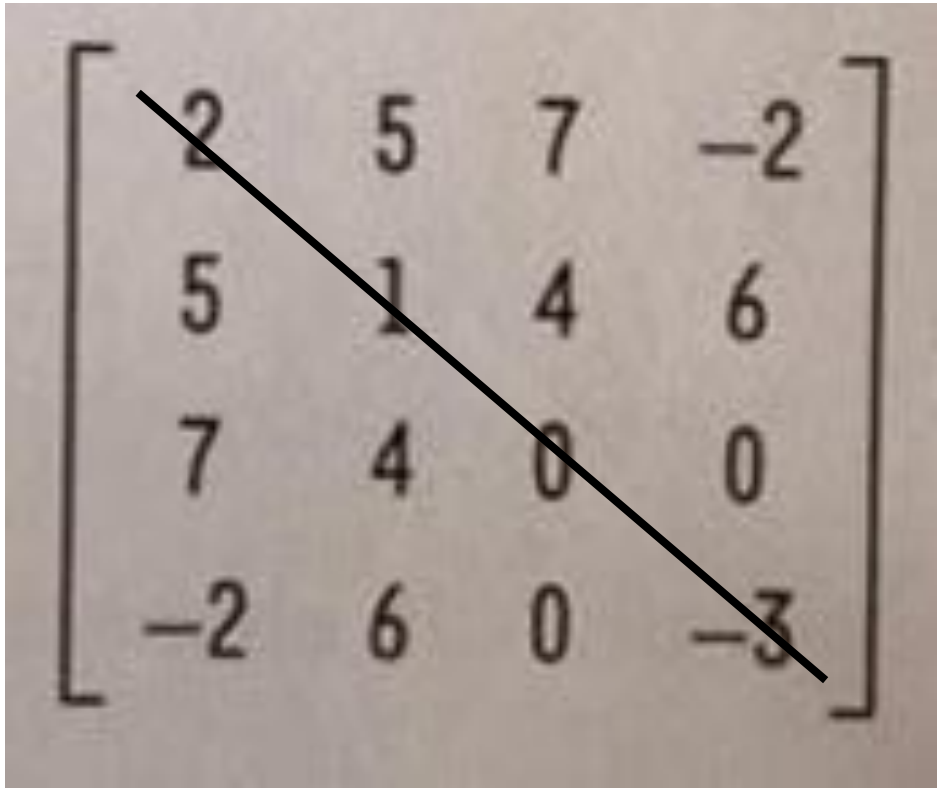


	A	B	C	D	E	F
A	0	3	5	1	2	2
B	1	0	1	2	3	1
C	4	2	0	4	1	3
D	5	4	2	0	4	5
E	3	1	4	3	0	4
F	2	5	3	5	5	0

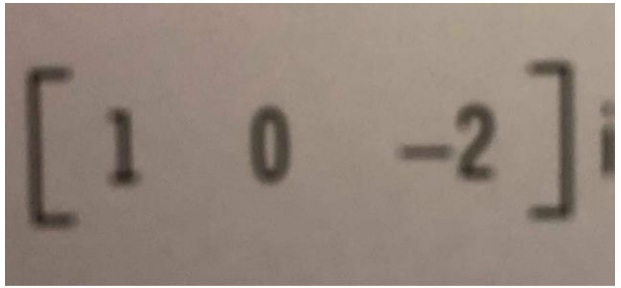
Diagonal Matrix



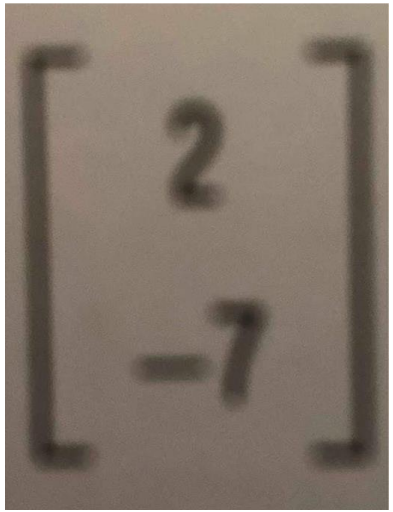
Symmetrical Matrix



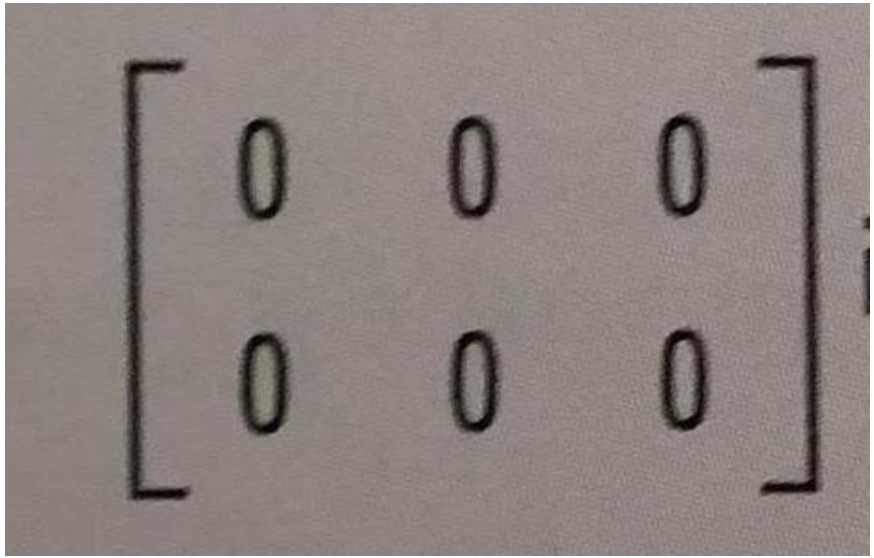
Row matrix



Column Matrix

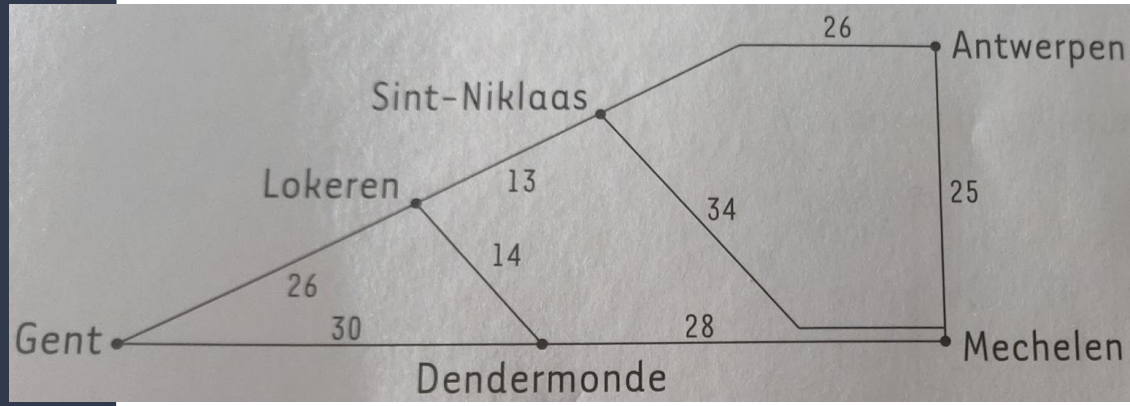


Zero matrix



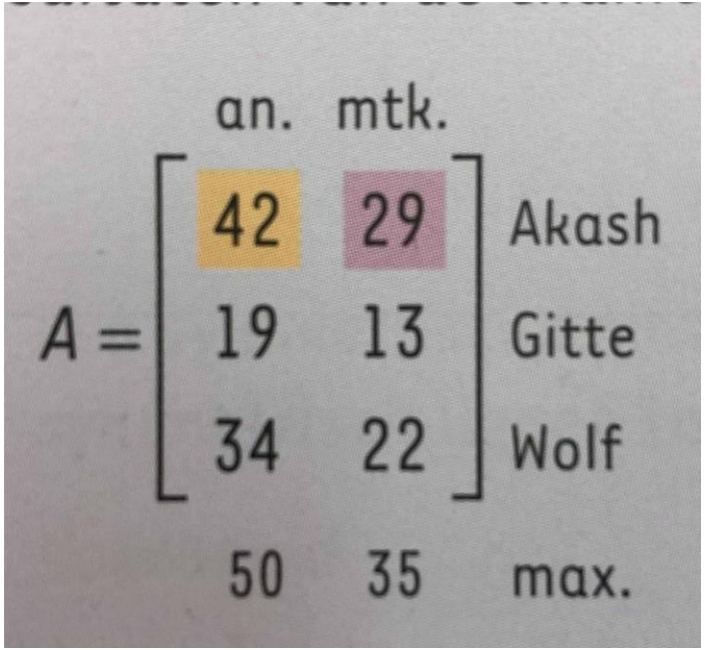
Exercise:

1) What's the dimension ?
2) Give the element b23,b44,b61
3) Which element has the longest route?
4) What is special about the form of the matrice ?

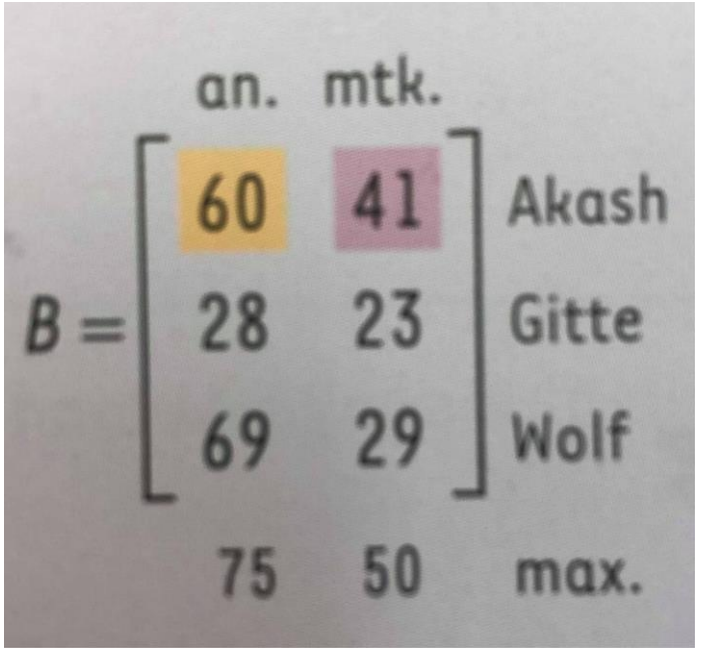


$$B = \begin{array}{c} \begin{matrix} A & D & G & L & M & S \end{matrix} \\ \begin{bmatrix} 0 & 53 & 65 & 39 & 25 & 26 \\ 53 & 0 & 30 & 14 & 28 & 27 \\ 65 & 30 & 0 & 26 & 58 & 39 \\ 39 & 14 & 26 & 0 & 42 & 13 \\ 25 & 28 & 58 & 42 & 0 & 34 \\ 26 & 27 & 39 & 13 & 34 & 0 \end{bmatrix} \end{array} \begin{matrix} A \\ D \\ G \\ L \\ M \\ S \end{matrix}$$

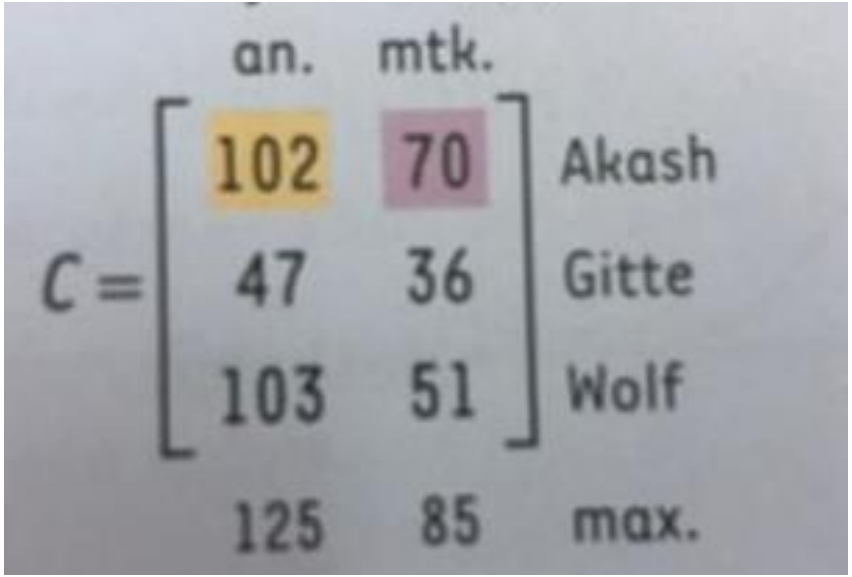
Adding up matrices



$A =$



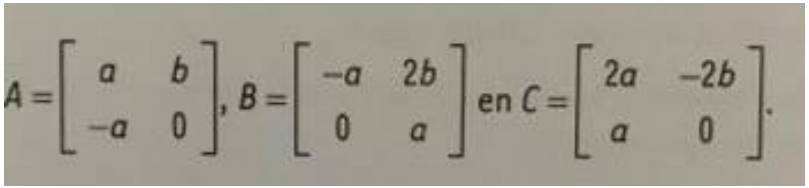
$B =$



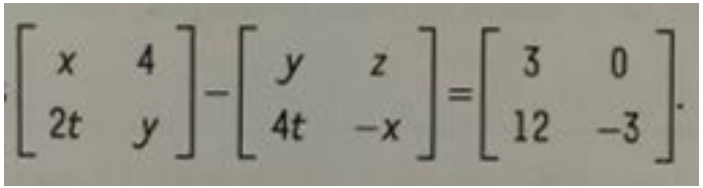
Solution

Exercises

A - B +C if



Determine X, Y, Z and T



Multiply with Matrices

The school is paying for the teachers who get to school by bike. They calculate the bicycle compensation a month. They get €0,15 for each kilometres.

To calculate the bicycle compensation, we need to multiply every number in the matrix A with 0,15.
For example:
240 x 0,15 = €36

march April

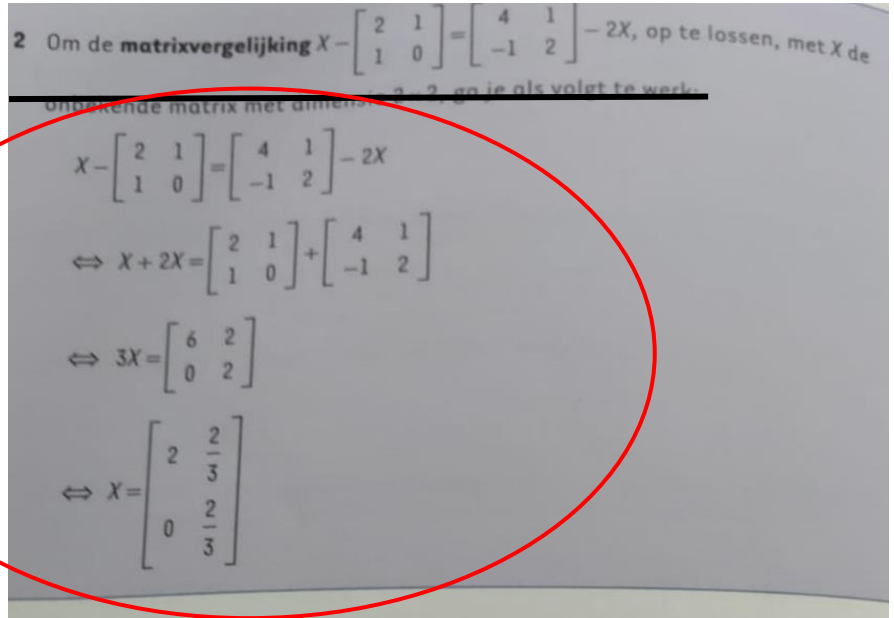
$$A = \begin{bmatrix} 240 & 144 \\ 105 & 65 \\ 288 & 160 \end{bmatrix} \begin{matrix} \text{lkr 1} \\ \text{lkr 2} \\ \text{lkr 3} \end{matrix}$$

maart april

$$B = 0{,}15A = \begin{bmatrix} 36{,}00 & 21{,}60 \\ 15{,}75 & 9{,}75 \\ 43{,}20 & 24{,}00 \end{bmatrix} \begin{matrix} \text{lkr 1} \\ \text{lkr 2} \\ \text{lkr 3} \end{matrix}$$

Theory: multiplying matrices

1) To solve the matrix equation with X the unknown matrix with dimension 2 X 2 we do this:



2 Om de **matrixvergelijking** $X-\begin{bmatrix}2&1\\1&0\end{bmatrix}=\begin{bmatrix}4&1\\-1&2\end{bmatrix}-2X$, op te lossen, met X de

$$X-\begin{bmatrix}2&1\\1&0\end{bmatrix}=\begin{bmatrix}4&1\\-1&2\end{bmatrix}-2X$$

$$\Leftrightarrow X+2X=\begin{bmatrix}2&1\\1&0\end{bmatrix}+\begin{bmatrix}4&1\\-1&2\end{bmatrix}$$

$$\Leftrightarrow 3X=\begin{bmatrix}6&2\\0&2\end{bmatrix}$$

$$\Leftrightarrow X=\begin{bmatrix}2&\frac{2}{3}\\0&\frac{2}{3}\end{bmatrix}$$

Exercice 4

Thank you for your
your attention!

What is an Equation?

In mathematics, the equality between two algebraic expressions is called equation, which will be called members of the equation. In the equations, they will appear related through mathematical operations, numbers and letters (unknowns).

Don't confuse it with a polynomial that they have no equality

- First degree equation.

$3x + 2 = x + 4$

$3x - x = 4 - 2$

$2x = 2$

$x = 1$

- A second degree equation.

$x^2 + 3x + 2 = 0$

PUT SOME ORDER

$6x^2 = -5x+1$

$6x^2 +5x=+1$

$6x^2+5x-1=0$

Now It´s your turn to order the equations

* $x^2 - 17x = -52$
* $3x^2 -25 = -10x$

Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

- **This is the formula you have to know, otherwise you won't be able to do any of them**
- **We'll call the first known number 'a', the second one 'b' and the third one 'c'**

For example: $x^2 + 5x + 6 = 0$

a b c

- **Here is a video that could help you:**

Complete Second Degree Equations

$$x^2 + 3x + 2 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a} =$$

$$= \frac{-3 \pm \sqrt{3^2 - 4 \cdot 1 \cdot 2}}{2 \cdot 1} =$$

$$= \frac{-3 \pm \sqrt{9 - 8}}{2} =$$

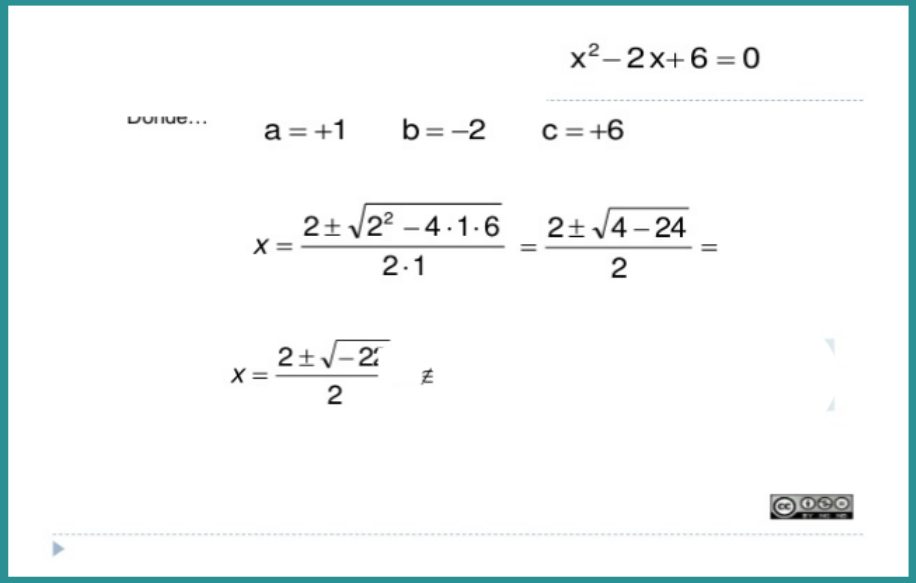
$$= \frac{-3 \pm \sqrt{1}}{2} =$$

$$= \frac{-3 \pm 1}{2} = \begin{cases} \frac{-3 + 1}{2} = -1 \\ \frac{-3 - 1}{2} = -2 \end{cases}$$

✔ It is complete because we have a, b and c . To solve it we have to use the formula, and as we know where each number goes, we place it and solve it.

✔ There are two solutions: we use the positive value in one of them, and the negative in the other one.

Equations without solution.



In this part, using the formula you´ll see that the equation it doesn´t have solution.

There is no solution if we have the sign ´´-´´ in the squared root.

double solution

- In some cases the solution is double.
- this happens when the last step is + - 0
- Let´s see it in the example

$$x = \frac{-4 \pm \sqrt{4^2 - 4.1.4}}{2.1}$$

$$x = \frac{-4 \pm \sqrt{16 - 16}}{2} = \frac{-4 \pm \sqrt{0}}{2} = \frac{-4 \pm 0}{2}$$

THE SPANISH TEAM PRESENTS:

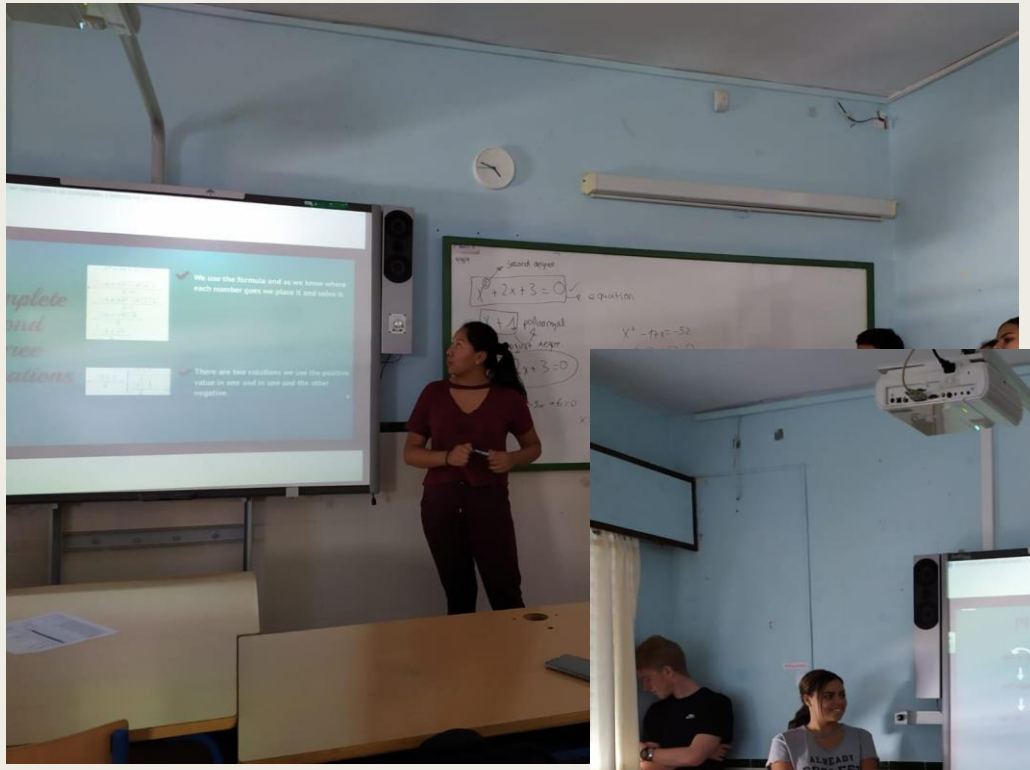
THE MAKING OF OUR MATH CLASS

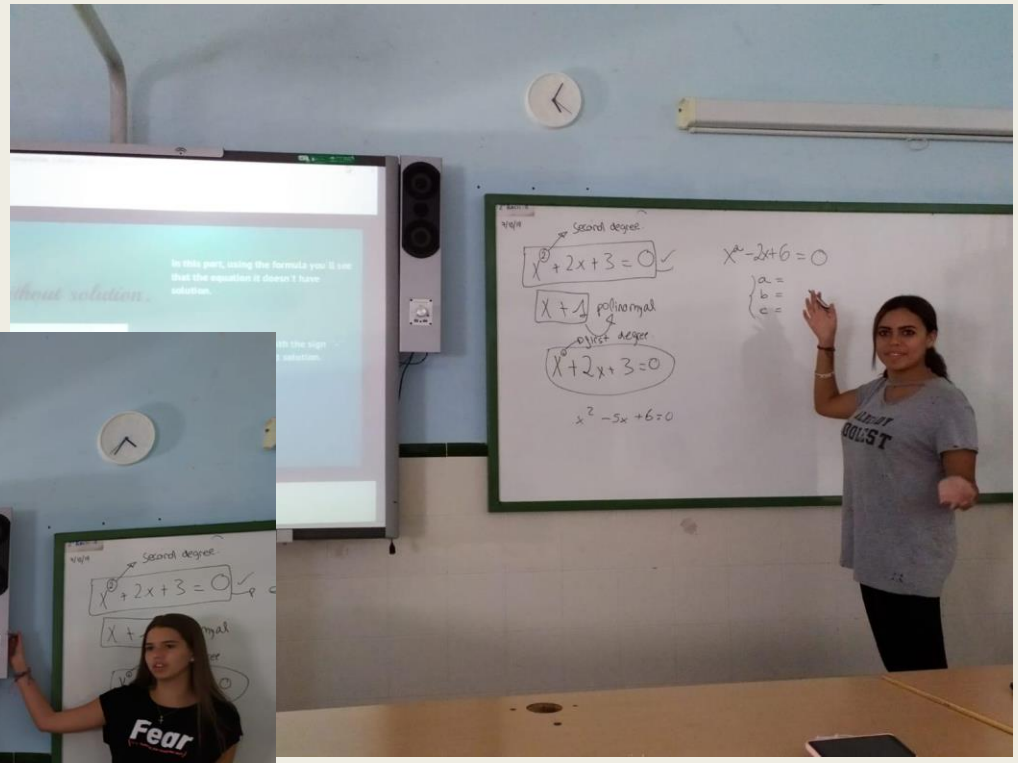
Choosing the subject:

Dividing the tasks:

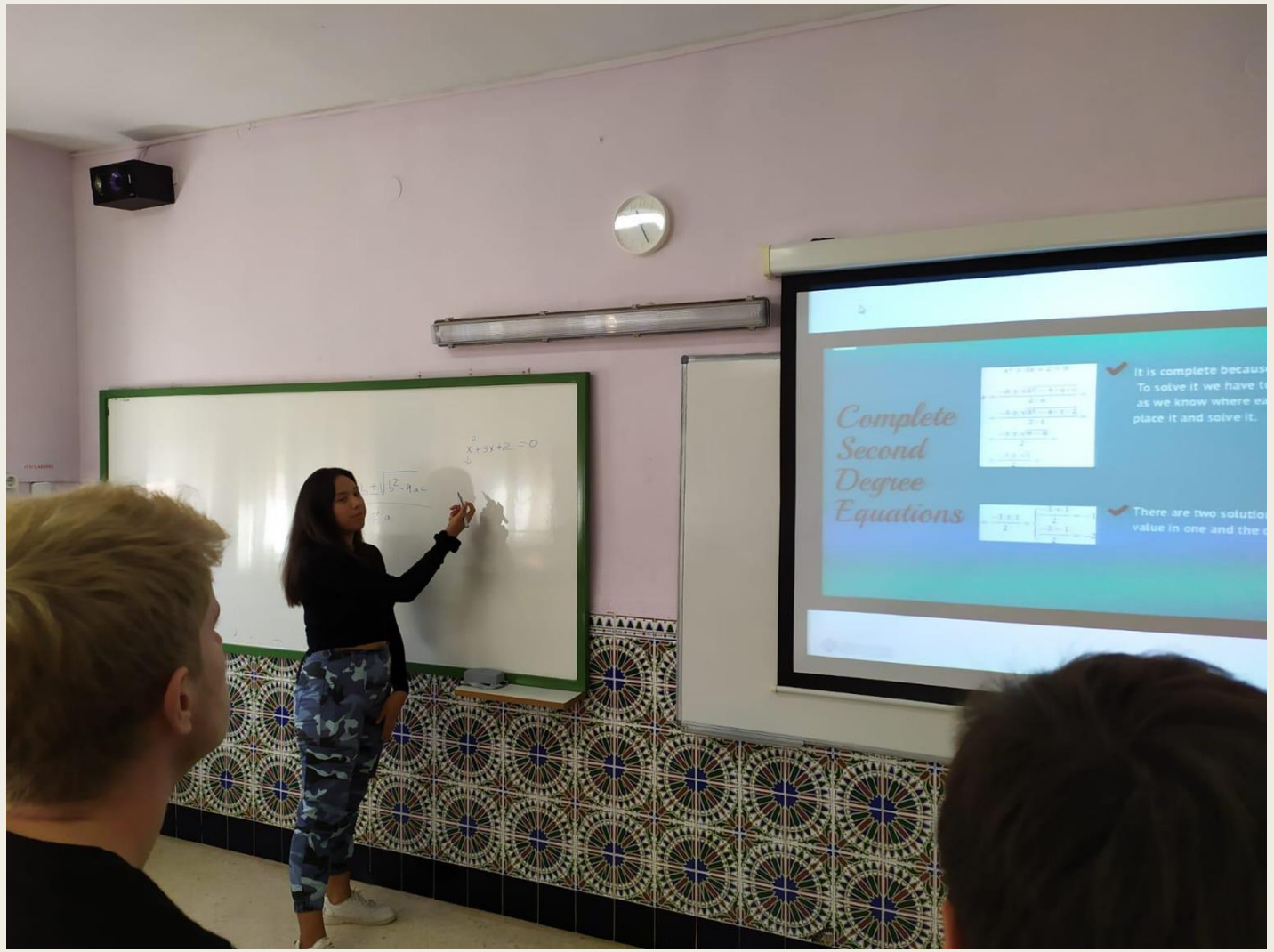
Working on the presentation:

Practising the class:



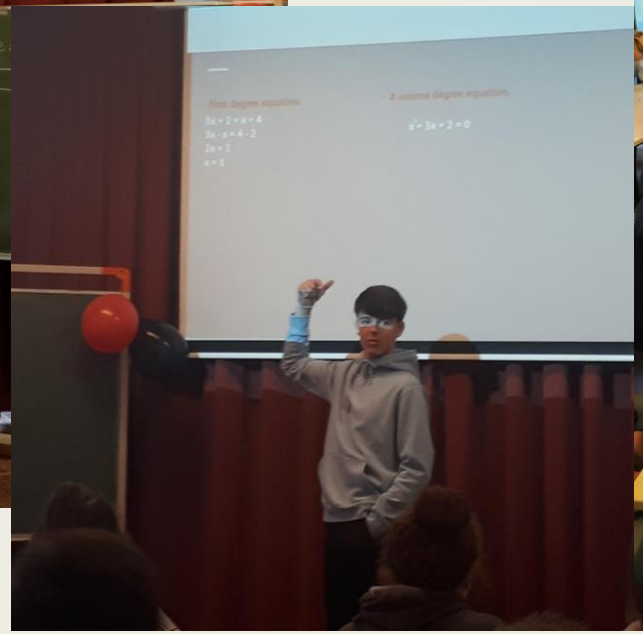


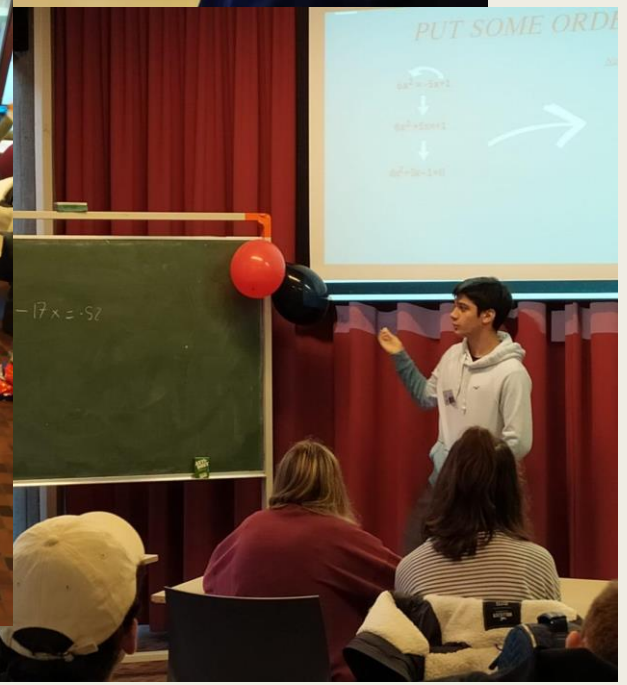
Practising with public:



Correcting mistakes:

Doing the exposition in Berkenboom to the Erasmus students:



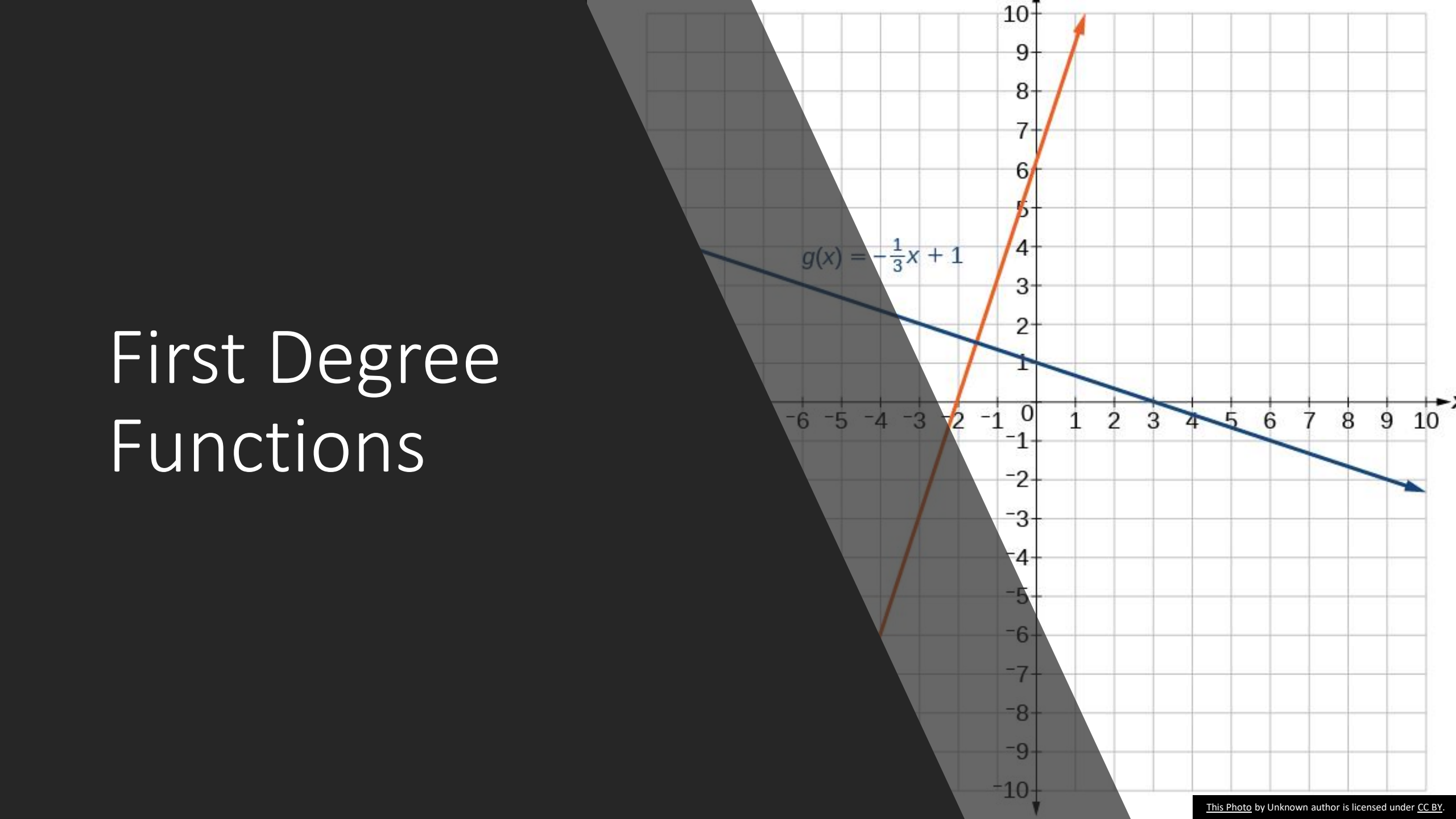


Doing the exposition in Berkenboom to the regular students:

To sum up, it was a hard work that involved all of us and we're happy with the results and we enjoyed the experience.

Graphing Functions

First Degree Functions



First Degree Functions/ Linear Functions

A first degree function, or linear function is a function of a line.

It can be written in the form $f(x)=ax+b$

When graphed it is a straight line

When graphed...

The value of b is the point where the function crosses the *y*-axis (also known as the *y*-intercept)

The value of *a* is the rate of change of the function (the slope of the line)

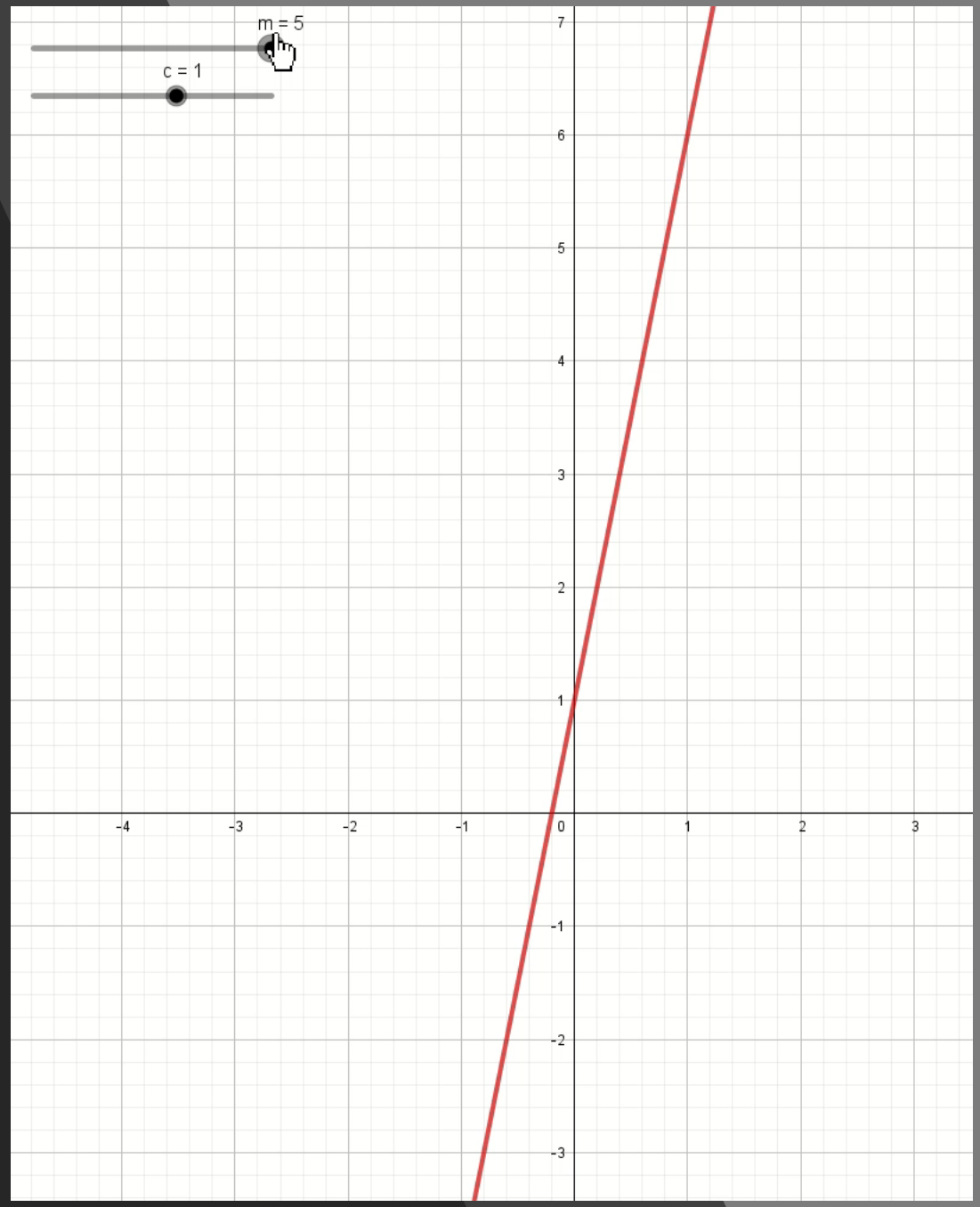
A linear function, in the form $f(x)=ax+b$ is the same as the equation of a line $y=mx+c$

$y=mx+c$

m = rate of change (slope of the line)

c = initial value (*y*-intercept)

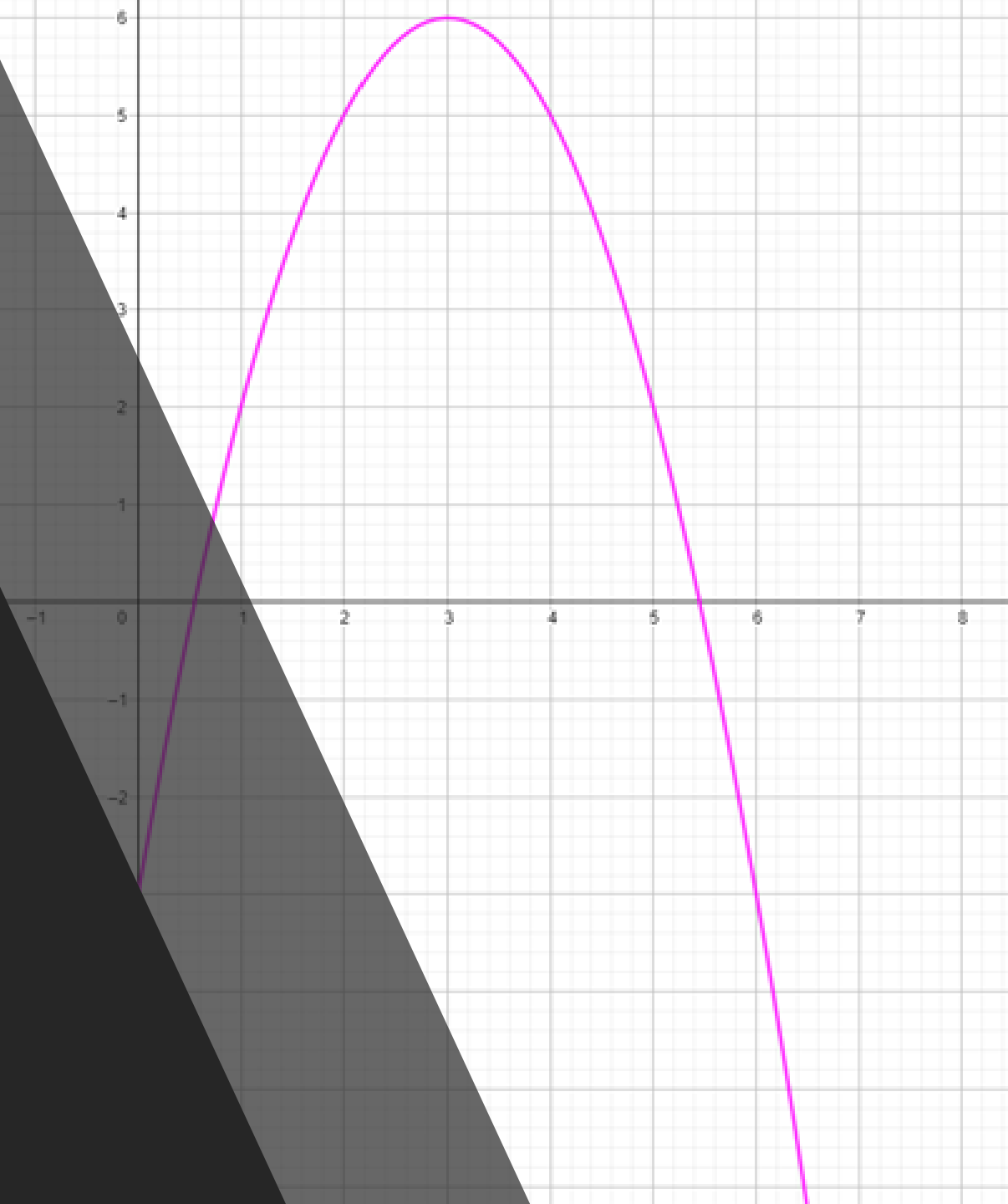
Linear Functions on Geogebra



Game Time

Second Degree Functions

Quadratic functions



What is a quadratic function?

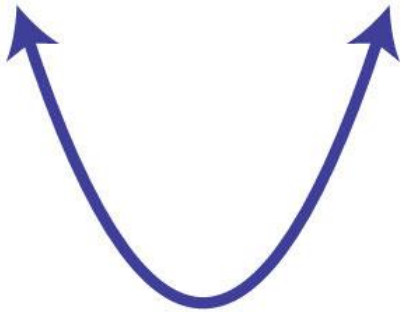
A quadratic function, or second degree function is a function that can be described by an equation of the form $f(x)=ax^2+bx+c$ where $a \neq 0$.

In a quadratic function, the greatest power of the variable is 2. The graph of a quadratic function is a parabola.

Parabola

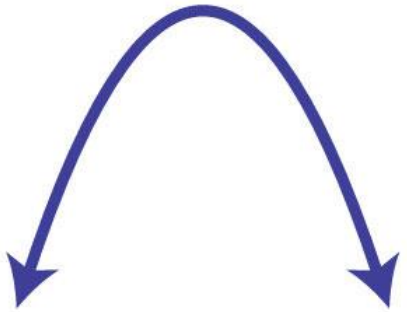
Parabola $y = ax^2 + bx + c$

$a > 0$



opens upward

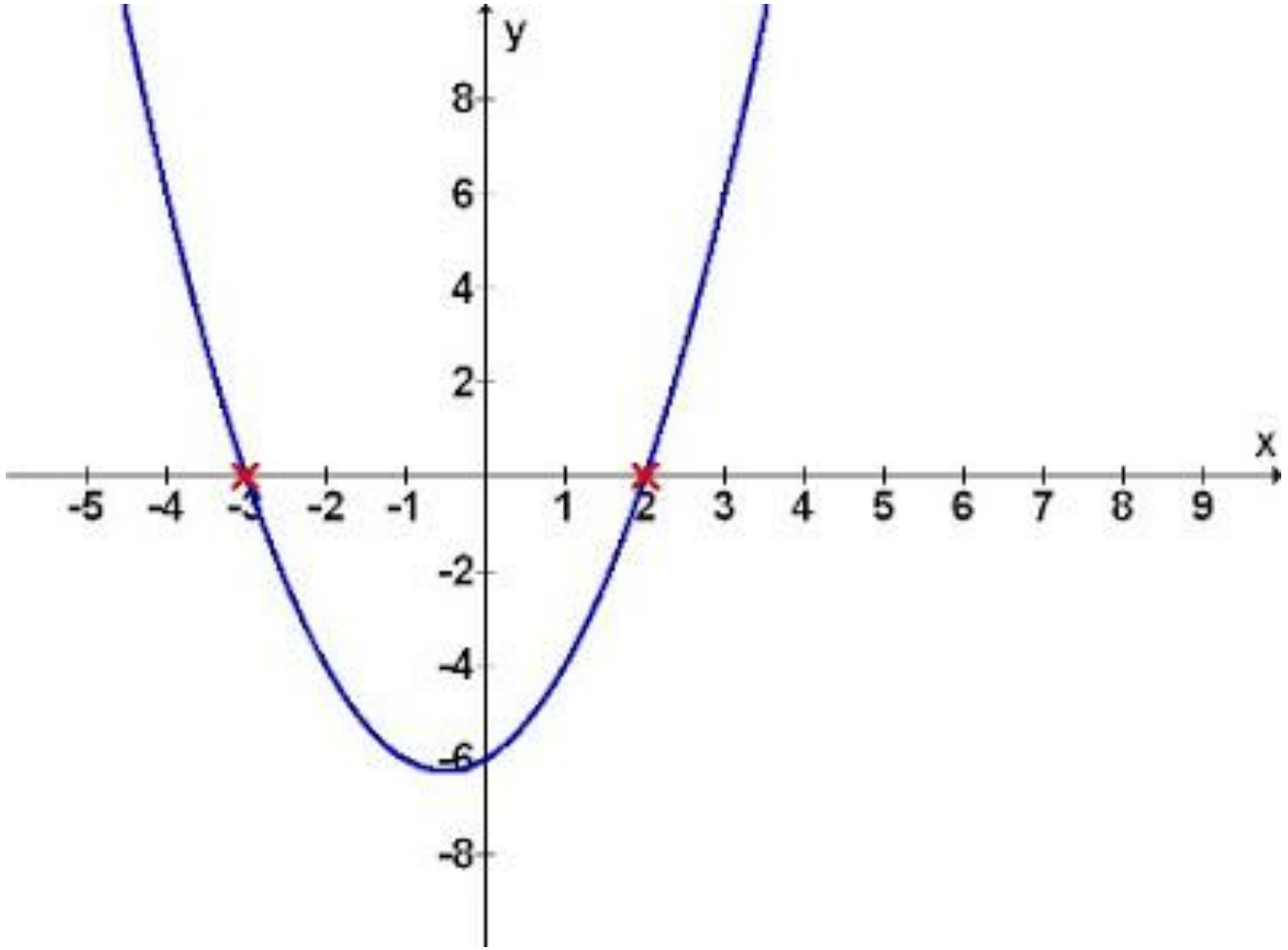
$a < 0$



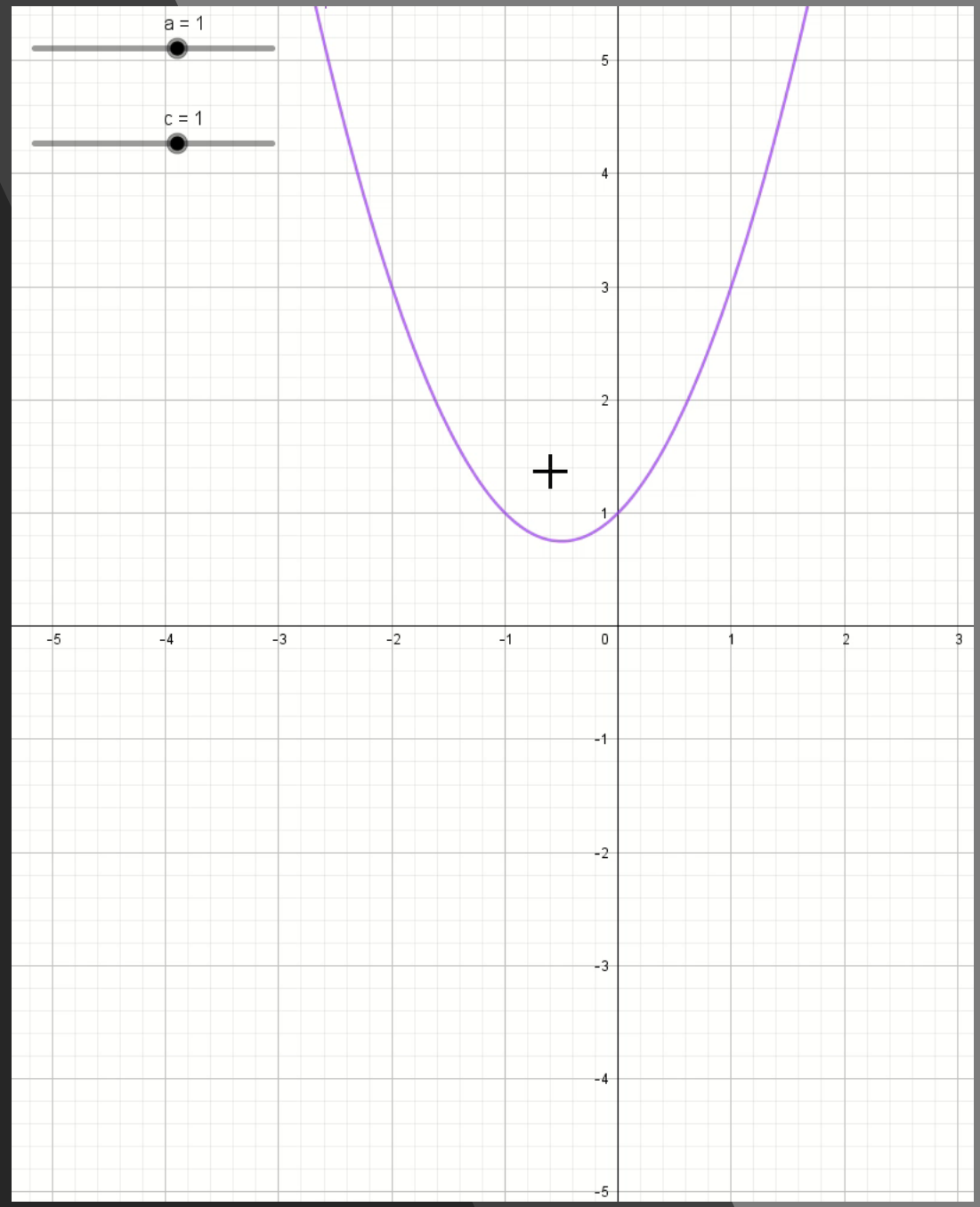
opens downward

What are the roots of a quadratic function?

- The roots of the function is where graph cuts the x-axis.



Quadratic Functions on GeoGebra



Game Time

Recap on graphing functions

Kahoot!!

We're going to play a game of Kahoot

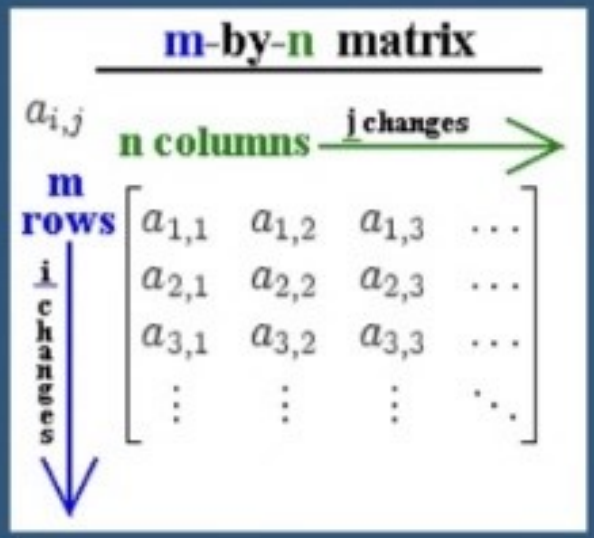
Kahoot


Matrix
Method
About
Offices
Team
HUNGARIAN
ALGORITHM


Introduction
In mathematics the Hungarian algorithm is a combinatorial optimization method that solves the assignment problem in polynomial time.

Matrix

To use this algorithm we must use matrices.
What is a matrix?
It's a rectangular array of numbers, symbols, or expressions, arranged in rows and columns.



Example

You are the director of a company the sellers are located respectively in the following cities:
-Austim
-Boston
-Chicago
You want your sellers to fly to three other cities:
-Denver
-Edmonton
-Fargo

From / to	Denver	Edmonton	Forgo
Austin	250	400	350
Boston	400	600	350
Chicago	200	400	250

Example

-Where you need to send your agents so that the total cost of tickets is minimal?
We introduce a matrix called the cost matrix

$$\begin{pmatrix} 250 & 400 & 350 \\ 400 & 600 & 350 \\ 200 & 400 & 250 \end{pmatrix}$$

-A possible choice could be 250+600+250= 1100
Or maybe 250+400+350= 1000, which is even better

Example

-After trying them all, you will find that the combination with the least cost is
400+350+200=950

Now let's try it with the Hungarian algorithm!

Example

-After trying them all, you will find that the combination with the least cost is 400+350+200=950

Now let's try it with the Hungarian algorithm!

Theorem

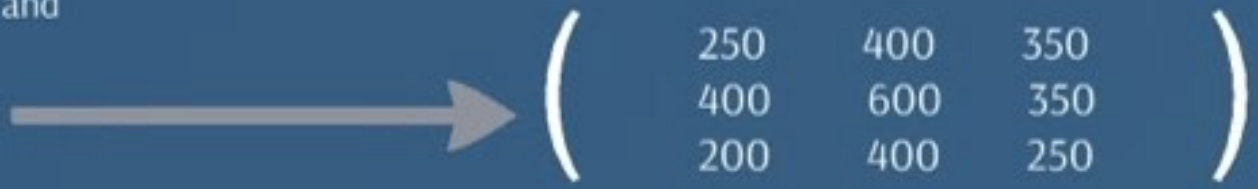
- If a number is added to or subtracted from all the entries of each row on column of a cost matrix, then on optimal assignment for the result in cost matrix as also an optimal assignment for the oriental cost matrix

Step 1

-From each row, we find the row minimum and subtract it from all entries in that row

-Each row has at least one zero

-All entries are positive or zero



Step 2

-From each column, we find the minimum and subtract if from all entries on that column

-Each row and each column has at least one zero

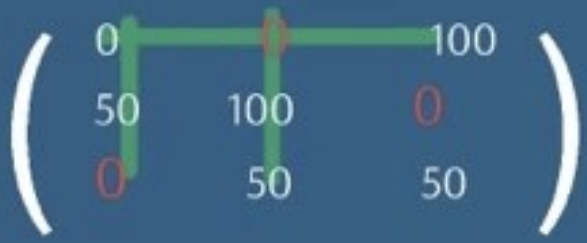
Step 3

-We draw lines across rows and columns in such a way that all zeros are covered and that the minimum number of lines have been used (in this case lines across the 1st and the 3rd row and across the 1st column)

Step 4

-A test for optimality:
-If the number of lines just drawn is n (number of rows of the cost matrix); we are done. If the number of lines" < n, we go to step 5.

The first case is for shorter exercises



Step 5 (only if necessary)

-We find the smallest entry which is not covered by any of the lines. Then subtract it from each entry which is not covered by the lines and add it to each entry which is covered by a vertical and horizontal line. Now we can go back to step 3.

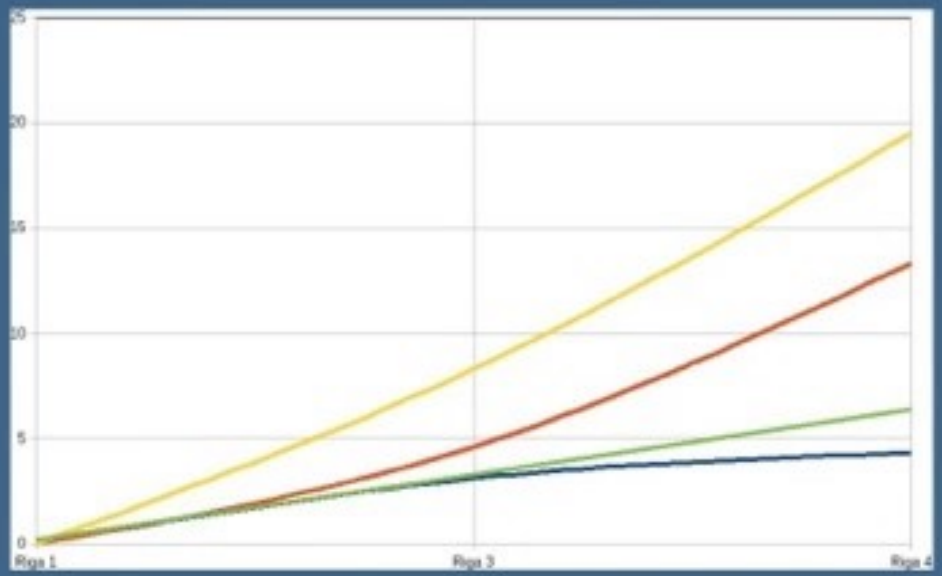
Maximization problem

-If we have, instead of a minimization problem, a maximization problem, multiply the matrix C by -1 and proceed as above. If C is not a square matrix (there are more tasks than workers or conversely), we have to augment C into a square matrix by adding zero rows or columns.

Why the algorithm?

The hand by hand checking method works well only when we have small problems, in fact how n grows, it increases the attempts, because there are n! ways of assigning n resources to n tasks.

-Blue = n
-Green = n^2
-Red = e^n
-Yellow = n!



What's the n! ?

n!= n*(n-1)*....*1

-For example:
3!= 3*2*1=6

The Masterminds

Buica Antonio, Levav Maya, Lizzadro Luca, Longo Tommaso,
Ometto Vittorio,Pasqualin Davide, Pinarolli Leonardo, Rubinelli Johannes

Did you understand?

Skip

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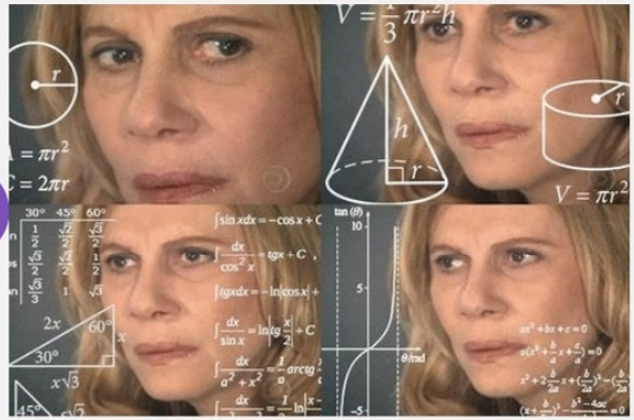

0 Answers

- ▲ Yes
- ◆ What were we talking about?
- ● No
- ■ Why are we still going to school?

Who was Harold W.Khun?

Skip

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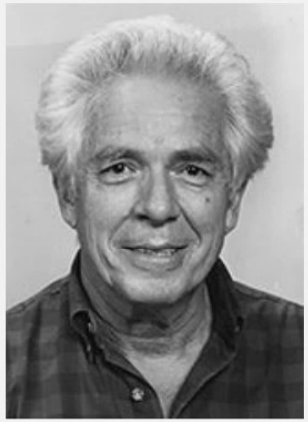

0 Answers

- ▲ A physicist
- ◆ A mathematician
- ● A fisherman
- ■ A unemployed / maintained

Where and when was Harold born?

Skip

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0
Answers

- ▲ Bruxelles-11th May 1947
- ◆ Vienna-29th February 1899
- ● Santa Monica-29th July 1925
- ■ Polo Nord-yesterday

What did Harold win?

Skip

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0
Answers

- ▲ Oscar
- ◆ Nobel
- ● Platinum record
- ■ Jon von Neumann Theory Prize

What is a matrix?

Skip

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$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

0 Answers

- ▲ A film
- ◆ A rectangular array
- ● A type of fish
- ■ A mathematical operation

Why the Hungarian Algorithm is called "Hungarian"?

Skip

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0 Answers

- ▲ Because most part of the work was made by 2 ungherians
- ◆ Because Hungarians are cool
- ● because the inventor was Hungarian
- ■ Because in Hungary there are a lot of fishies

Choose the correct algorithm definition

Skip

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0 Answers

- ▲ Add or subtract a number from each row and column
- ◆ Subtract the same number from each row and column
- ● Add the same number to each row and column
- ■ Multiply or divide the same number from each row and column

What is the algorithm for?

Skip

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0 Answers

- ▲ To find the maximum cost
- ◆ To go fishing with friends
- ● To free 6ix9ine (snitch)
- ■ To find the minimum cost

8 guys have to make a Carbonara. So they went to the supermarket to buy 3 ingredients. They must find the less expensive

Skip

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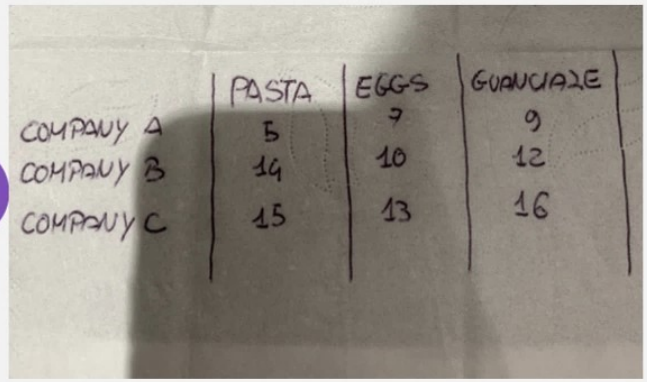
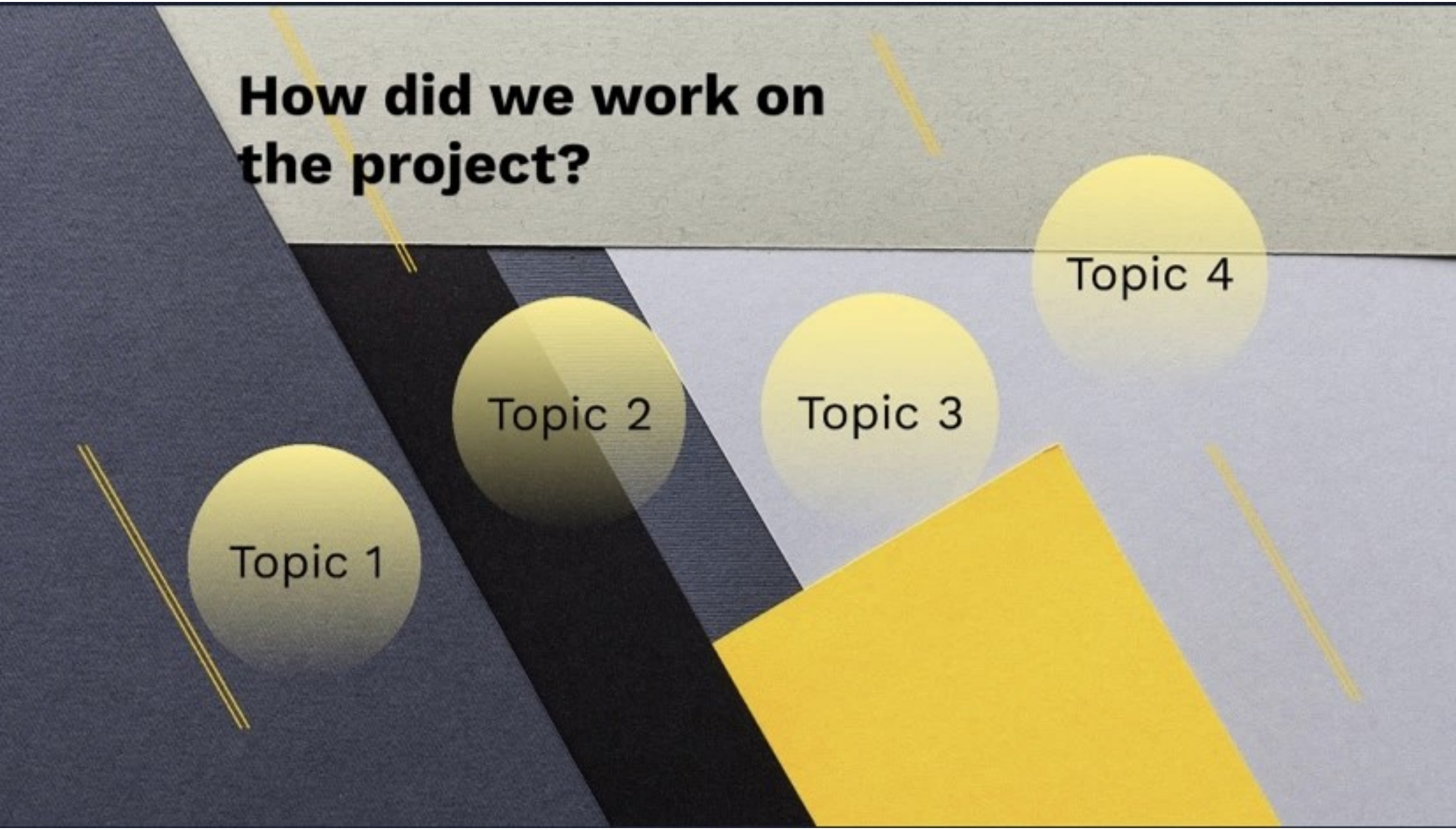


	PASTA	EGGS	GUANCIALE
COMPANY A	5	7	9
COMPANY B	14	10	12
COMPANY C	15	13	16

0
Answers

- ▲ 5+10+13=28
- ◆ 9+10+15=34
- ● 5+12+13=30
- ■ salmon+pike=big lake trout


How did we work on the project?
Topic 1
Topic 2
Topic 3
Topic 4

How did we start?

We started our work by looking for an original topic that could also involve those who were not skill in mathematics

The idea

The idea who was recommended by our math teacher.
At the beginning of the year we were without the teacher and we didn't know how to start the work.

How did we split the work?

To work on the project we organize ourselves in two meetings a week where for an hour the whole class worked on various steps of the presentation

Process

1) We started by focusing on Harold Khun's life
2) We studied the algorithm and prepared some exercises about it
3) We prepared the presentation:
-powerpoint
-prezi
-kahoot

Presentation

Trigonometry

Who are we?

- students from Belgium
- 16/17 years old

BELGIUM

BELGIUM ON A MAP

BRUSSELS

- capital city
- amazing and beautiful by night
- every year flower market in Brussels’ big market




ANTWERP

- the port of Antwerp
- Sportpaleis/Lotto Arena
- ‘De Meir’




GENT

- Gravensteen
- Graslei/Korenlei
- Gentse Feesten



FAMOUS BELGIAN FOOD

- Fries
- (Brussels and Liège) waffles
- Chocolate and especially pralines
- Carbonade flamande
- Cuberdon
- Vol au vent
- Beer

THE BELGIAN COAST

- It’s an attractive place
- A lot of people have a second house or apartment here
- It’s the holiday place in Belgium

BELGIAN INVENTIONS

- Saxophone
- internet, Robert Cailliau was from Belgium
- Candy
- Praline
- Deodorant

FAMOUS BELGIAN PEOPLE

- Angèle
- Stromae
- Romelu Lukaku
- Kevin De Bruyne
- Eden Hazard
- Thibaut Courtois
- Wout Van Aert
- Max Verstappen (his mother)
- Kim Clijsters
- Nafi Thiam
- Nina Derwael

this was BELGIUM

Some mathematical terms in English

Teorema de pitágoras	Pythagorean theorem
distancia	distance
ángulo	angle
triángulo rectángulo	right-angled triangle
suma de ángulos	angle sum
proporción	ratio

Why do we need trigonometry?

Trigonometry

- to obtain unknown angles/ distances

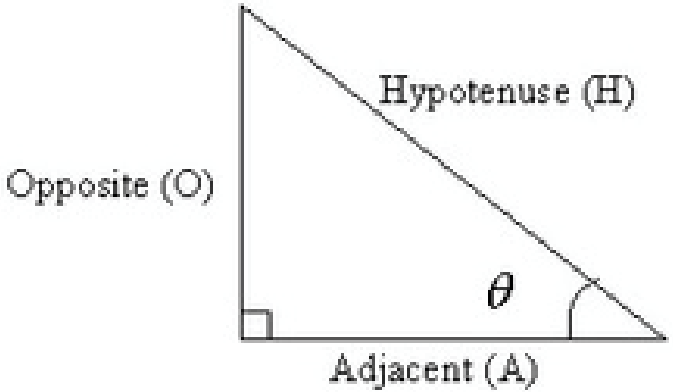
Pythagorean theorem

- to obtain unknown distances

What do we need?

- right-angled triangle
  - opposite side (= lado opuesto)
  - hypotenuse (= hypotenusa)
  - adjacent side (= lado adyacente)

- 2 known values
  - 2 distances
  - 1 distance and 1 angle



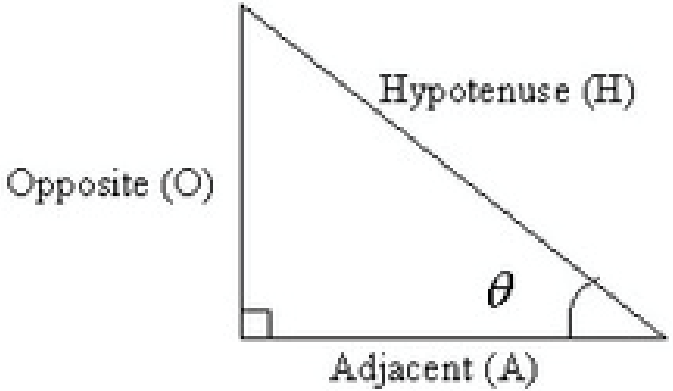
The basics

Pythagorean theorem: $a^2+b^2=c^2$

Sine α= opposite side / hypotenuse (SOH)

Cosine α= adjacent side / hypotenuse (CAH)

Tangent α= opposite side / adjacent side (TOA)



Now it's your turn...

- a right-angled triangle

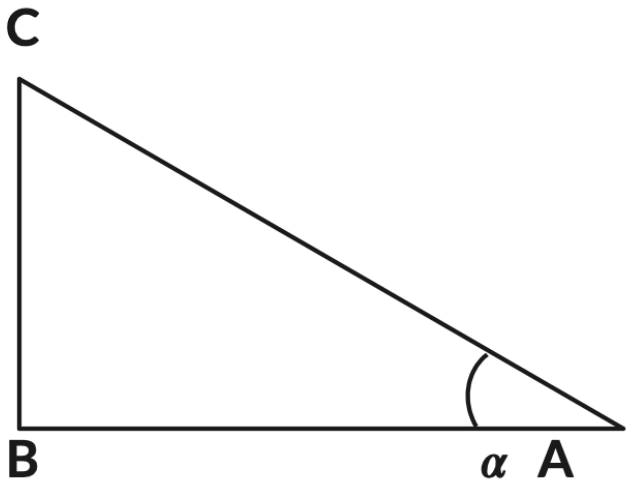
  What do we know?

  opposite side= 10 cm

  adjacent side= 15 cm

$\tan^{-1}(O / A) = \tan^{-1}(10 / 15)$

$\alpha = 33{,}7°$



Now it's your turn...

- a right-angled triangle

  What do we know?

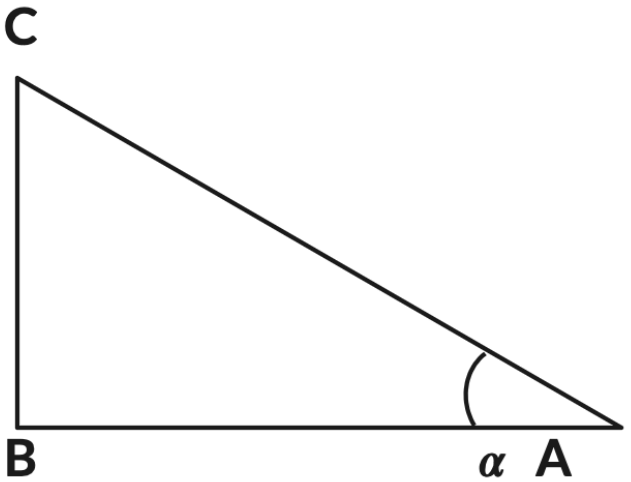
  opposite side= 8cm

  α= 50°

tan α = O/A => A= O/tanα

A= 8/ tan(50°)

A= 6,7 cm



Values to remember

α	0°	30°	45°	60°	90°
sine	0	1/2	√2/2	√3/2	1
cosine	1	√3/2	√2/2	1/2	0
tangent	?	?	?	?	?

What is tan (0) ?

=> tanα = sinα / cosα

=> tan 0° = sin 0° / cos 0°

=> tan 0° = 0 / 1

=> tan 0° = 0

α	0°
sine	0
cosine	1

What is tan (30) ?

=> tanα = sinα / cosα

=> tan 30° = sin 30° / cos 30°

=> tan 30° = (1/2) / (√3/2)

= (1/2) . (2/√3)

=> tan 30° = 1/√3

α	0°
sine	1/2
cosine	√3/2

What is tan (45) ?

=> tanα = sinα / cosα

=> tan 45° = sin 45° / cos 45°

=> tan 45° = (√2/2) / (√2/2)

=> tan 45°= 1

α	45°
sine	√2/2
cosine	√2/2

What is tan (60) ?

=> tanα = sinα / cosα

=> tan 60° = sin 60° / cos 60°

=> tan 60° = (√3/2)/ (1/2)

= (√3/2) . (2)

=> tan 60°= √3

α	60°
sine	√3/2
cosine	1/2

What is tan (90) ?

=> tanα = sinα / cosα

=> tan 90° = sin 90° / cos 90°

=> tan 90° = 1 / 0

=> tan 90°= /

α	90°
sine	1
cosine	0

Thank you for your attention!

the progress

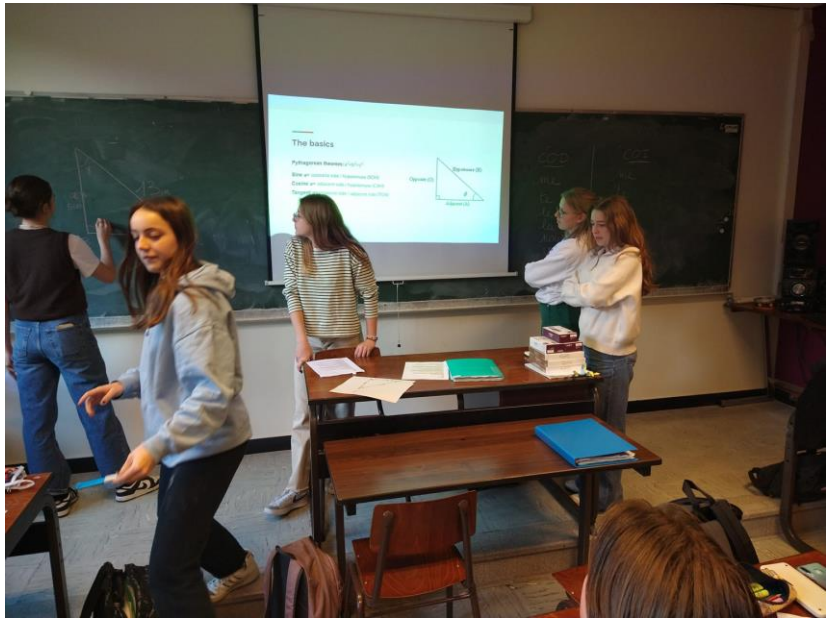
The game

- Preparing a game
- Too complicated for students
- We scratched the idea

All are work for nothing

- Prepared our PowerPoint and text
- Wrong subject
- Teacher’s fault

New lesson

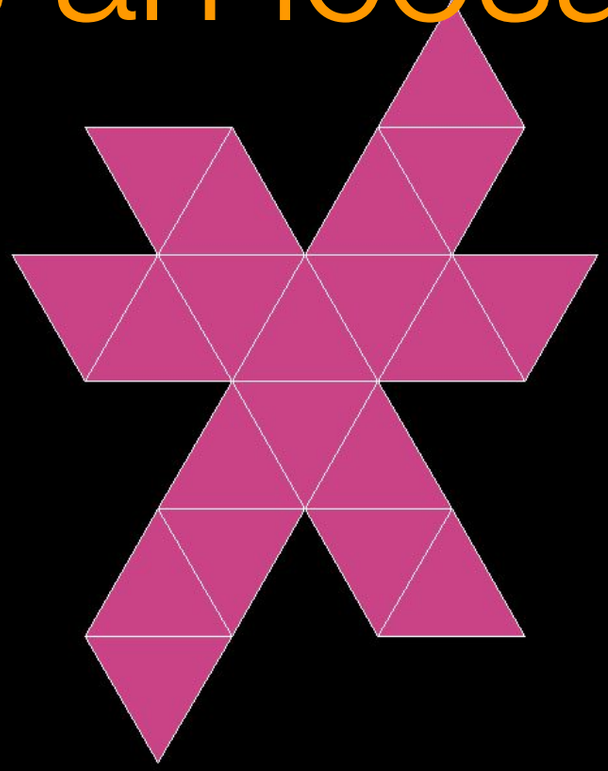


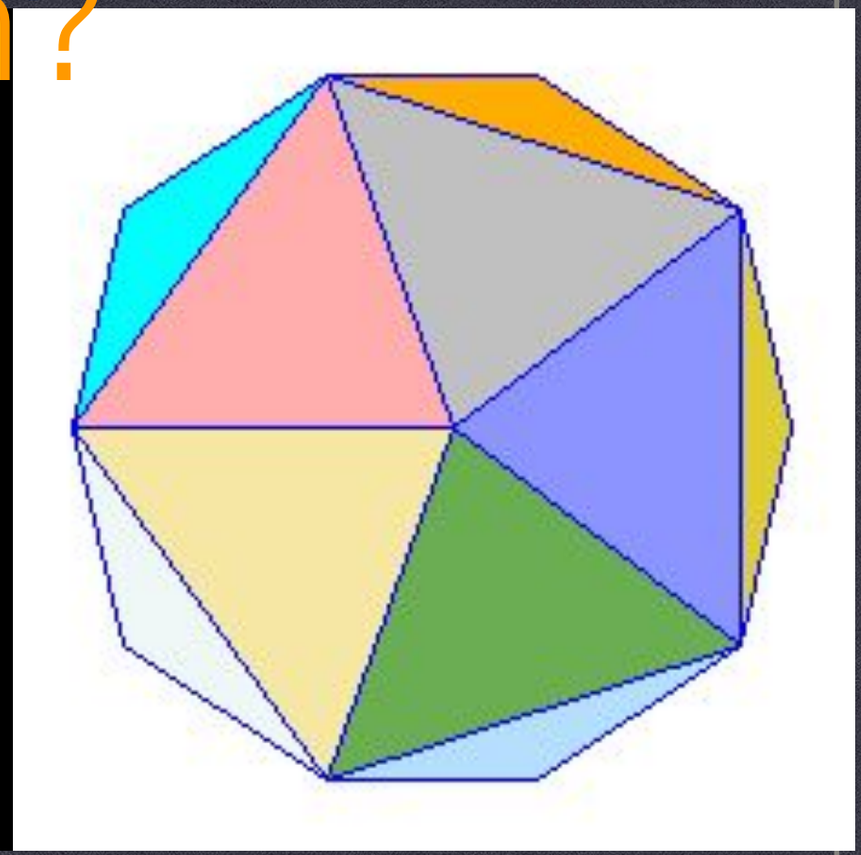
We were ready to go

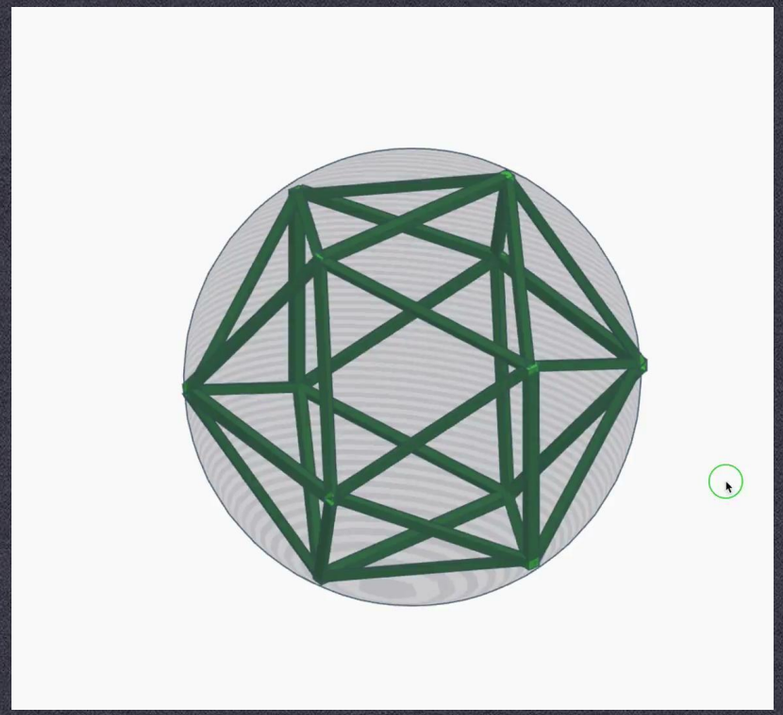
Lesson in Marbella

Dome

what is an icosahedron?

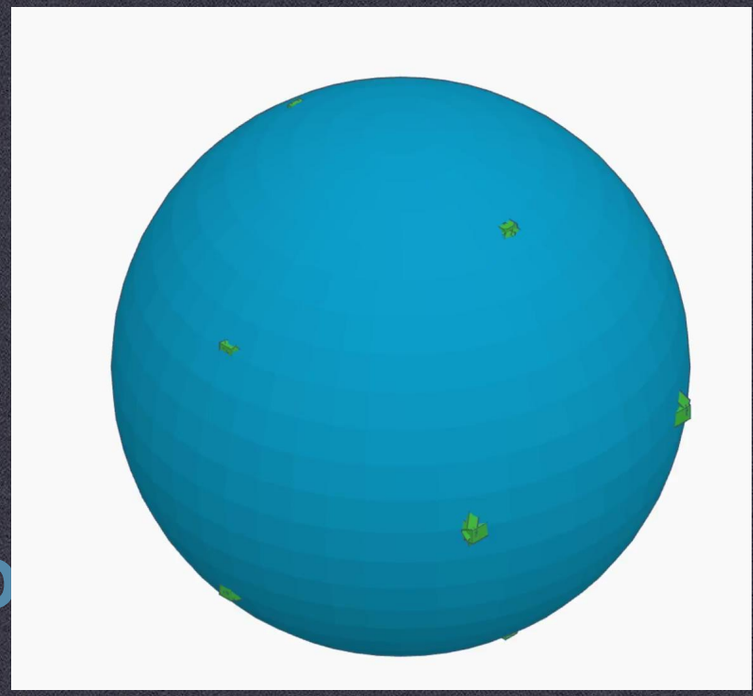


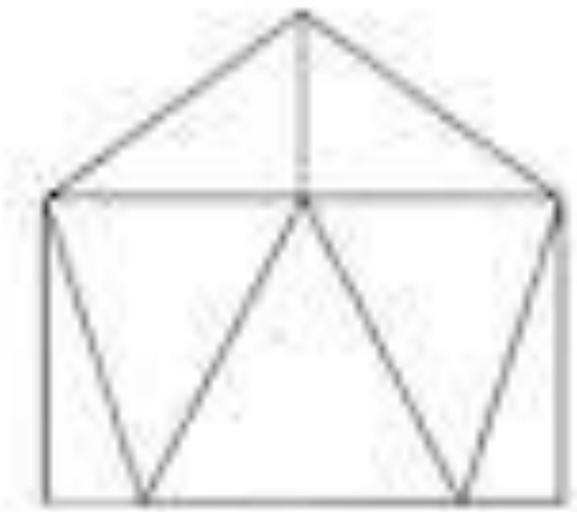




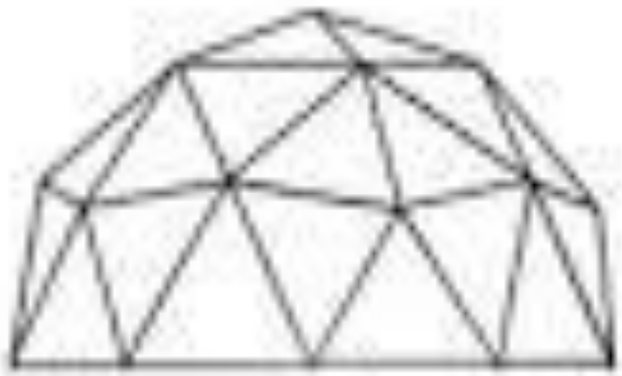
AN ICOSAHEDRON IS A REGULAR SOLID WITH 20 FACES (EQUILATERAL TRIANGLES)

EACH VERTEX IS LOCATED ON THE SURFACE OF A SPHERE





V1

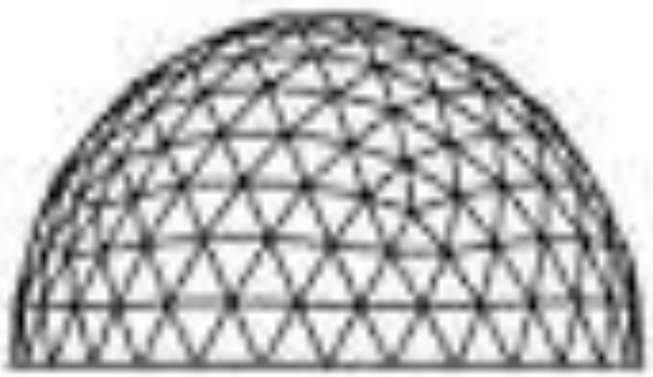


V2

V3

V4

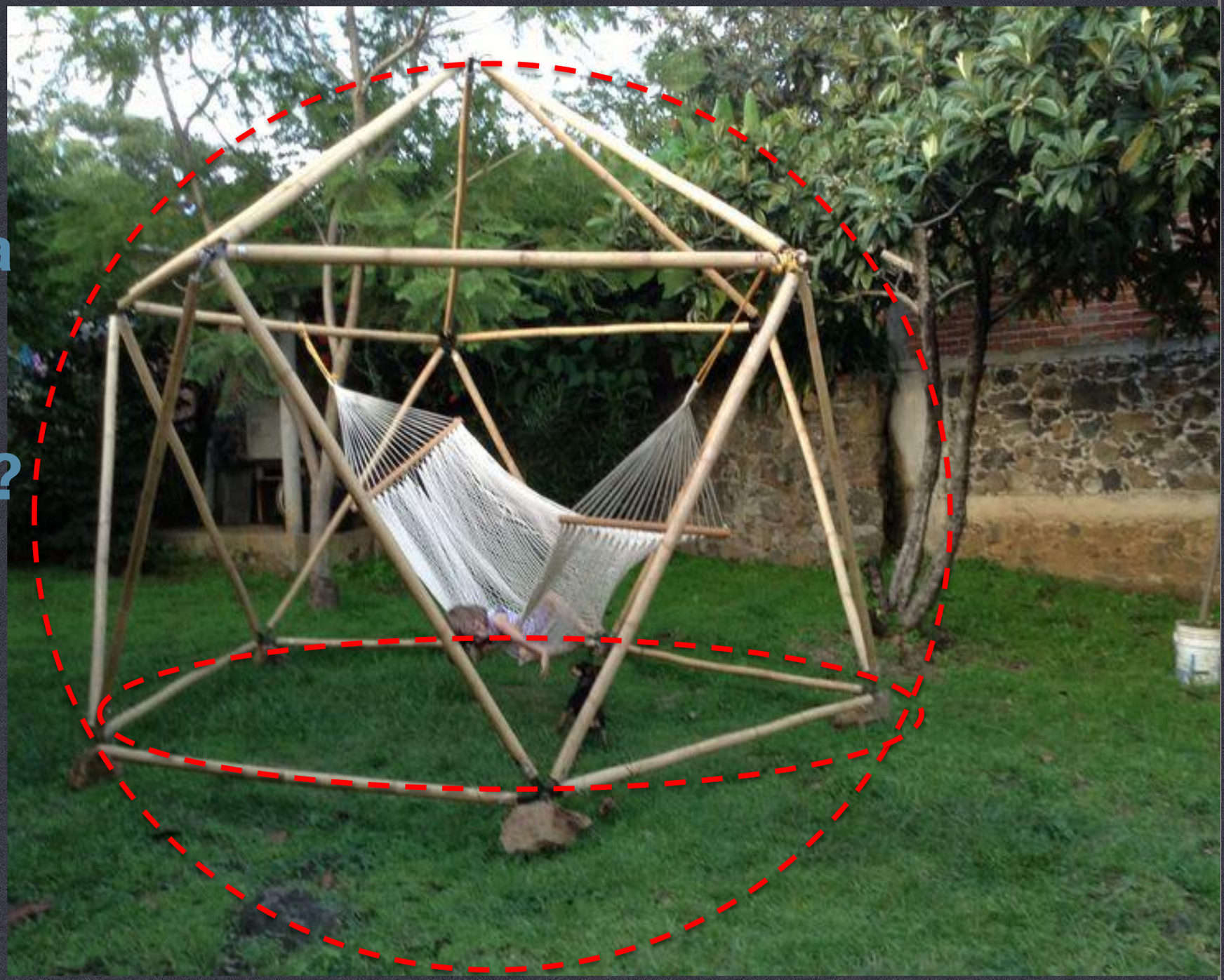
V5



V6

It depends of how many vertex we have,
the domo will seem more or less as as a sphere

And can I build a DOME with this figure (an icosaedrom)?



YES, but it doesn't look like a sphere at all

A DOME IS TO GET MORE POINTS OF THE SPHERE FROM AN ICOSAHEDRON

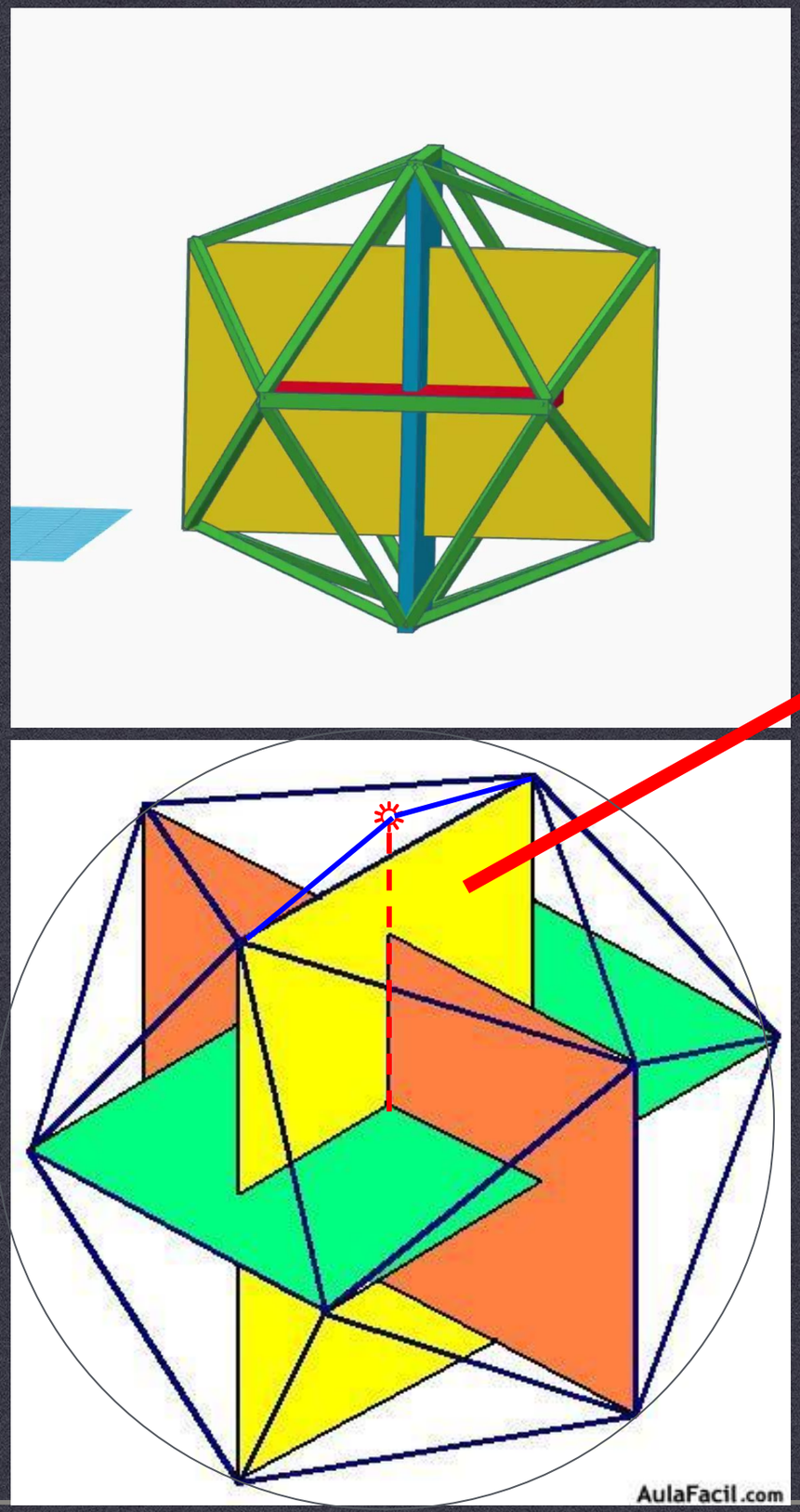
HOW?

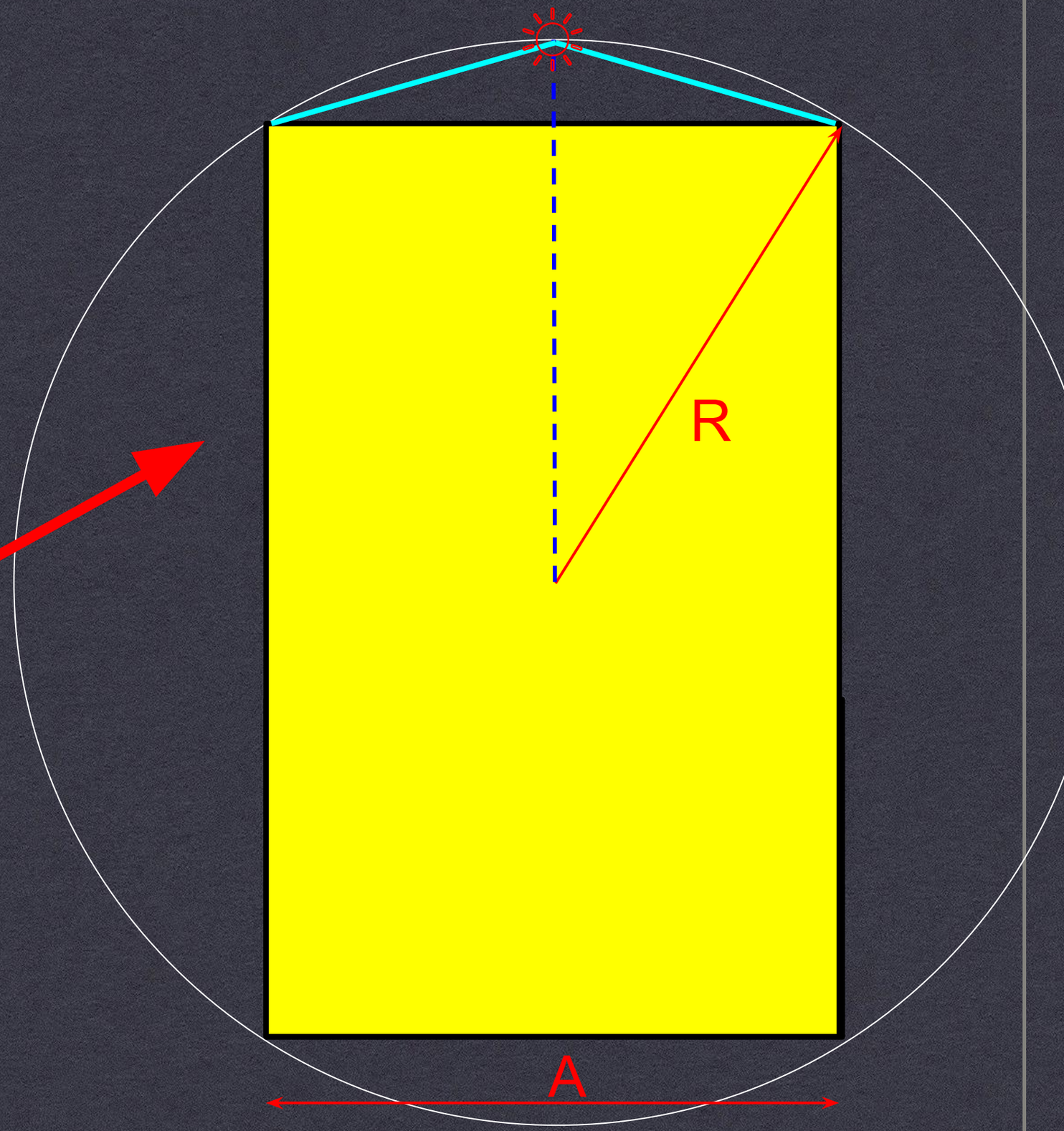
VERTEXES OF THE SPHERE

CENTERS OF THE SIDES

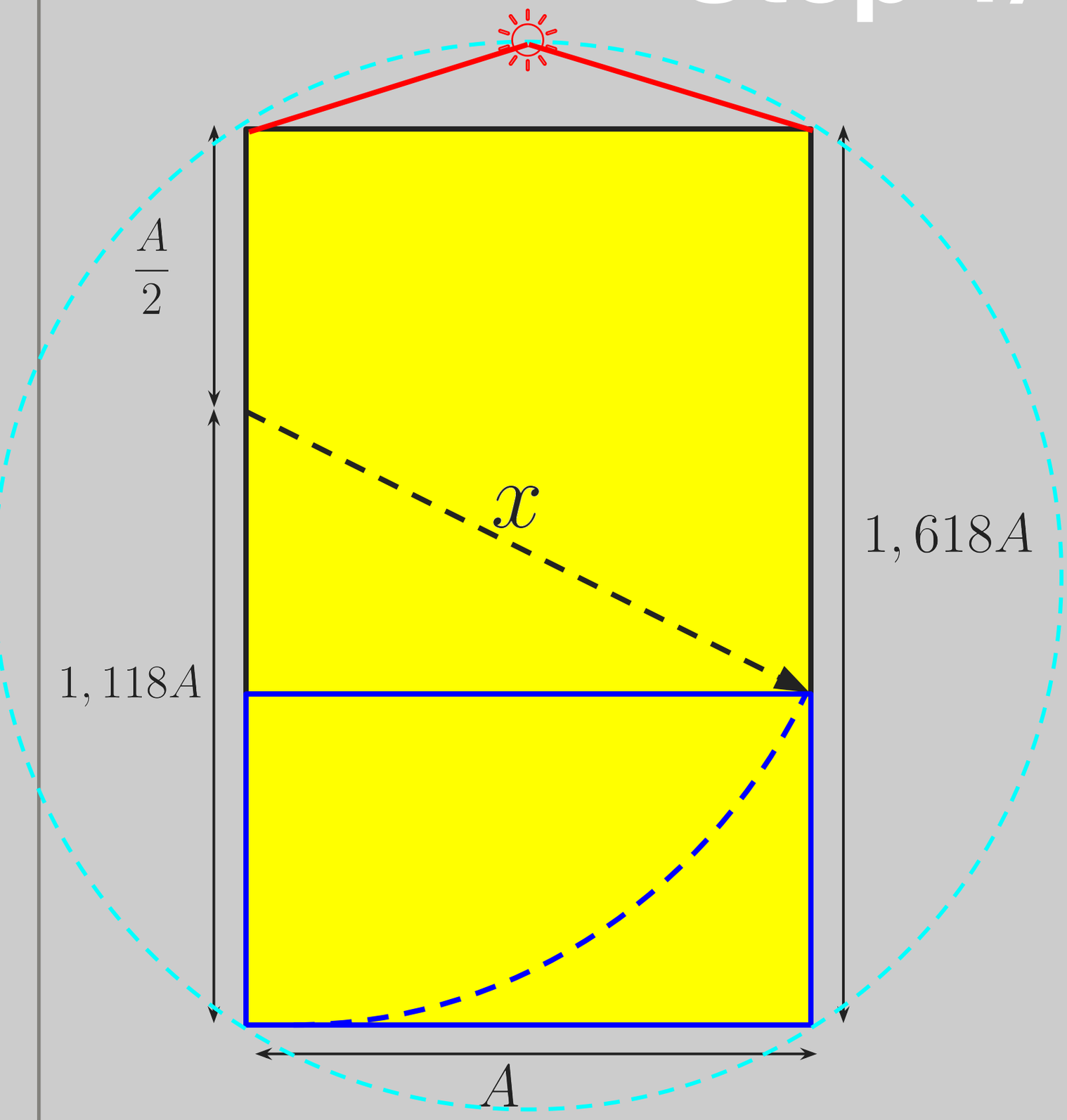
NEW VERTEXES!

how is it calculated?





Step 1/3



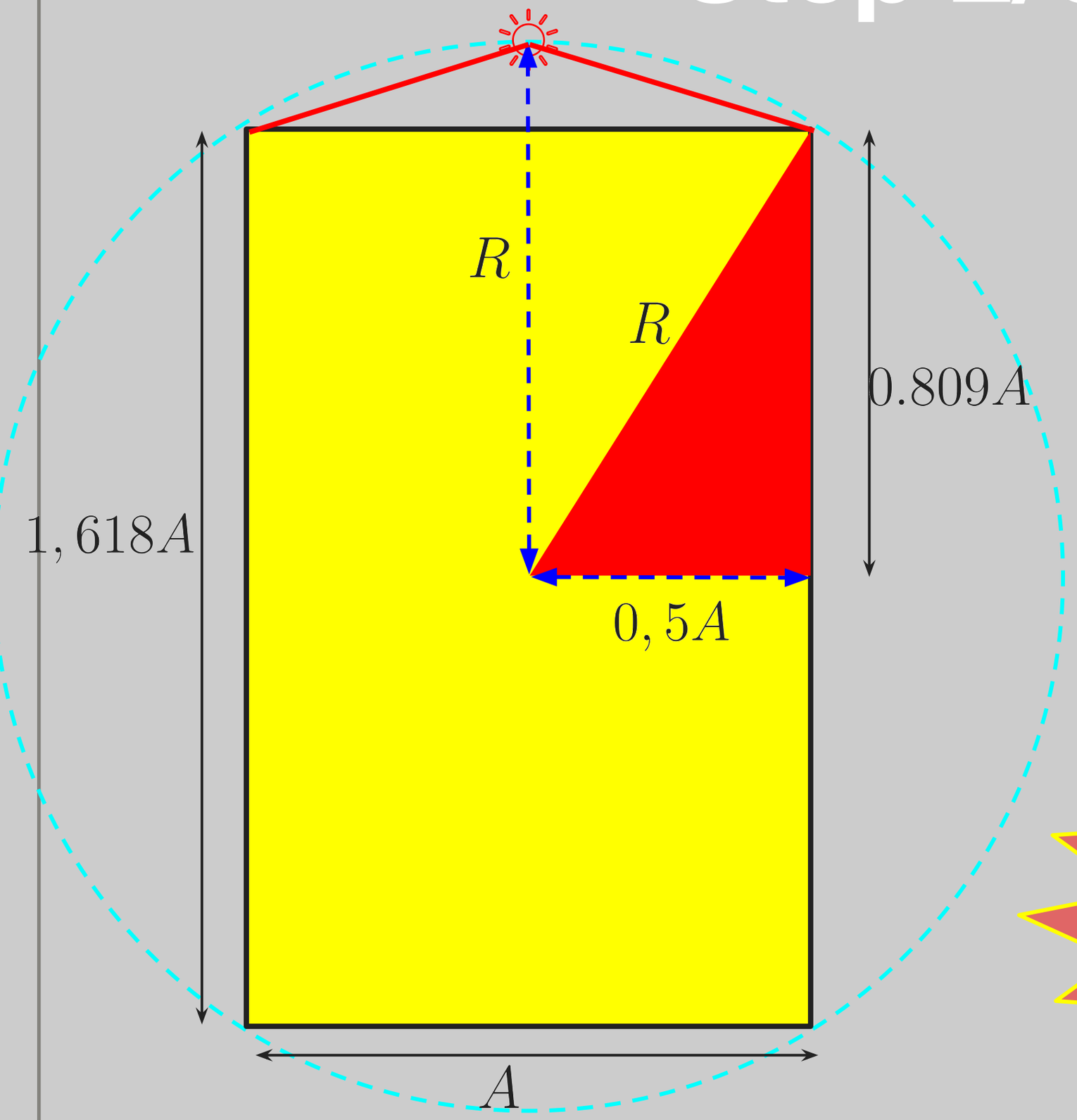
$$x = \sqrt{A^2 + \left(\frac{A}{2}\right)^2}$$

$$x = \sqrt{A^2 + \frac{A^2}{4}}$$

$$x = \sqrt{\frac{5A^2}{4}}$$

$$x = \frac{A\sqrt{5}}{2} = 1,118A$$

Step 2/3



$$R = \sqrt{(0,5A)^2 + (0,809A)^2}$$

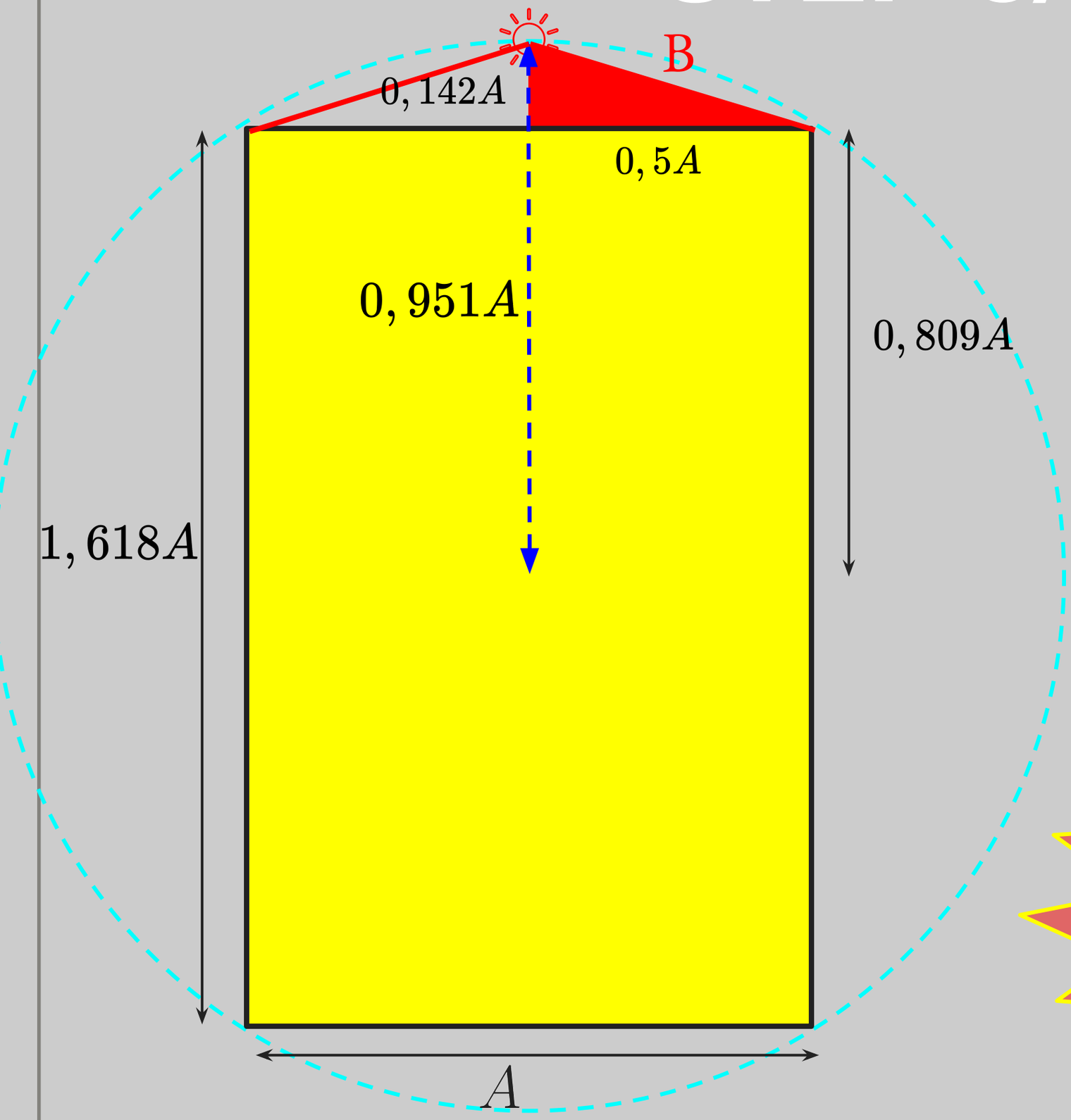
$$R = \sqrt{0,25A^2 + 0,654A^2}$$

$$R = \sqrt{0,904A^2}$$

$$R = 0,951A \qquad A = \frac{R}{0,951}$$

A=1,052R

STEP 3/3



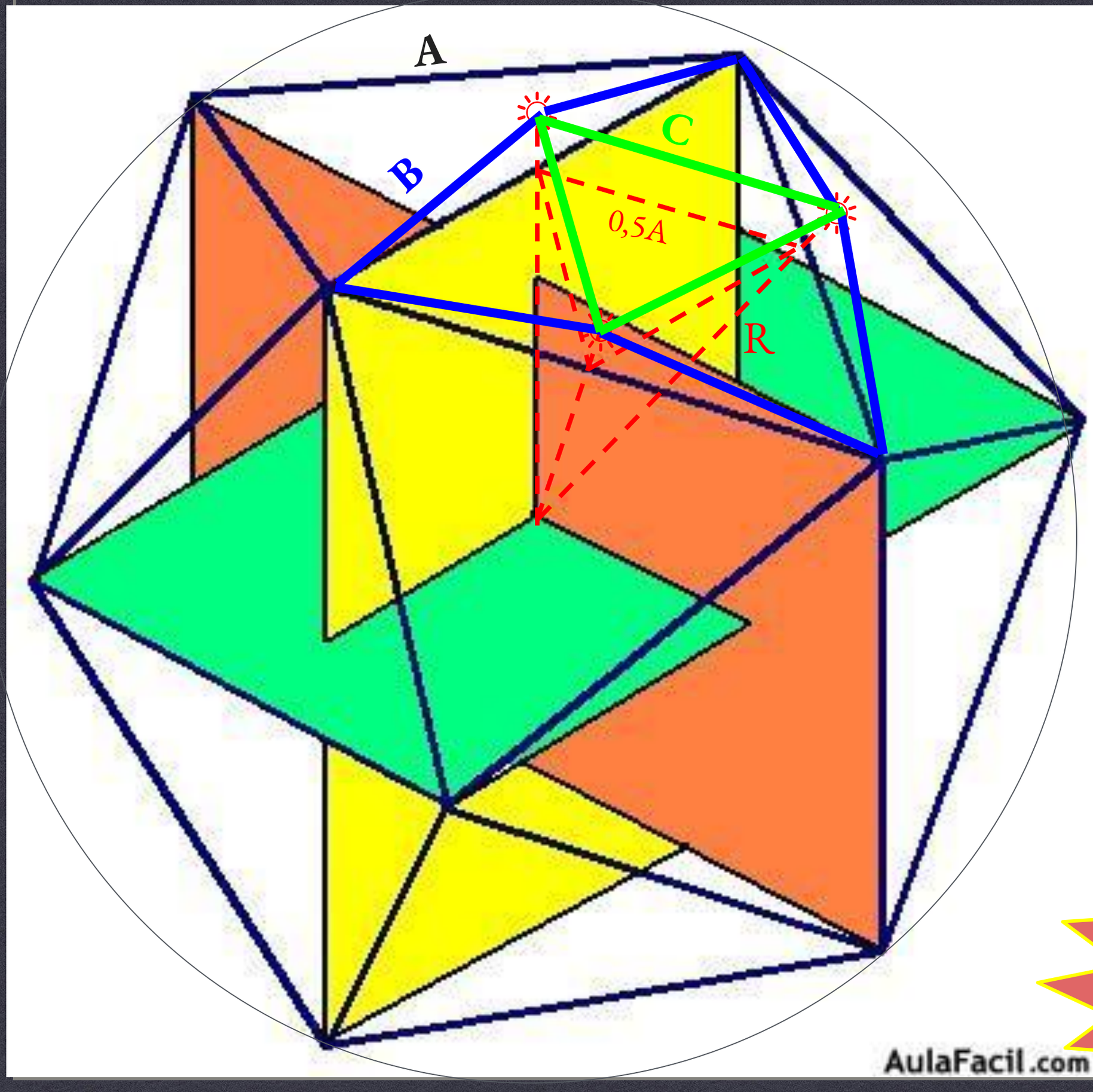
$$B = \sqrt{(0,5A)^2 + (0,142A)^2}$$

$$B = \sqrt{0,25A^2 + 0,020A^2}$$

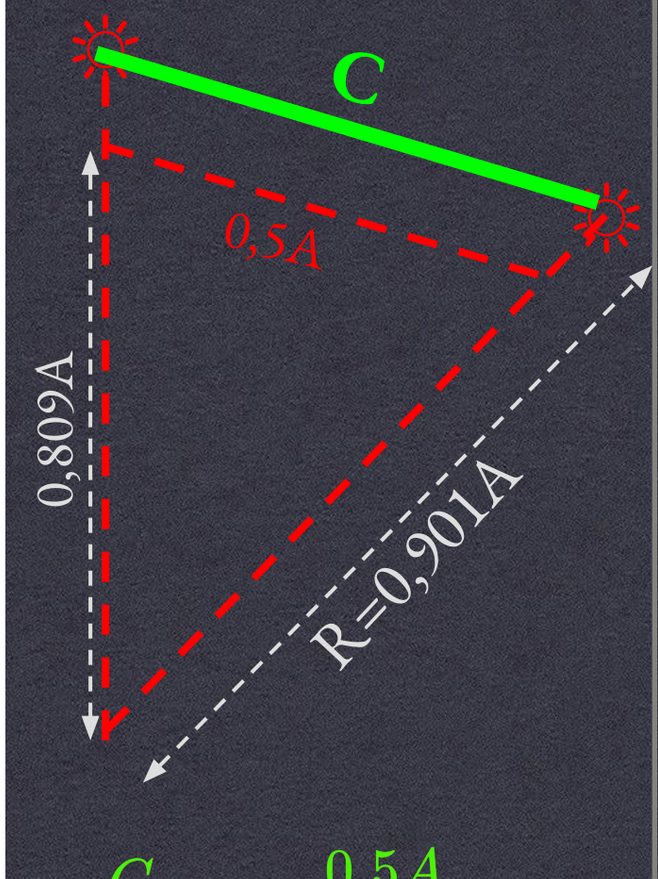
$$B = \sqrt{0,27A^2}$$

$$B = 0,519A$$

B=0,519A



LAST STEP

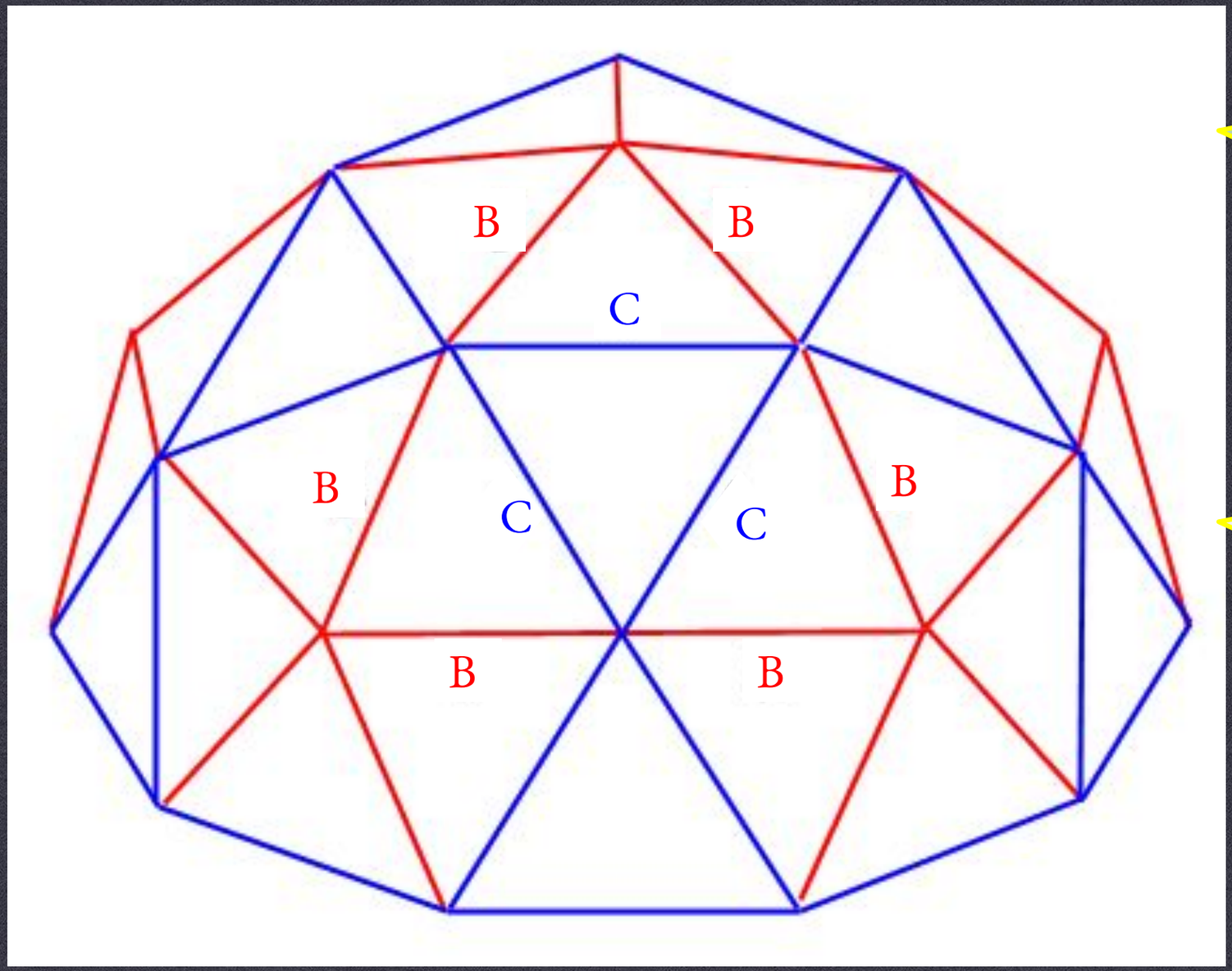


$$\frac{C}{R} = \frac{0{,}5A}{0{,}809A}$$

$$C = \frac{0{,}901A \times 0{,}5A}{0{,}809A}$$

C=0,556A

ASSEMBLY DIAGRAM



A=1,052R

B=0,519A

C=0,556A

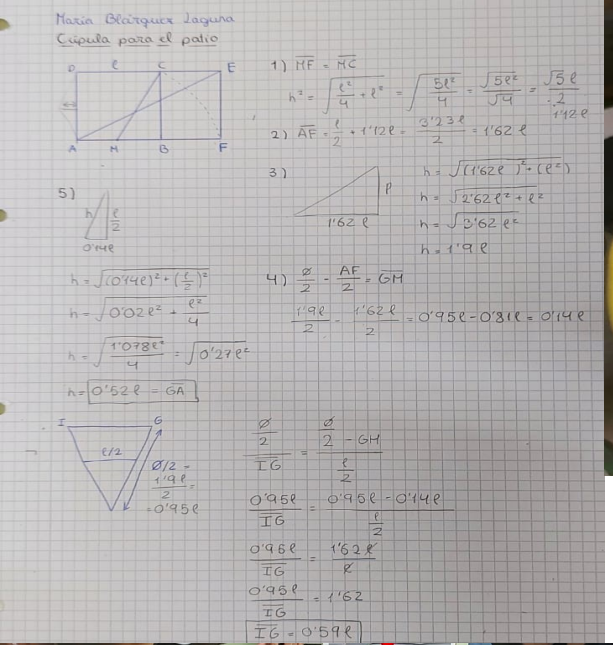
Example:
If we build a Dome of 10m of radium:
The icosahedron will have the side A=10x1,052=10,52m

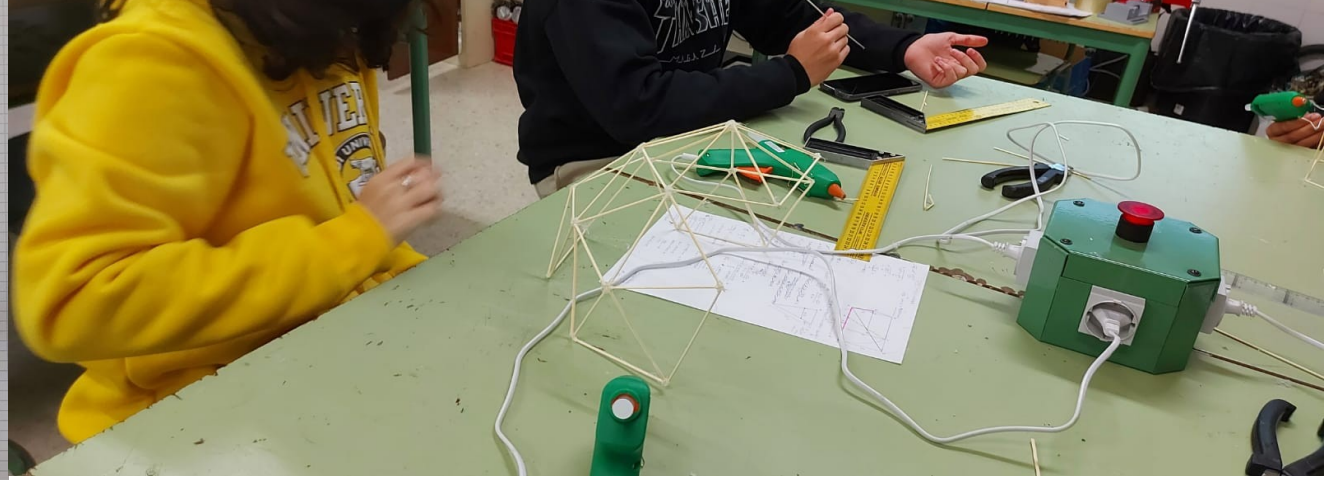
The type B bar will have: B=0,519x10,52=5,46m

The type C bar will have :C=0,556x10,52=5,85m

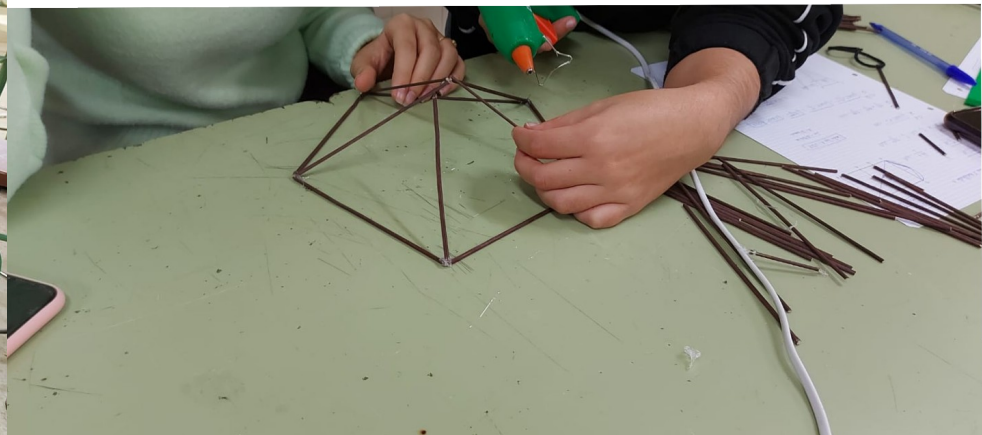
OUR MATHS LESSON

Spanish team

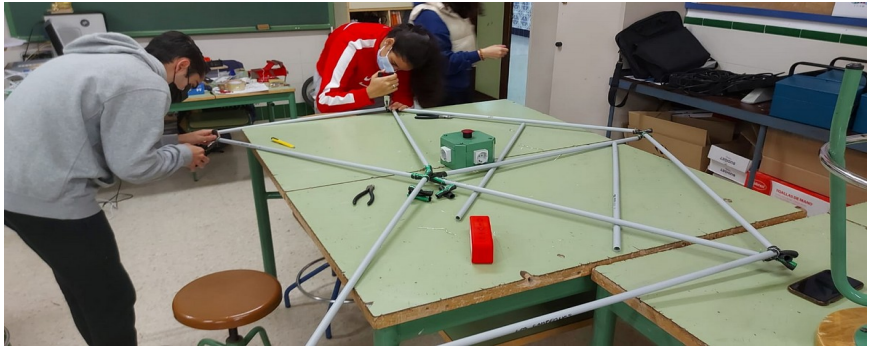




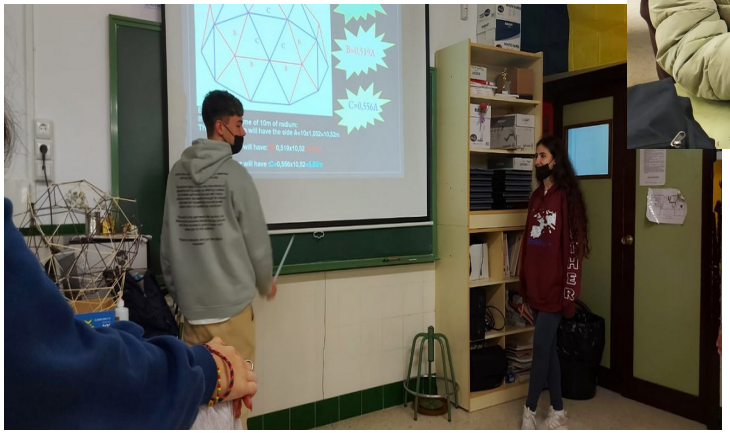
MAKING SOME MODELS



BUILDING THE FIRST PIECES

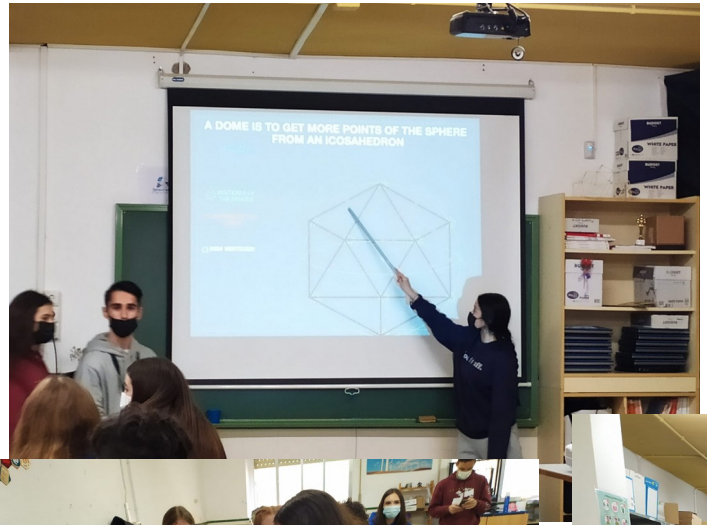


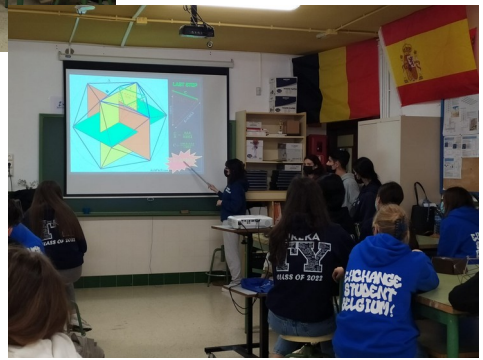
FINISHING THE DOME



Working on the presentation

THE DAY OF THE PRESENTATION





FINALLY WE SHOW OUR DOME

AND THE PRETTIEST PHOTO

GEOMETRY

BY

EUREKA SECONDARY, IRELAND.

WHO ARE WE?

EMMA

ARWYN

RACHAEL

CIARA

LAUREN

SOPHIE

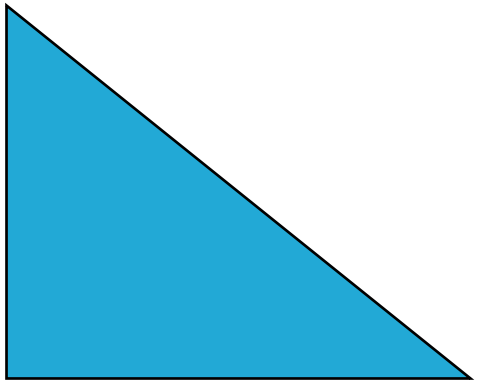
MADELEINE

REBECCA

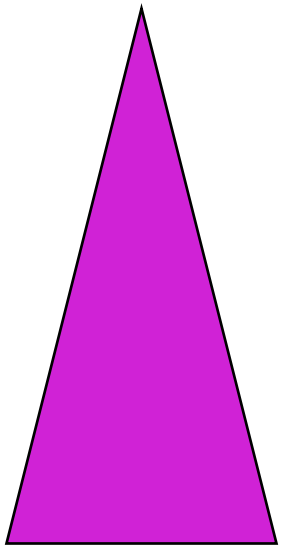
EIMEAR

INTRODUCTION

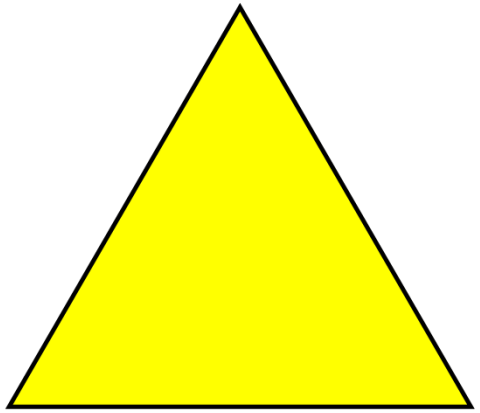
HOW DO WE RECOGNISE SIMILAR TRIANGLES?



Right angle triangle



Isosceles triangle

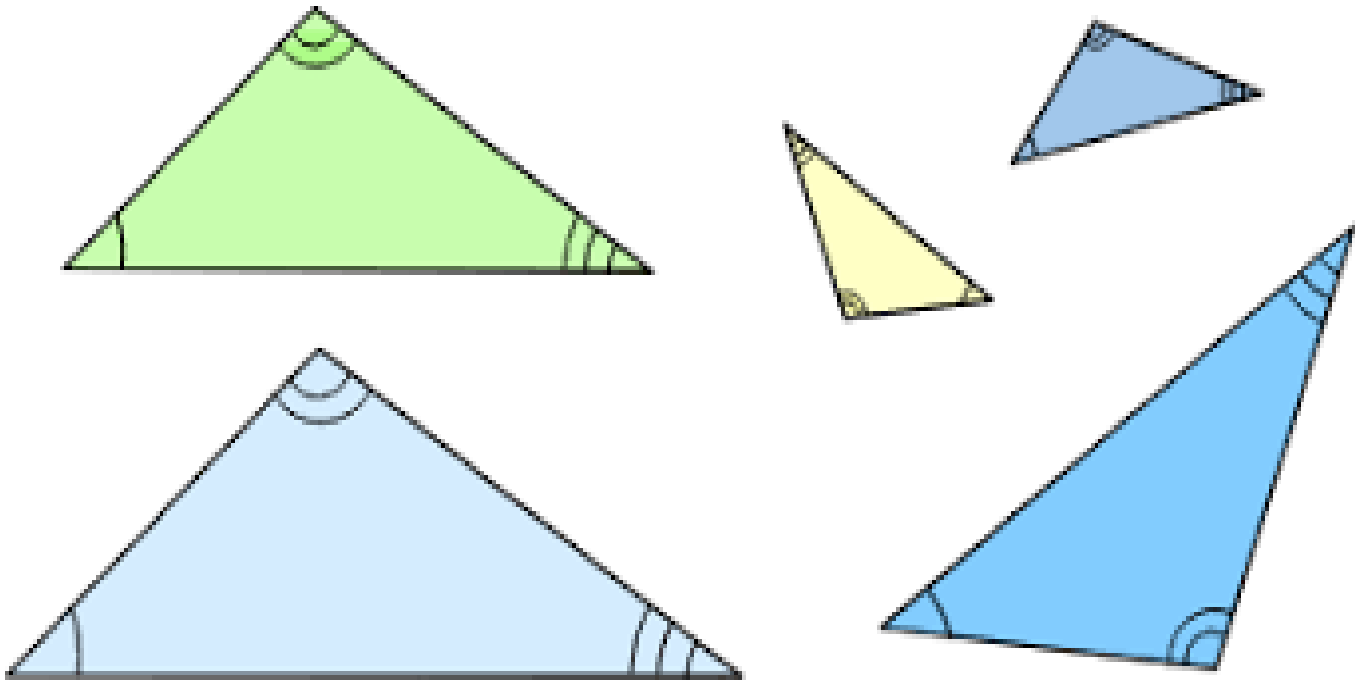


Equilateral triangle

Scalene triangle

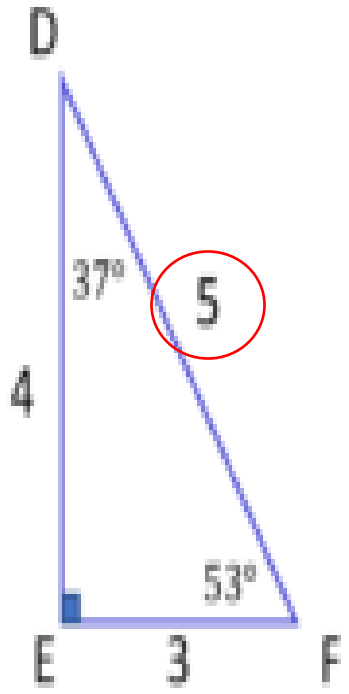
SO…. WHAT ARE SIMILAR TRIANGLES?

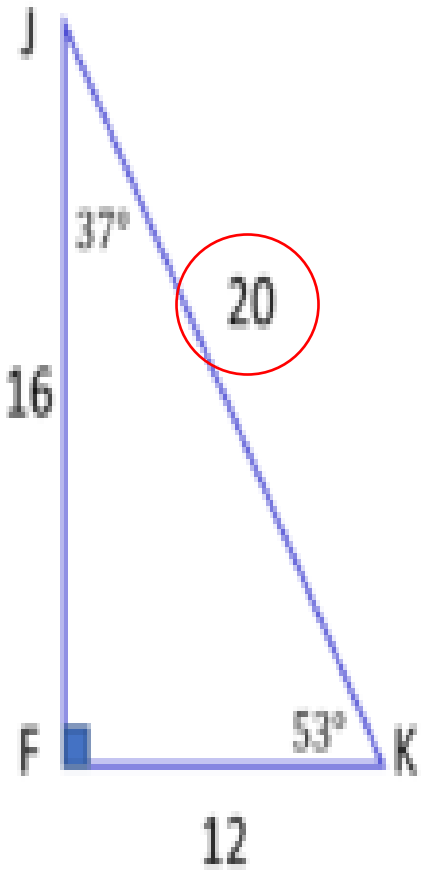
IN SIMILAR OR EQUIANGUALR TRIANGLES, ALL THREE ANGLES IN ONE TRIANGLE HAVE THE SAME MEASURE AS THE CORRESPONDING THREE ANGLES IN THE OTHER TRIANGLE.



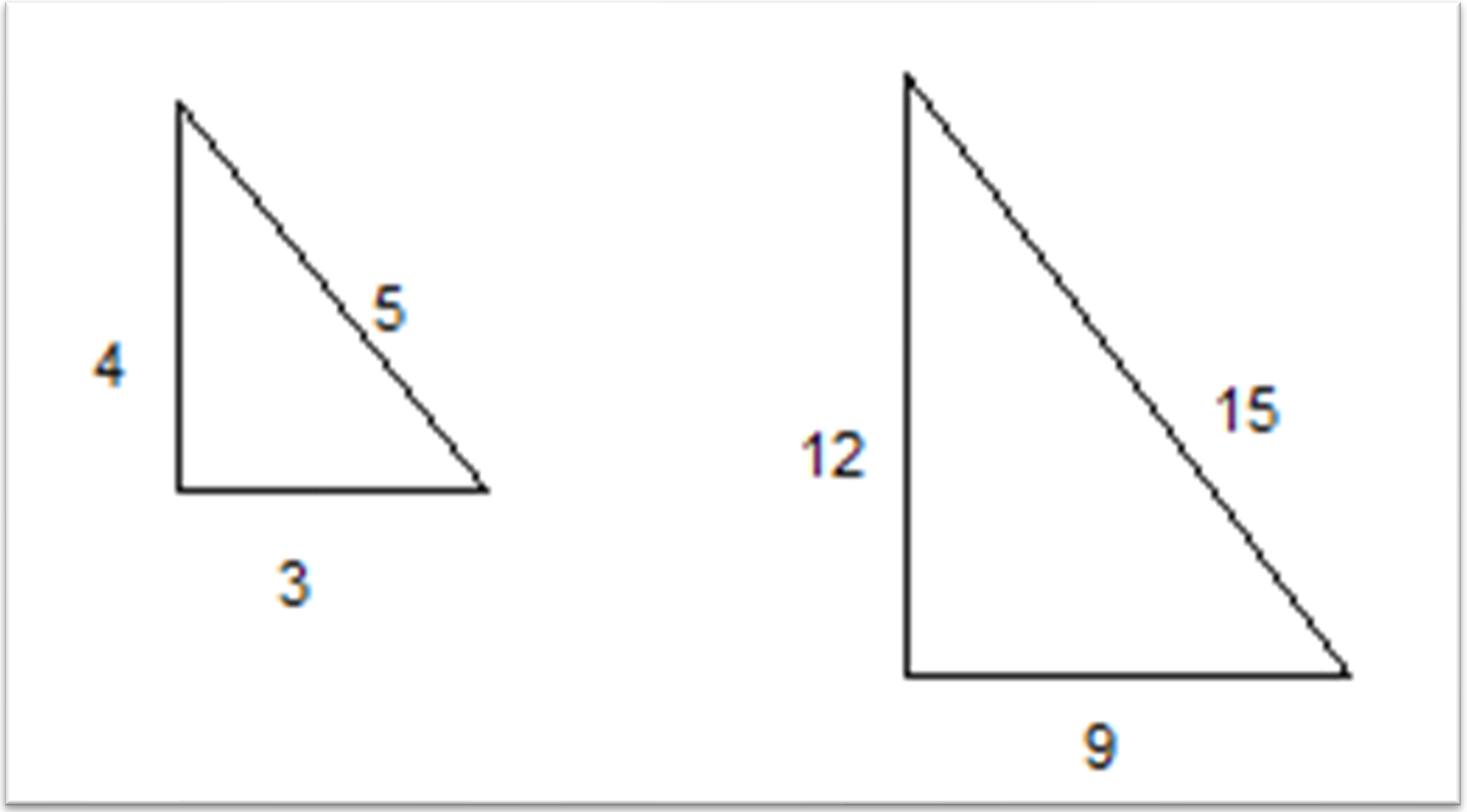
EXAMPLE OF A SIMILAR TRIANGLE

LOOK AT THE CIRCLED DIGITS AND TRY AND SEE IF YOU NOTICE ANY CONNECTION BETWEEN THEM?

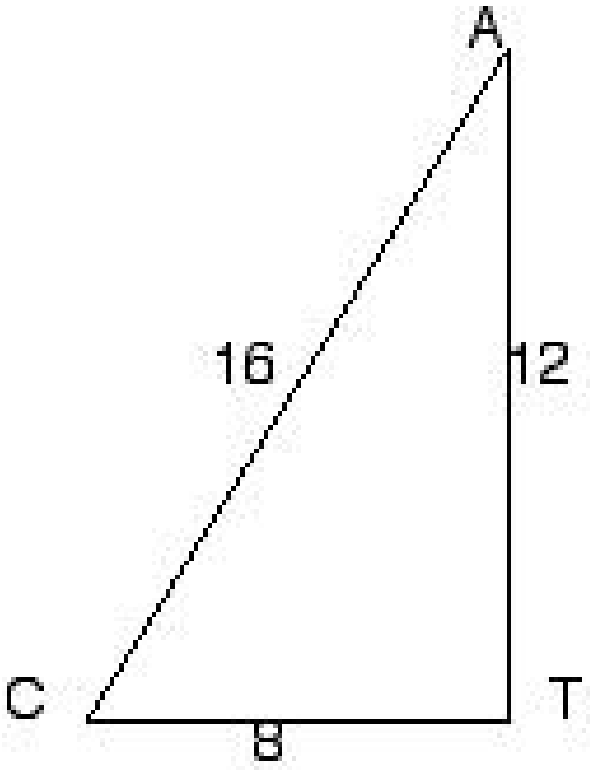


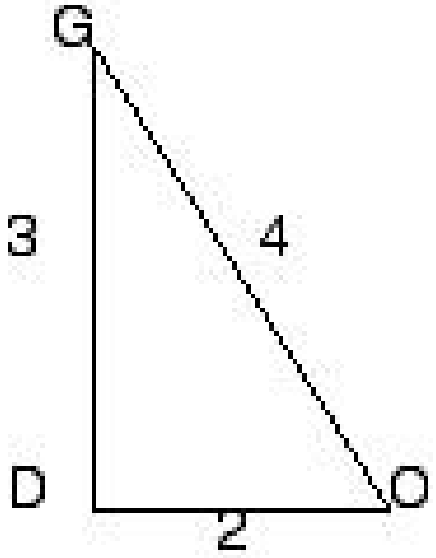


EXAMPLE 1

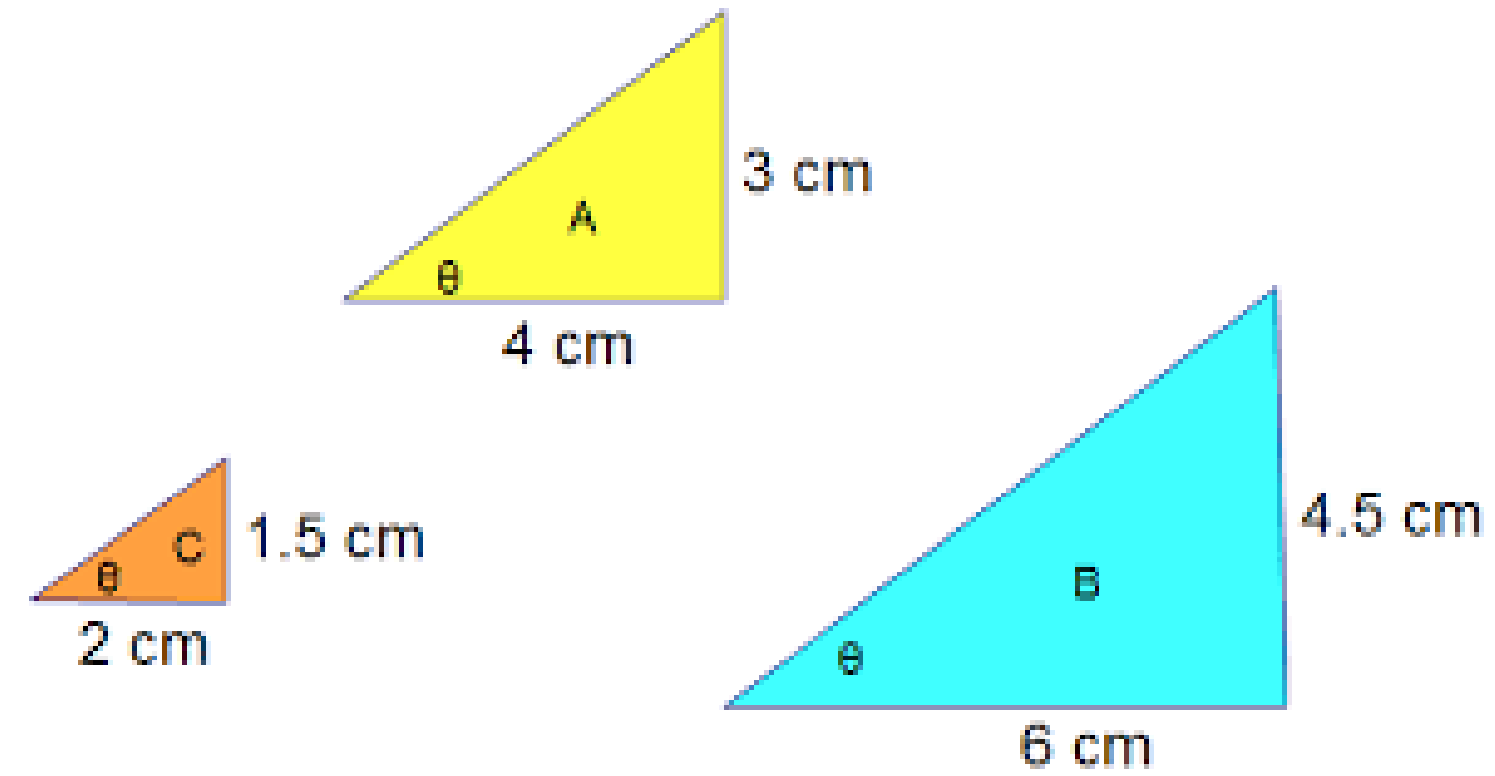


EXAMPLE 2

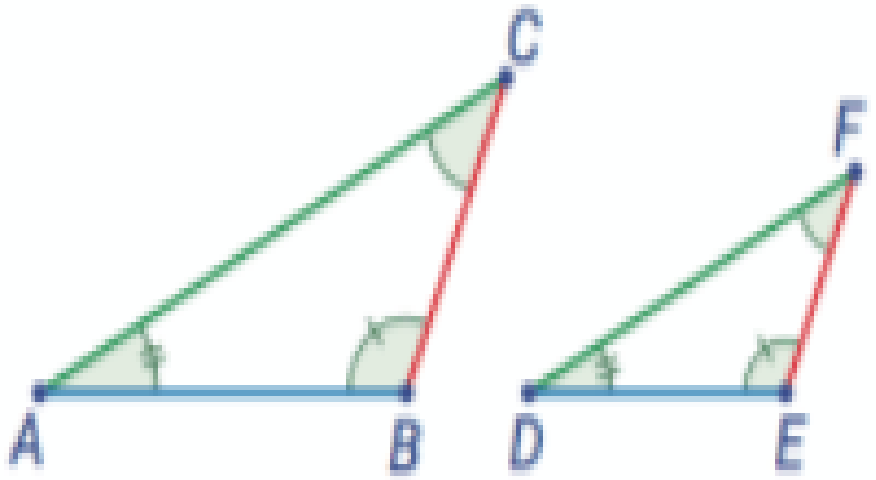




EXAMPLE 3

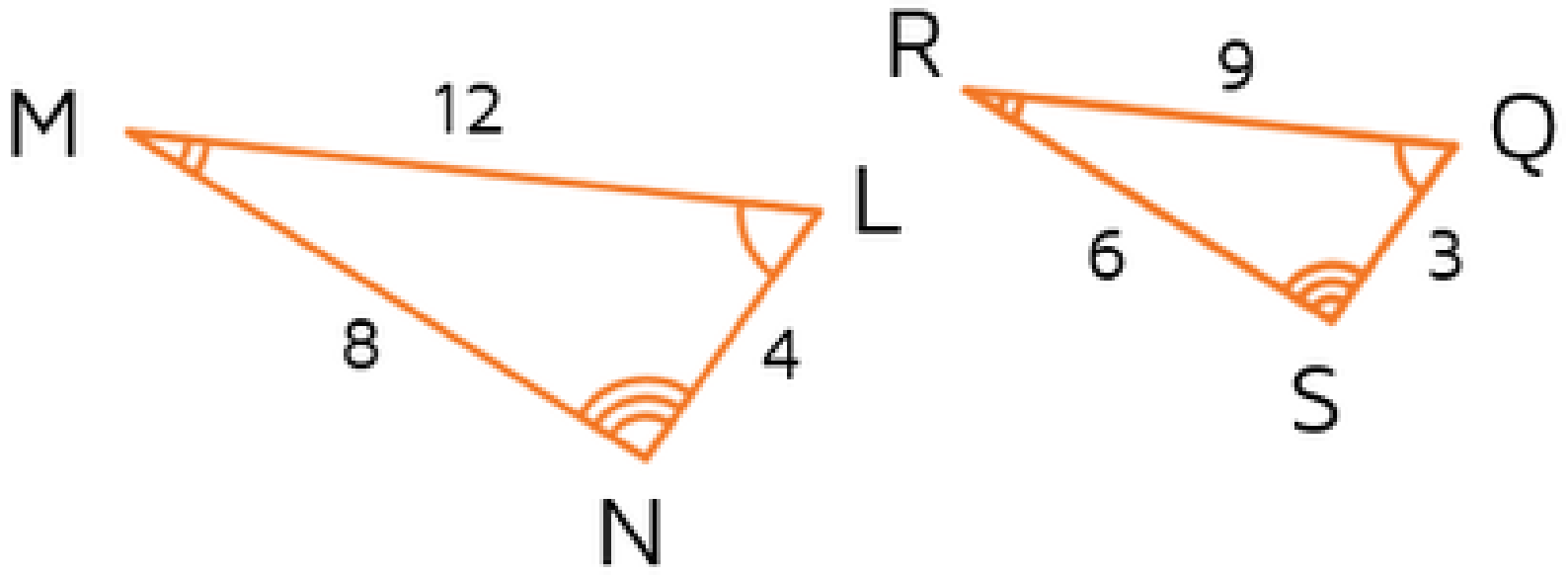


THE RATIO OF THE SIDES

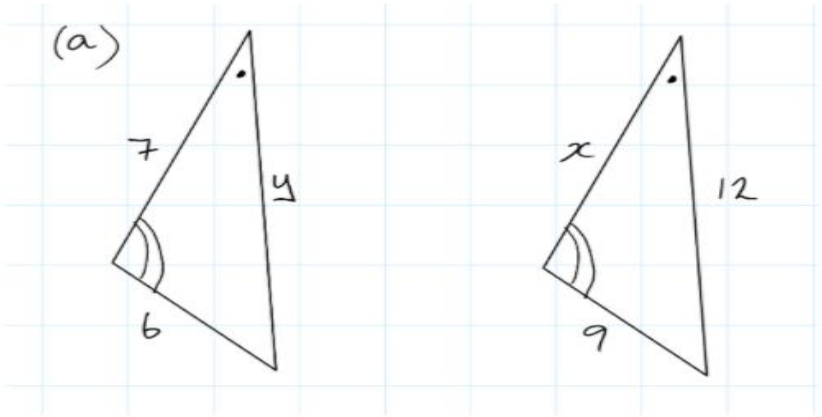


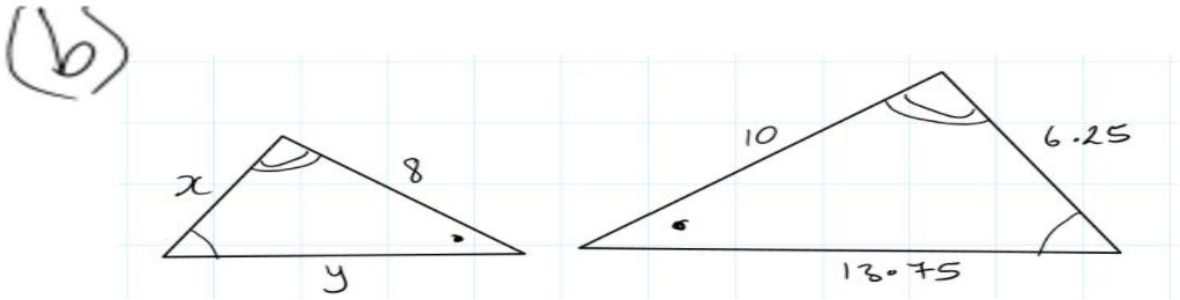
$$\frac{|AB|}{|DE|} = \frac{|AC|}{|DF|} = \frac{|BC|}{|EF|} \quad \text{or} \quad \frac{|DE|}{|AB|} = \frac{|DF|}{|AC|} = \frac{|EF|}{|BC|}$$

EXAMPLE 1



EXAMPLE 2



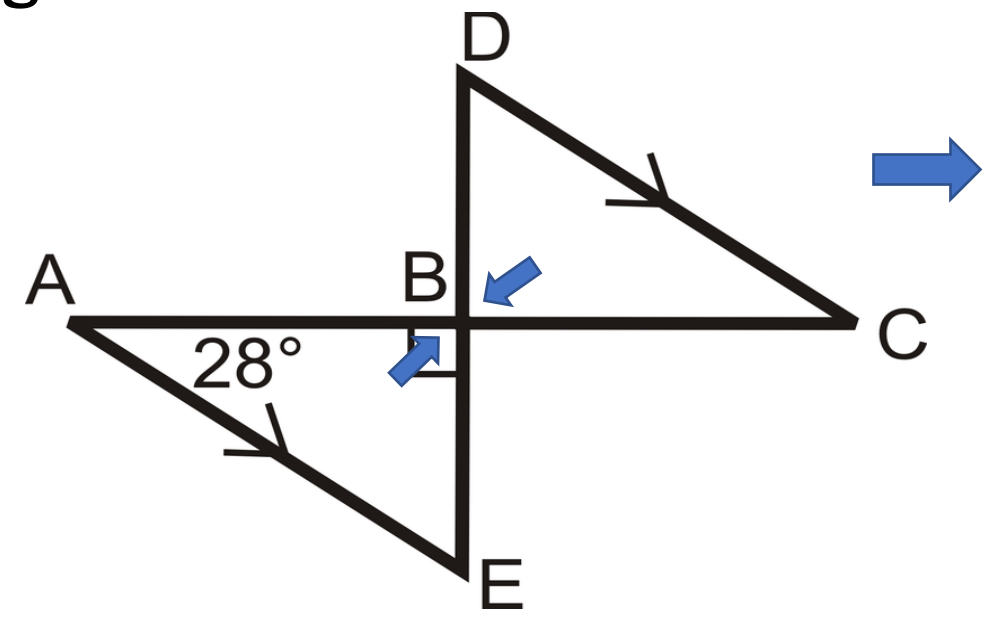


ANGLES IN SIMILAR TRIANGLES

Alternate angles

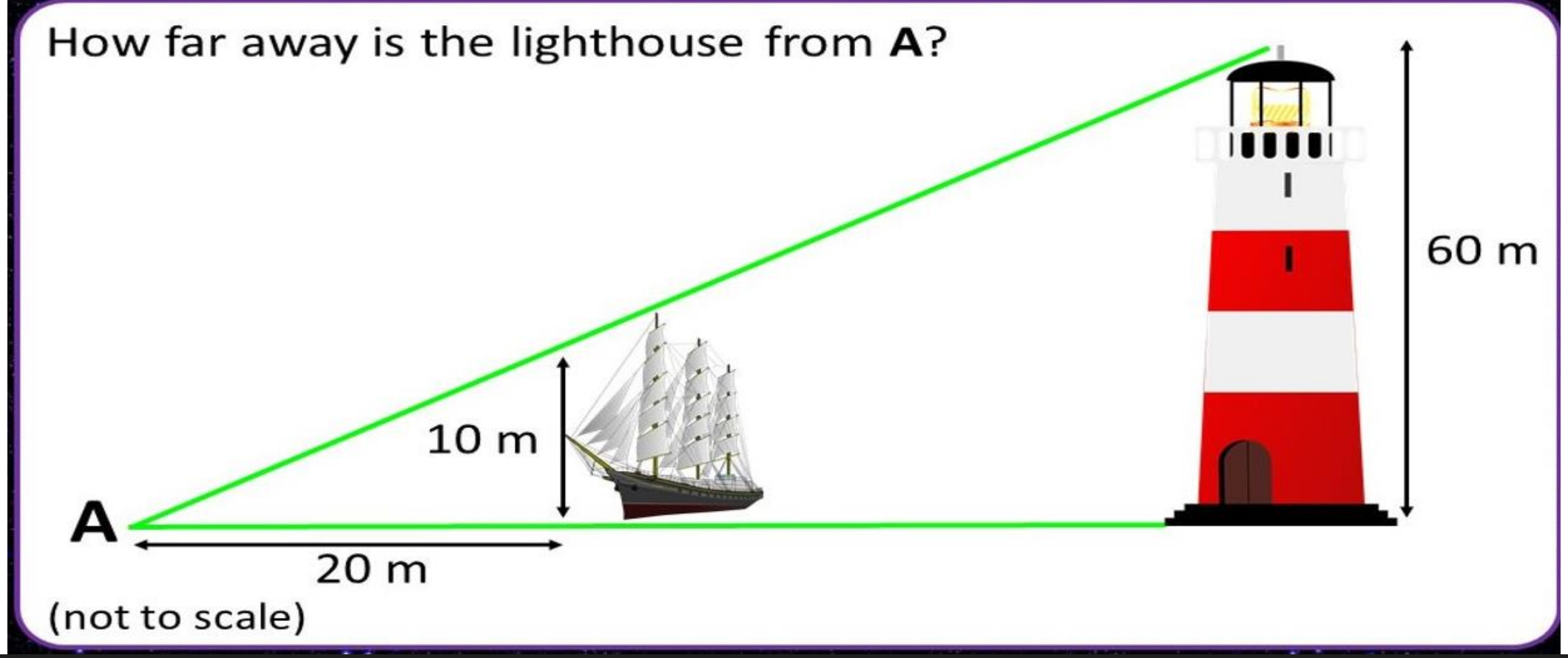
Angle D is alternate

to angle E



Vertically opposite

These angles are vertically opposite



REAL LIFE EXAMPLES

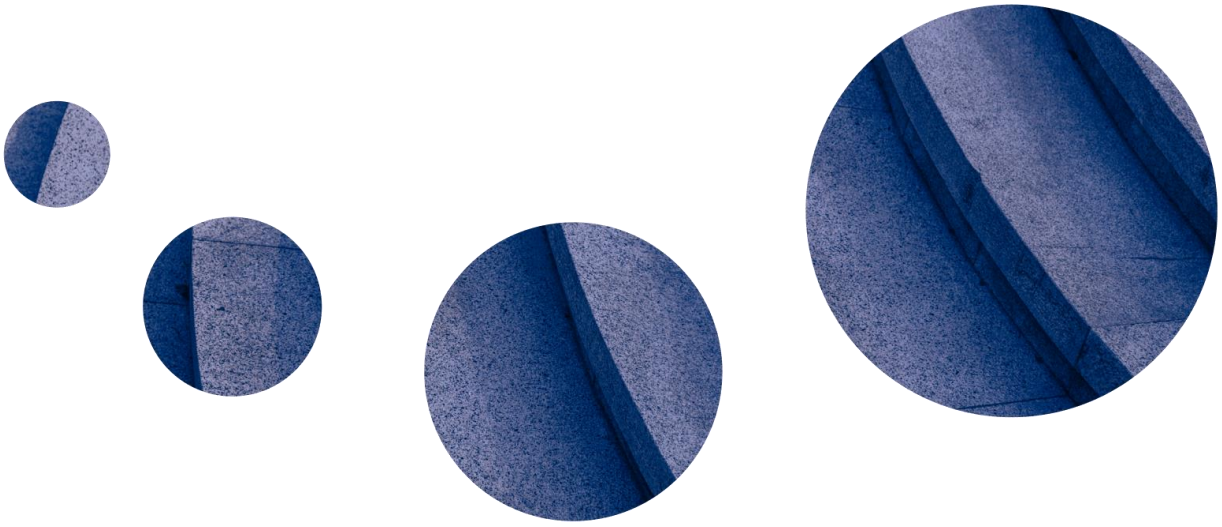
KAHOOT

Kahoot!

SUM UP

WHAT ARE SIMILAR TRIANGLES?

HOW DO WE RECOGNISE SIMILAR TRIANGLES?



Class plan

Similar triangles

1. Introduction to us - name, age etc.
2. Triangle game - students are given triangles to match with, the only instruction is to match the triangles, our aim is to see if students can discover similar triangles
3. Introduction into similar triangles
    - What are similar triangles? We are going to use the triangles from the game to explain what similar triangles are
    - And how do we recognize these similar triangles? All three angles are equal in triangles, but the sides are in proportion. They are not the same length but the match up.
4. Explaining triangles
    - In similar or equiangular triangles, all three angles in one triangle have the same measure as the corresponding three angles in the other triangle.
5. The scale ratio of triangles
    - An example of finding the ratio
    - Three examples for the students to work through themselves
6. The ratio of the sides
    - Showing examples on the power point

    - Worksheet for students to complete
7. Showing real life examples of similar triangles - Looking at a lighthouse and ship example on the power point
8. Real life problems – (handouts)- 3 questions regarding similar triangles and one in relation to ratio of the sides
9. Kahoot
10. Answering questions

How did we prepare our class?

Difficulties

The first problem we ran into was that a lot of people quit the project at the last minute. Because of this we had to find new students who were able to participate.

Preparation

When we found those new students we only had one week left to organize the whole project. Luckily our teacher Mr Steven helped us a lot in the preparation. To anticipate the possible problems we could encounter we already gave the lesson to a Belgian class at our own school. Thanks to this we were able to optimize our class and make sure all the students understood what we were telling them.

The lesson itself

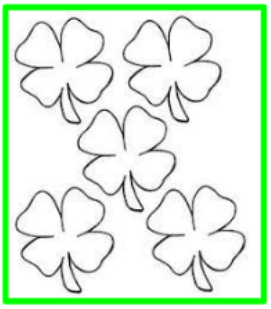
The lesson itself went well except for a few problems. The students weren't really participating in the beginning of the lesson so we started picking out random people and this helped a lot. The students learned something new but it wasn't too complicated for them.

The Kahoot that we had prepared was online, so we could do it the way we prepared him, because phones aren't allowed in the school. Because of this, we used colored paper. In this way, it was a bit difficult to see who the winner was, but now we could ask them better why they thought something was right or wrong.

How did we prepare our class?

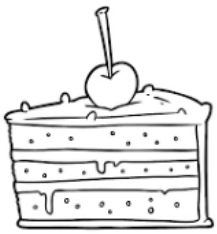
Examples

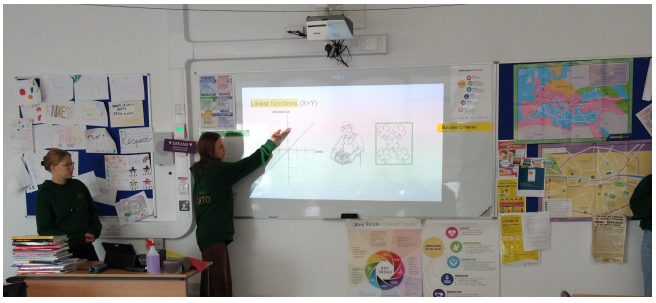
To explain the constant function we used the example of a wine cellar which always has to have the same temperature. Another example we gave was with a phone company who always charges the same amount of money every month.



To explain the linear function we used the example of farmer Patrick who has a piece of land. On the piece of land there are clovers. If he buys more land he will have more clovers.

To explain the linear function we used the example of a car driving. The car is driving and then encounters a traffic light. It reaches zero speed and then when the traffic light goes green again he speeds up. He leaves again.





To explain the exponential function we used the example where you have a cake of 10 pieces, when you are on your own, you have the 10 pieces for yourself. When there are 2 people, there are 5 pieces of the cake and when you are with 10 people, everyone has 1 piece. Another example we used was to build a house. When you're with not so many people, it will take a long time to build the house. When you are with a normal number of people, it will take a normal time to build the house and when you are with many people to build the house, the house will be built in a short time.

BELGIUM

BELGIUM ON A MAP

BRUSSELS

- capital city
- amazing and beautiful by night
- every year flower market in Brussels’ big market
- royal family -> King Fillip




ANTWERP

- the port of Antwerp
- Sportpaleis/Lotto Arena
- ‘De Meir’




GENT

- Gravensteen
- Graslei/Korenlei
- Gentse Feesten



FAMOUS BELGIAN FOOD

- Fries
- (Brussels and Liège) waffles
- Chocolate and especially pralines
- Carbonade flamande / stoofvlees
- Cuberdon
- Vol au vent
- Beer

THE BELGIAN COAST

- It’s an attractive place
- A lot of people have a second house or apartment here
- It’s the holiday place in Belgium

BELGIAN INVENTIONS

- Saxophone by Adolphe Sax
- internet, Robert Cailliau was from Belgium
- Candy
- Chocolate
- Deo

FAMOUS BELGIAN PEOPLE

- Angèle
- Stromae
- Romelu Lukaku
- Kevin De Bruyne
- Eden Hazard
- Thibaut Courtois
- Wout Van Aert
- Nafi Thiam
- Nina Derwael

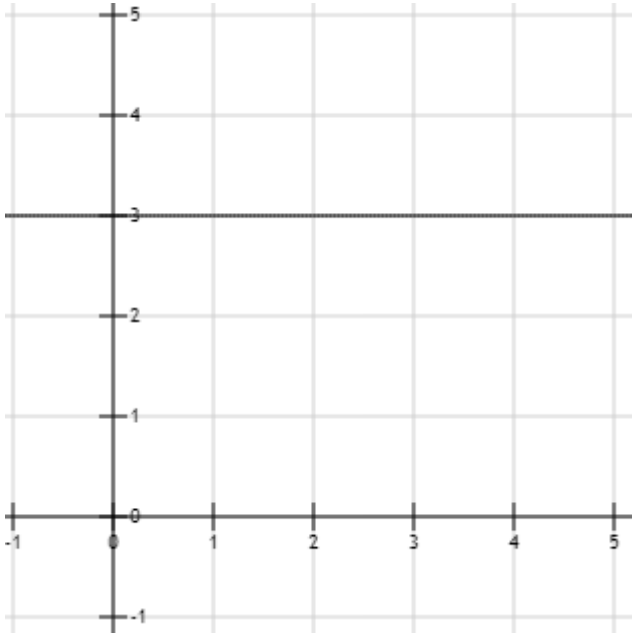
this was

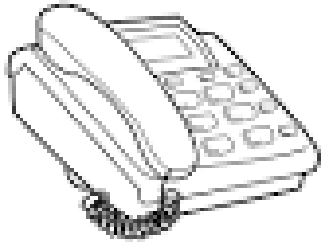
BELGIUM

Functions

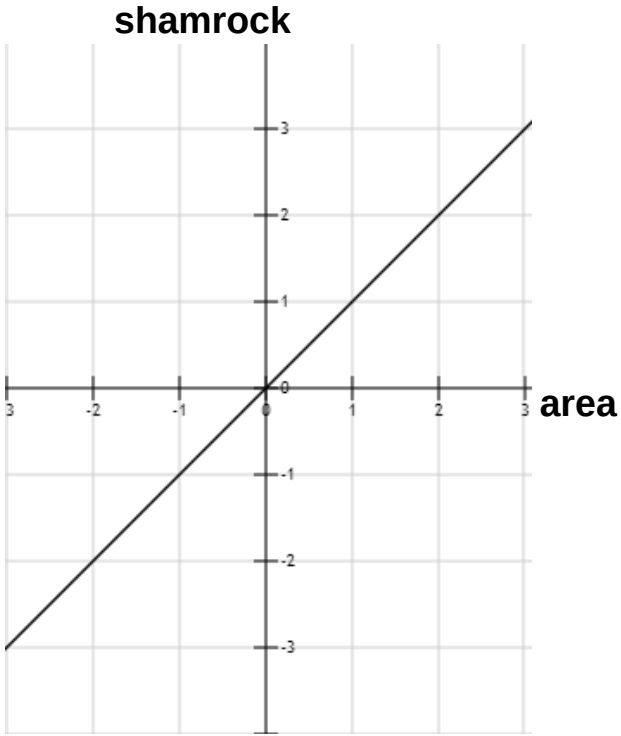
BY BELGIUM

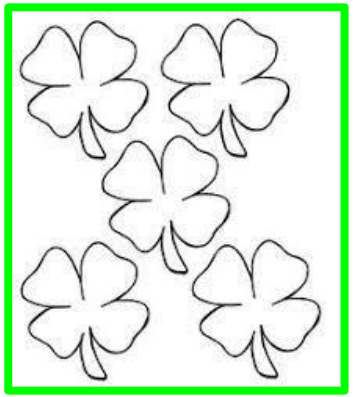
Constant functions (Y=A)



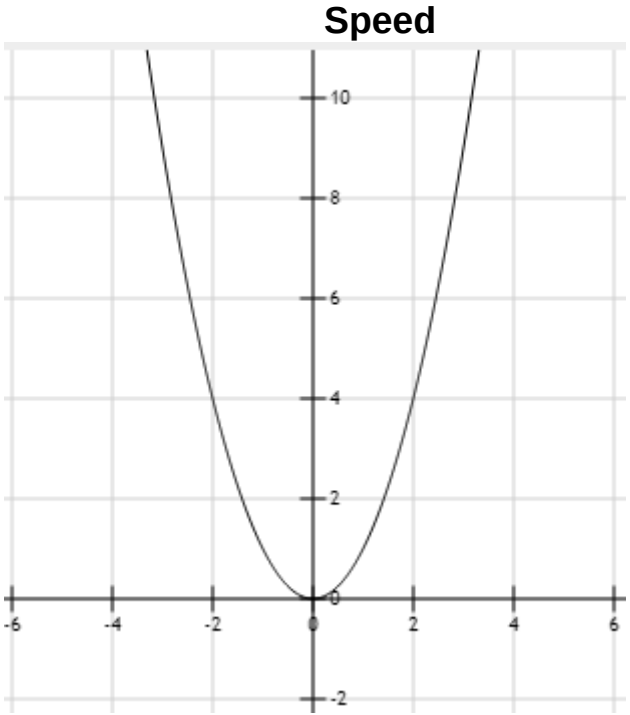


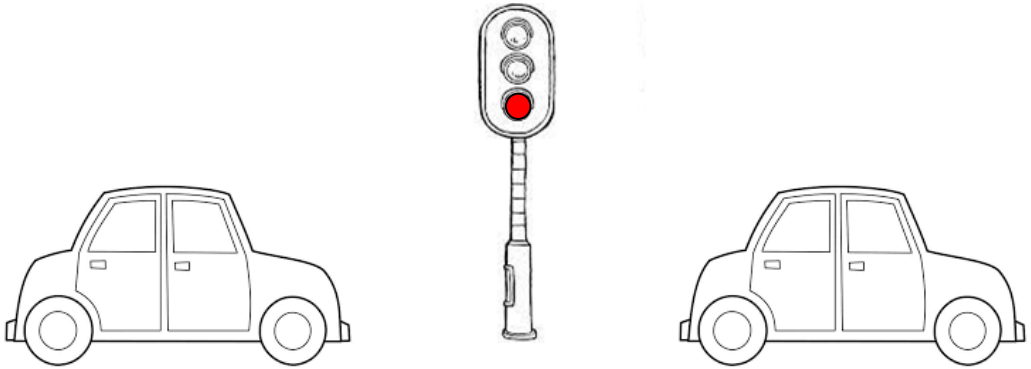
Linear functions (X=Y)



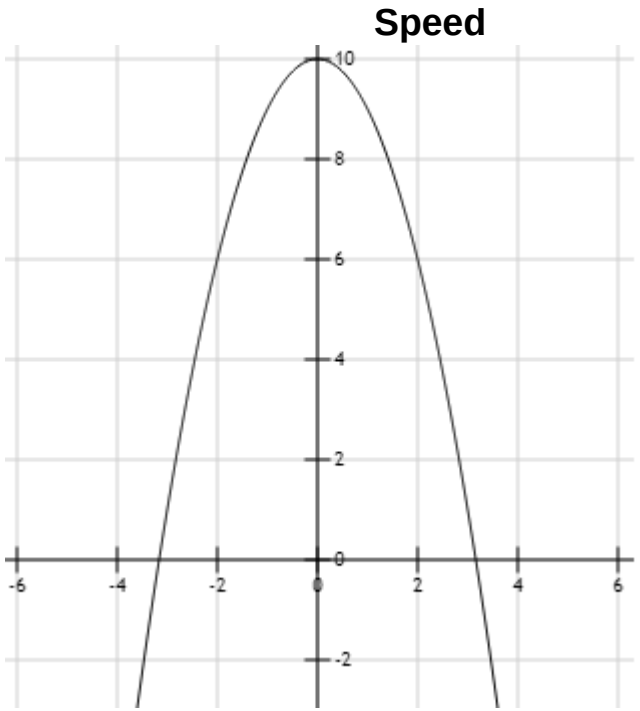


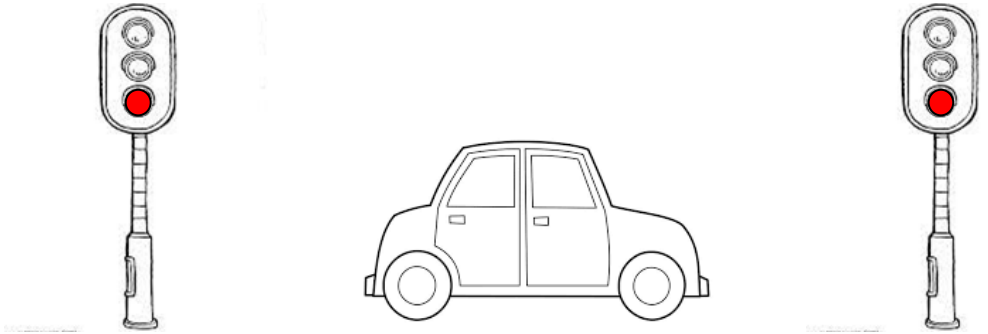
Quadratic functions ($Y=X^2$)



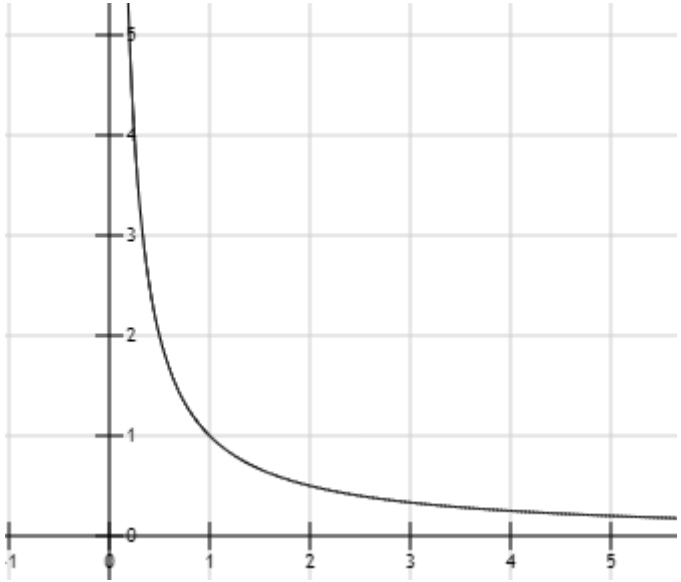


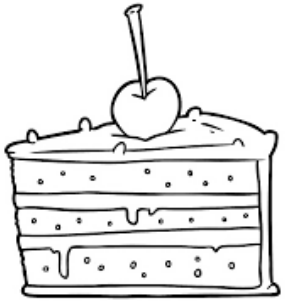
Quadratic functions ($Y=-X^2$)





Exponential functions (Y=1/X)

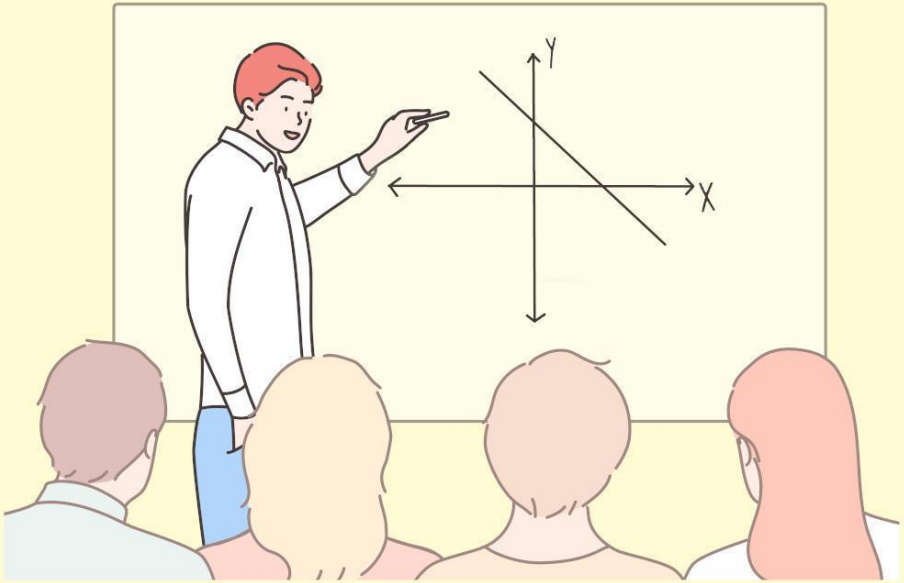




REPRESENTING LINEAR FUNCTIONS

Erasmus+

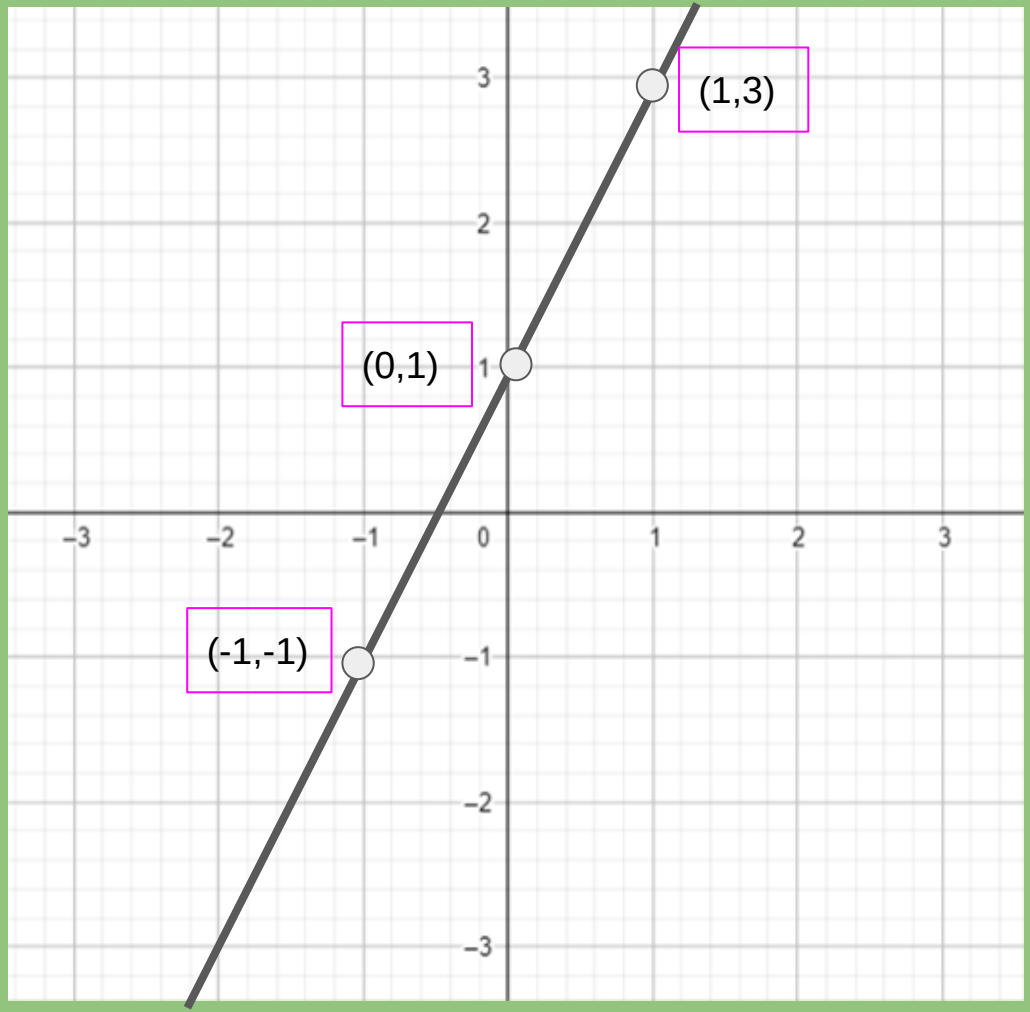
TOTALLY MATHS
Erasmus 2022



$$y=2x+1$$

TABLE OF VALUES

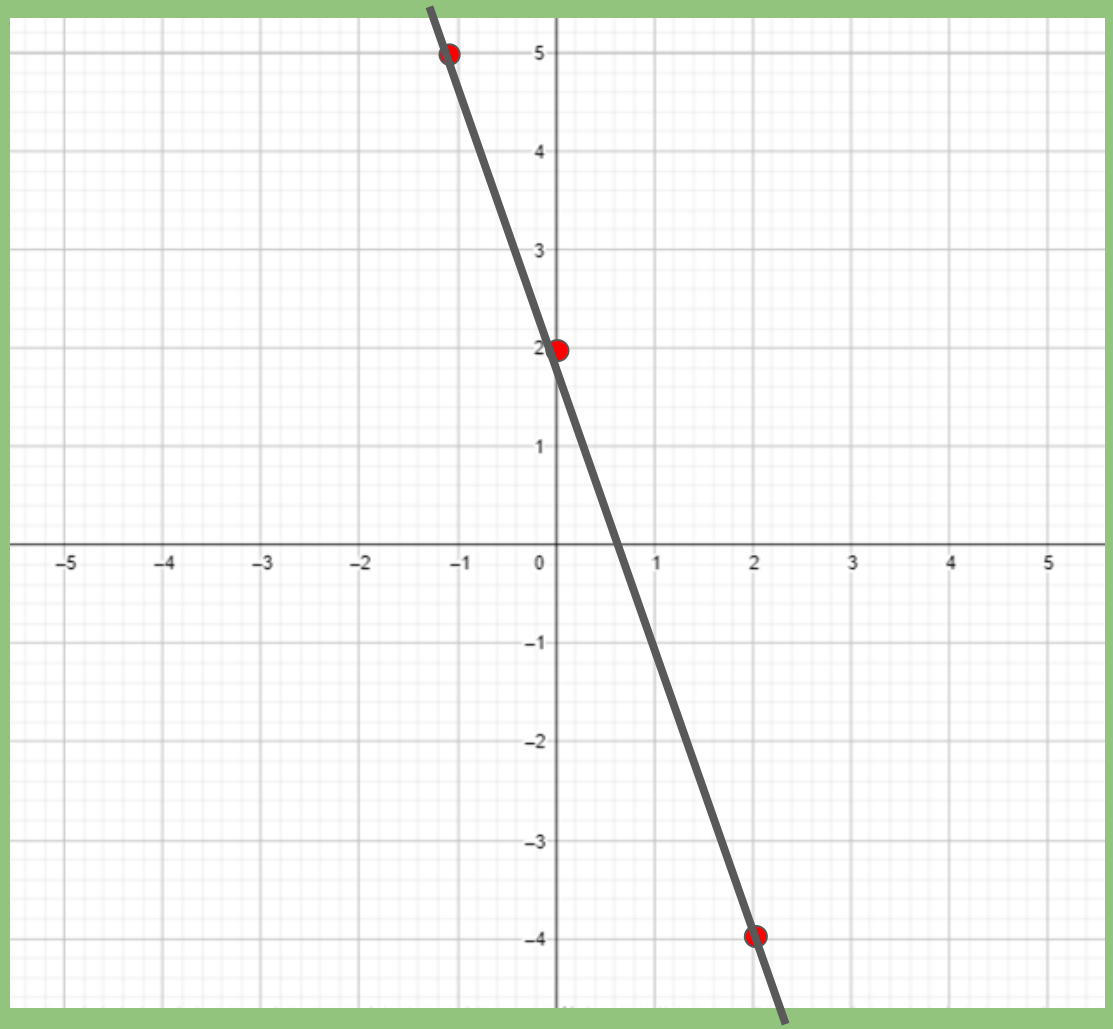
X	Y
0	1
1	3
-1	-1

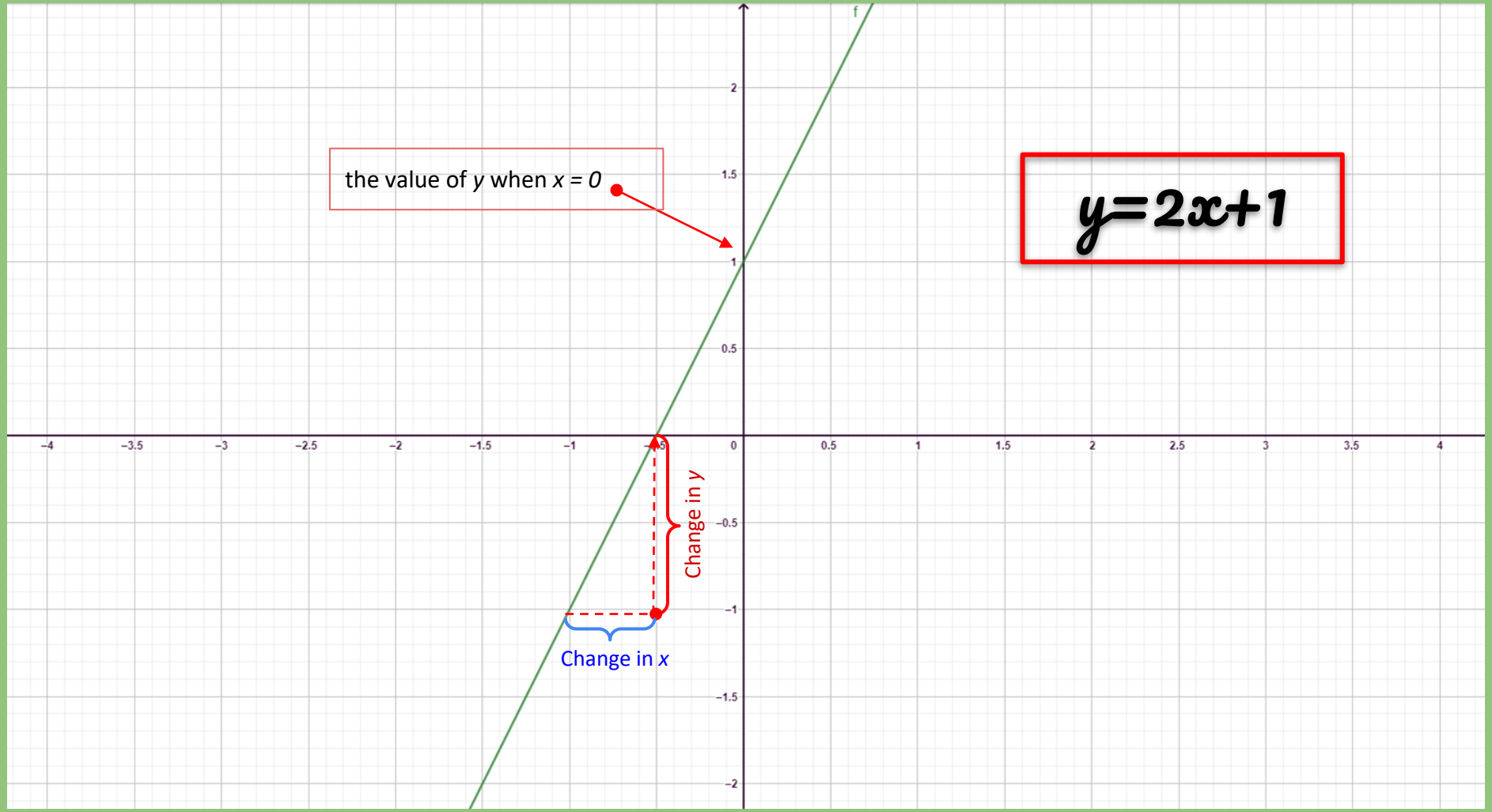


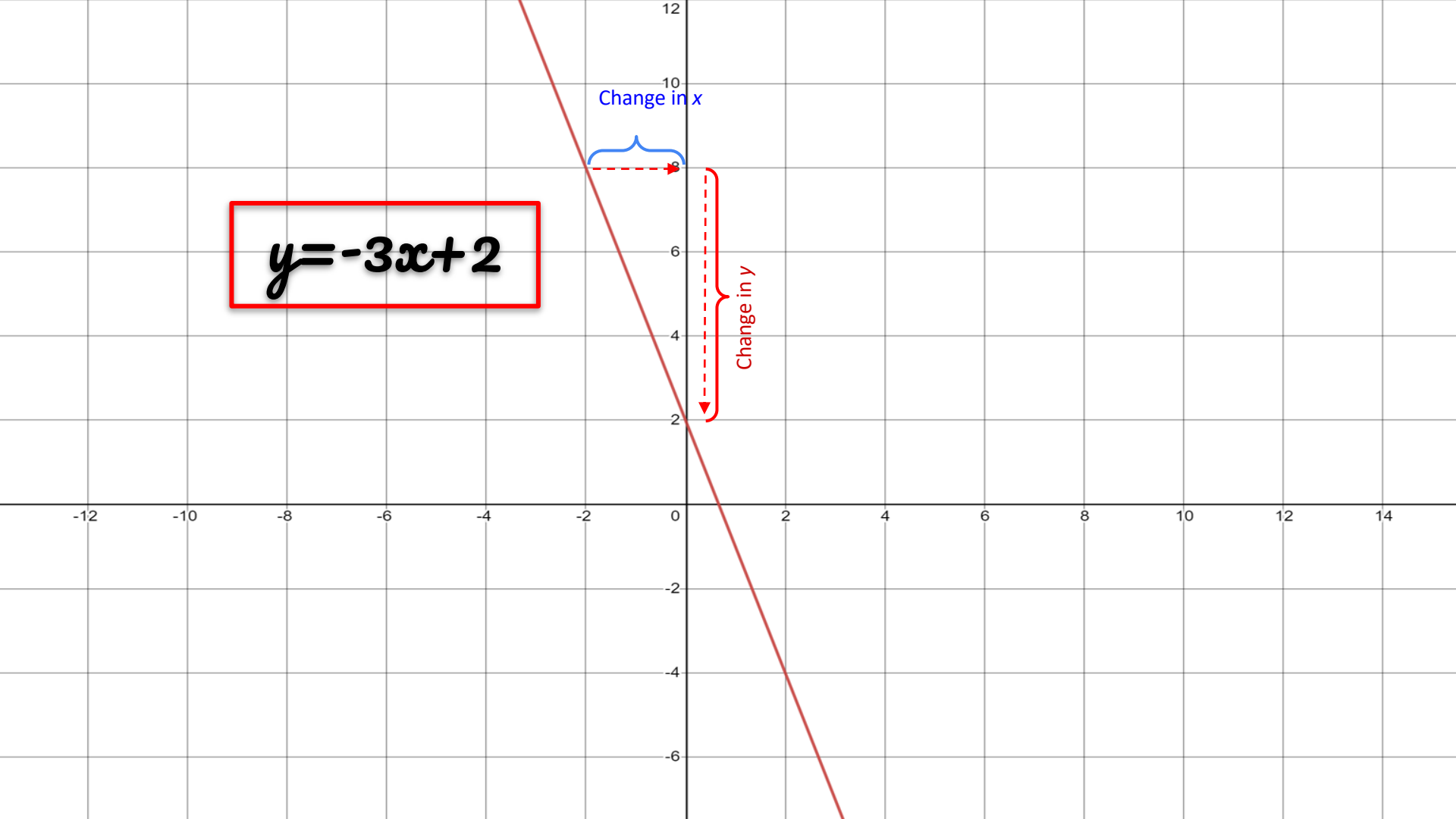
$$y=-3x+2$$

TABLE OF VALUES

X	Y
-1	5
0	2
2	-4




the value of y when x = 0
y=2x+1
Change in y
Change in x
f


y=-3x+2
Change in x
Change in y
12
10
8
6
4
2
0
-2
-4
-6
-12
-10
-8
-6
-4
-2
2
4
6
8
10
12
14

y=mx+n

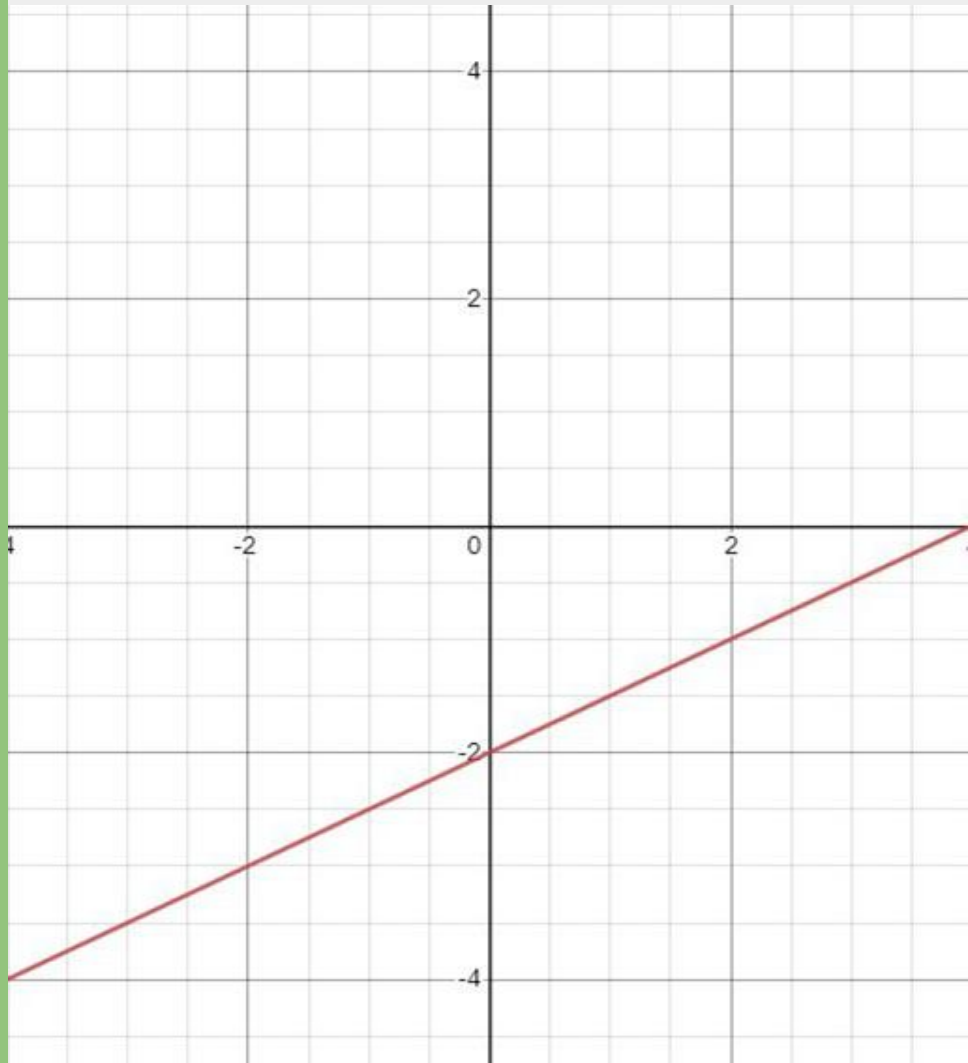
slope

y-intercept

y=1/2x-2

y-intercept: -2

slope of the line(x): 1/2

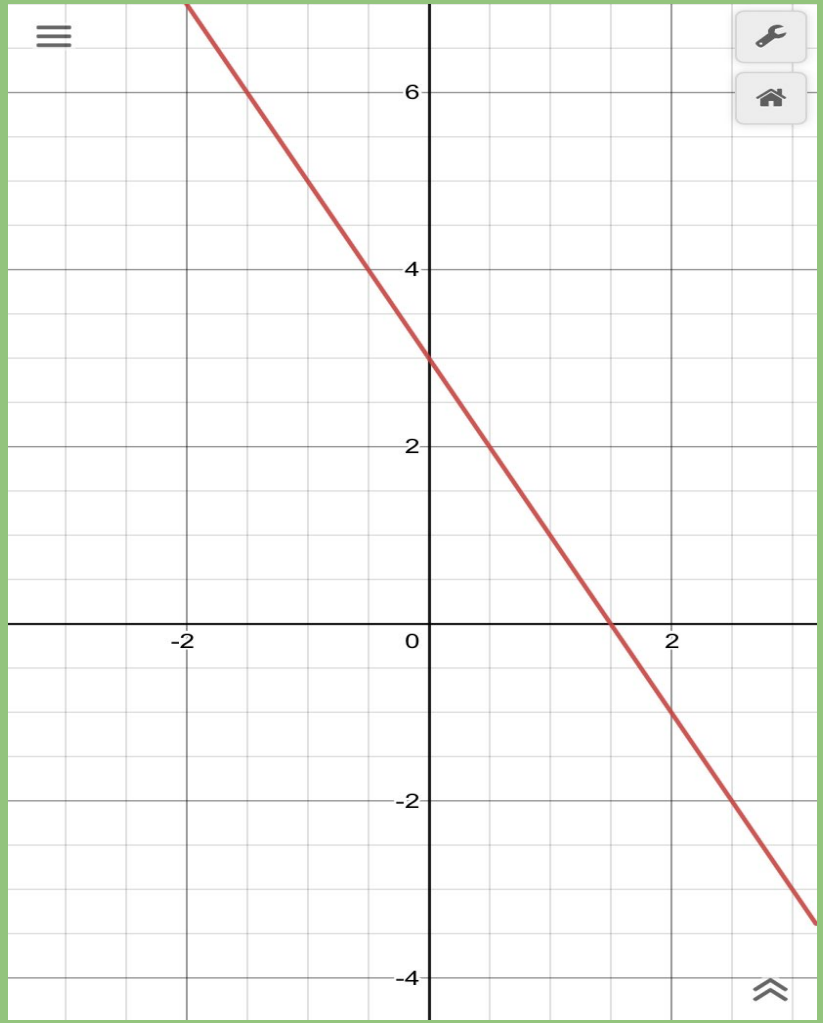


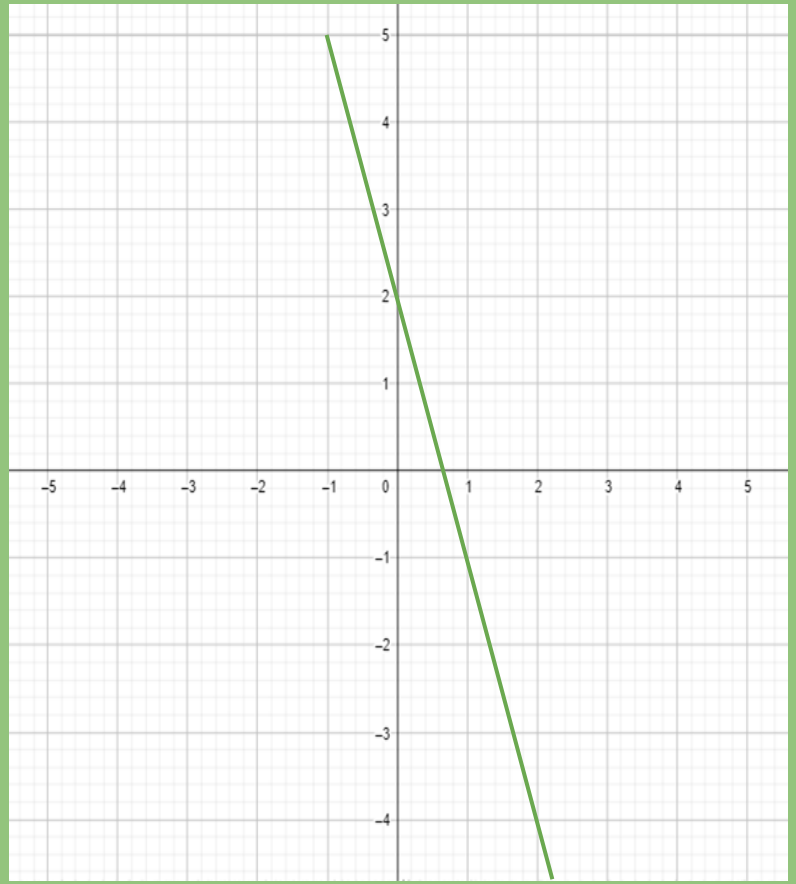
$y = -2x+3$

y-intercept : +3

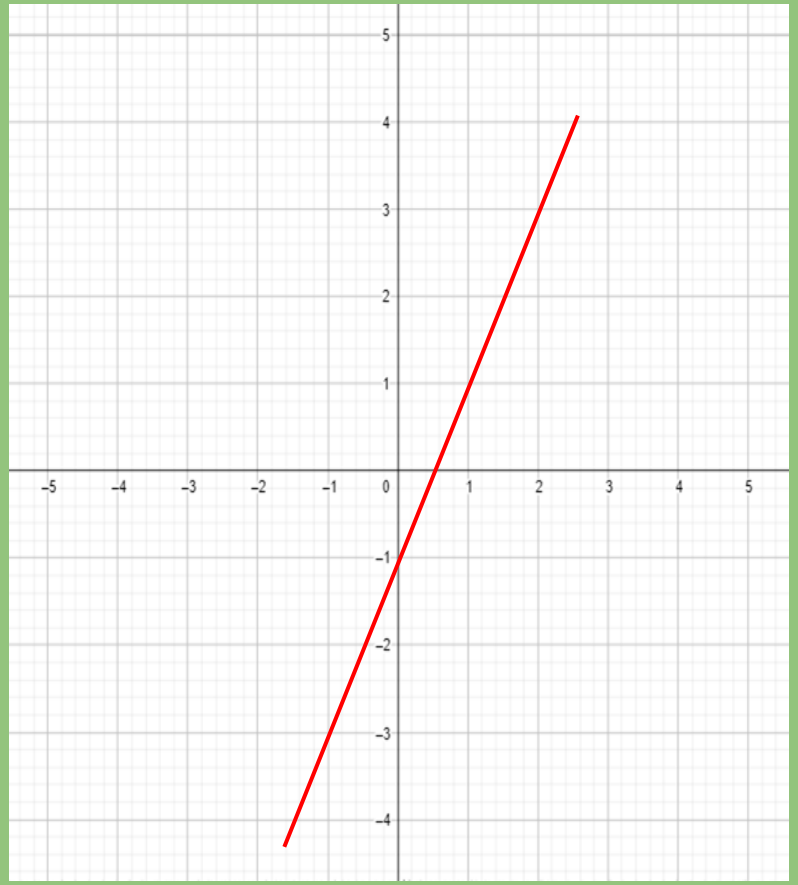
slope of the line (x)= -2/1

y=mx+n

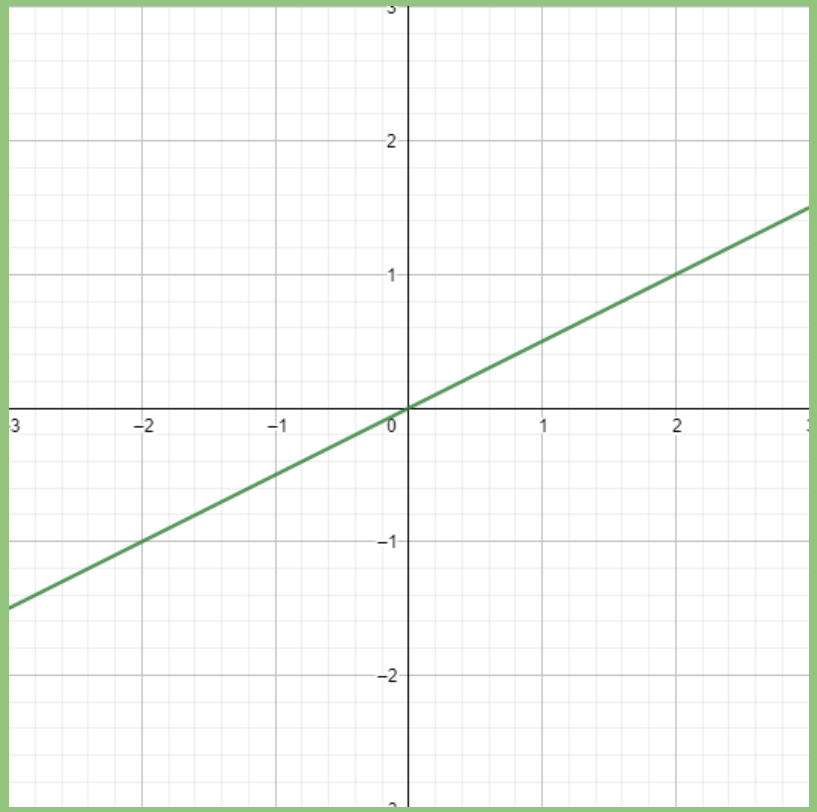




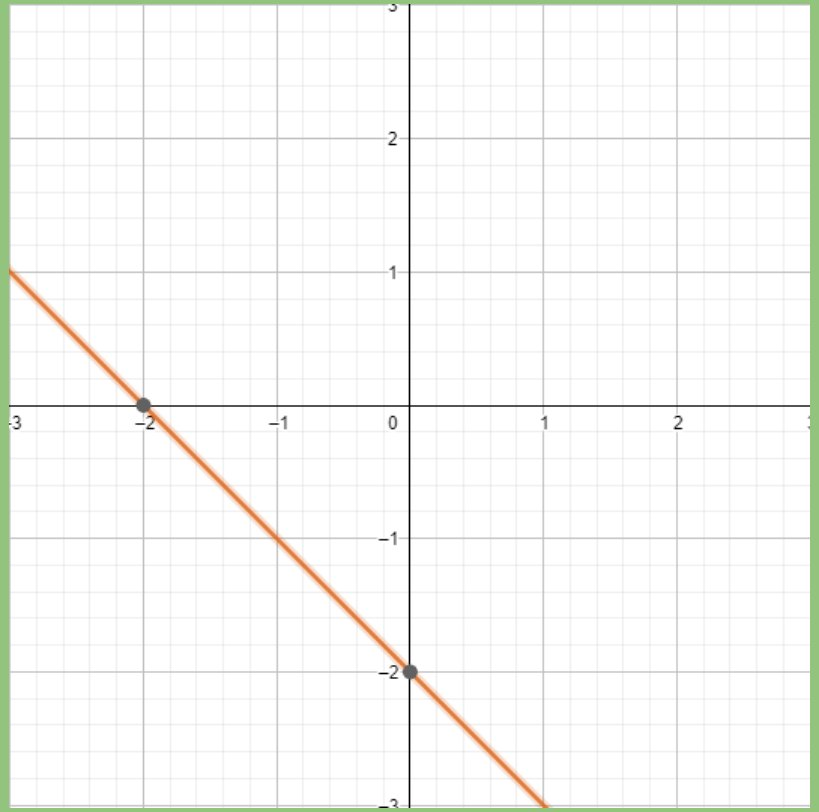
$y=-3x+2$



$y=2x-1$



$y=1/2x$



$y=-x-2$

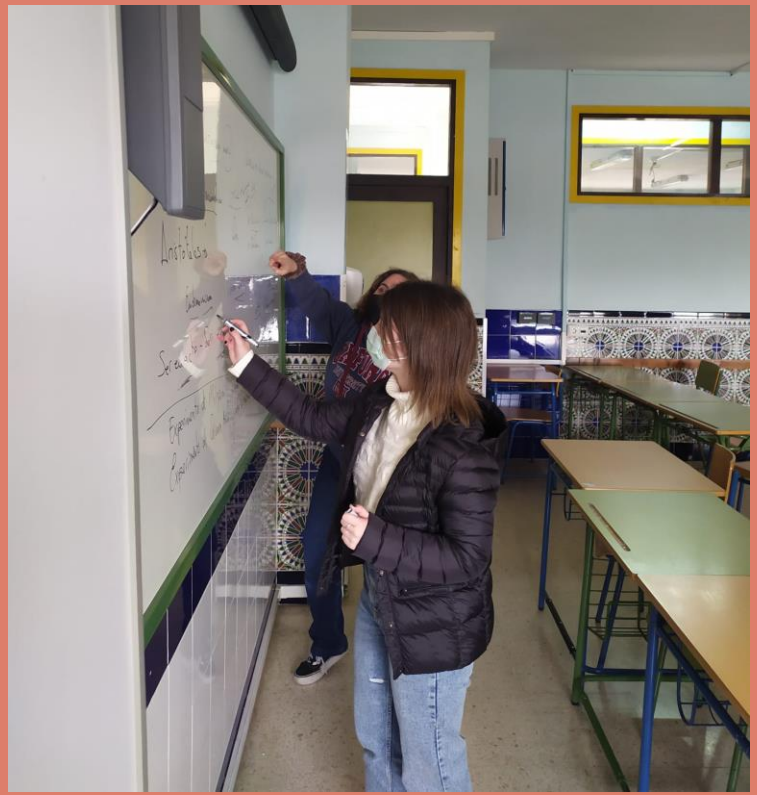
And now we are going to do a kahoot!

Thank you all for listening!
It was a pleasure being here today.

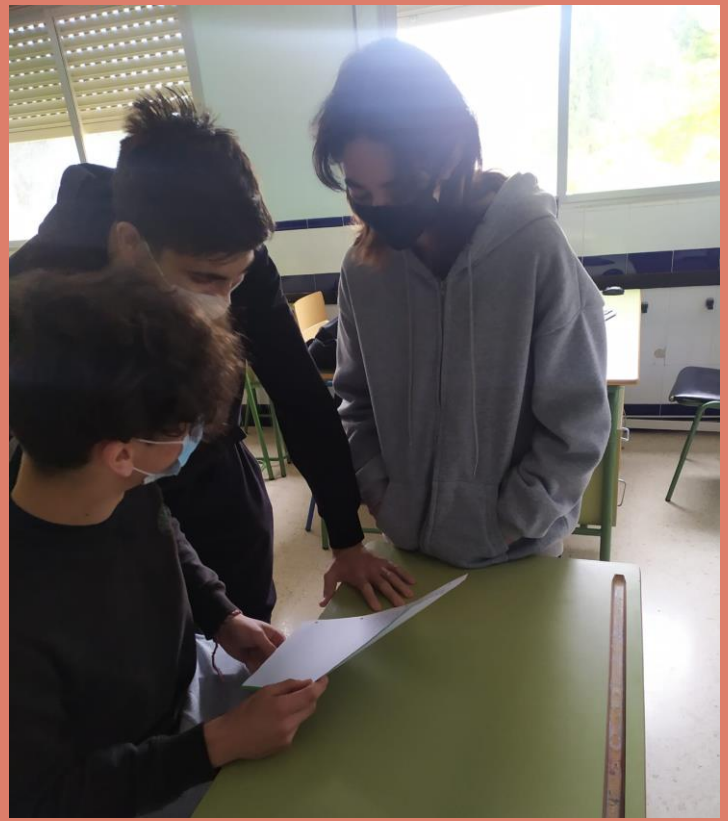
THE SPANISH TEAM PRESENTS:

THE MAKING OF OUR CLASS

Choosing the subject:

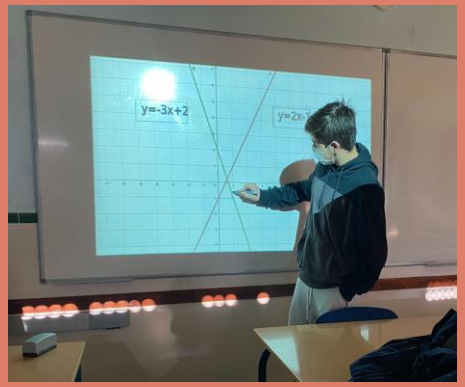


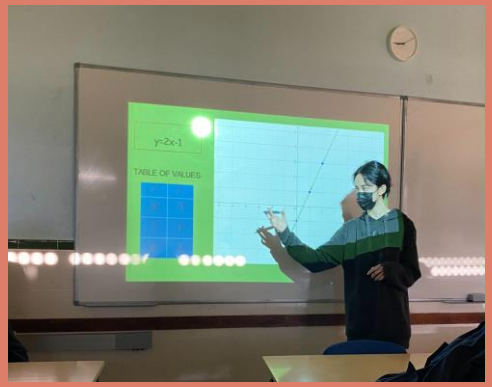
Dividing the tasks:

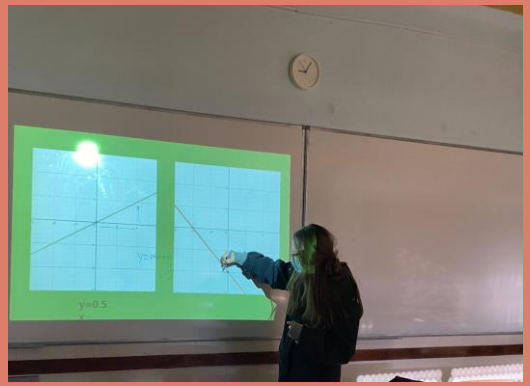


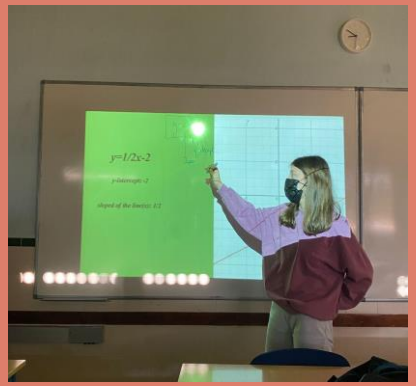
Working on the presentation:

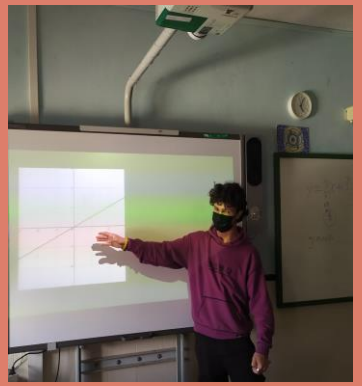
Practising the class:



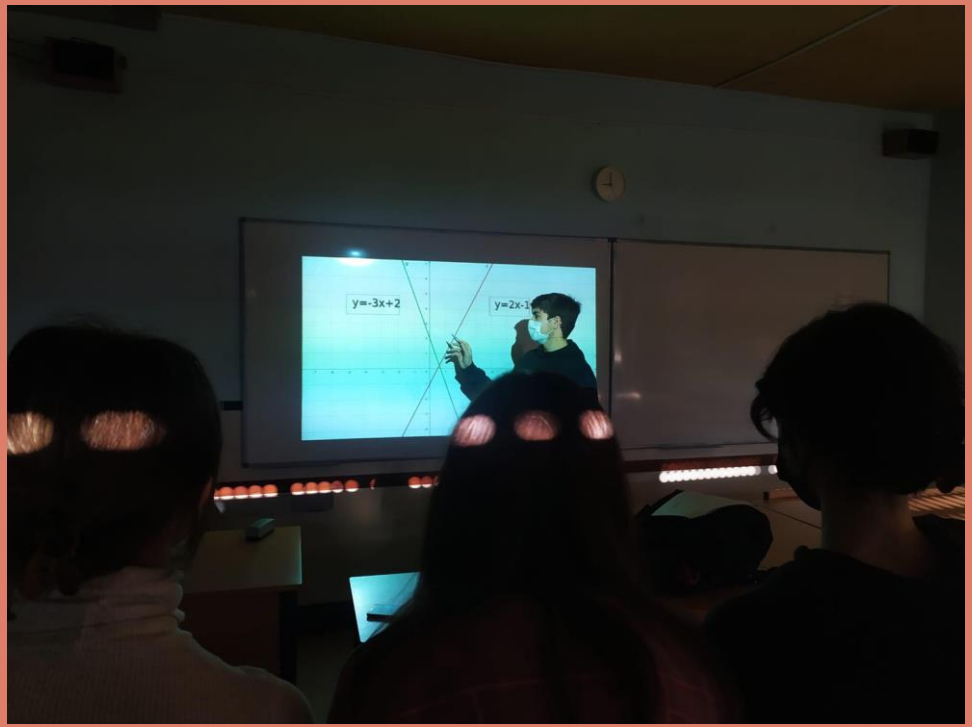






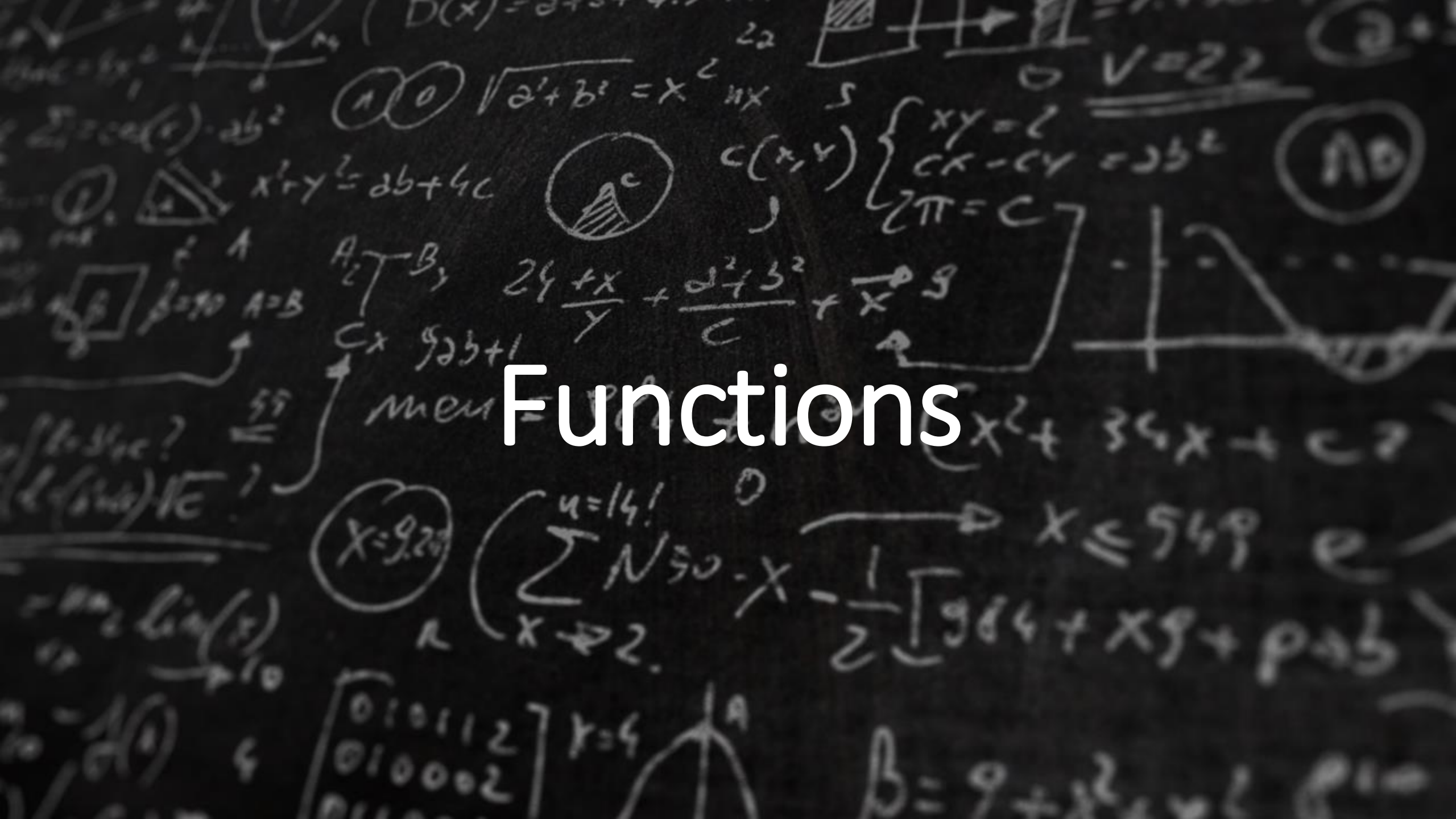


Practising with public:



Doing the exposition in Kells to the regular students:

It was a hard work, but we are all pleased and happy with the results and the experience:)



Functions

Meet our group!

Anna, 16

Niamh, 15

Alicia, 16

Kasey, 16

Eabha, 16

Emma, 16

Eva, 16

Introduction

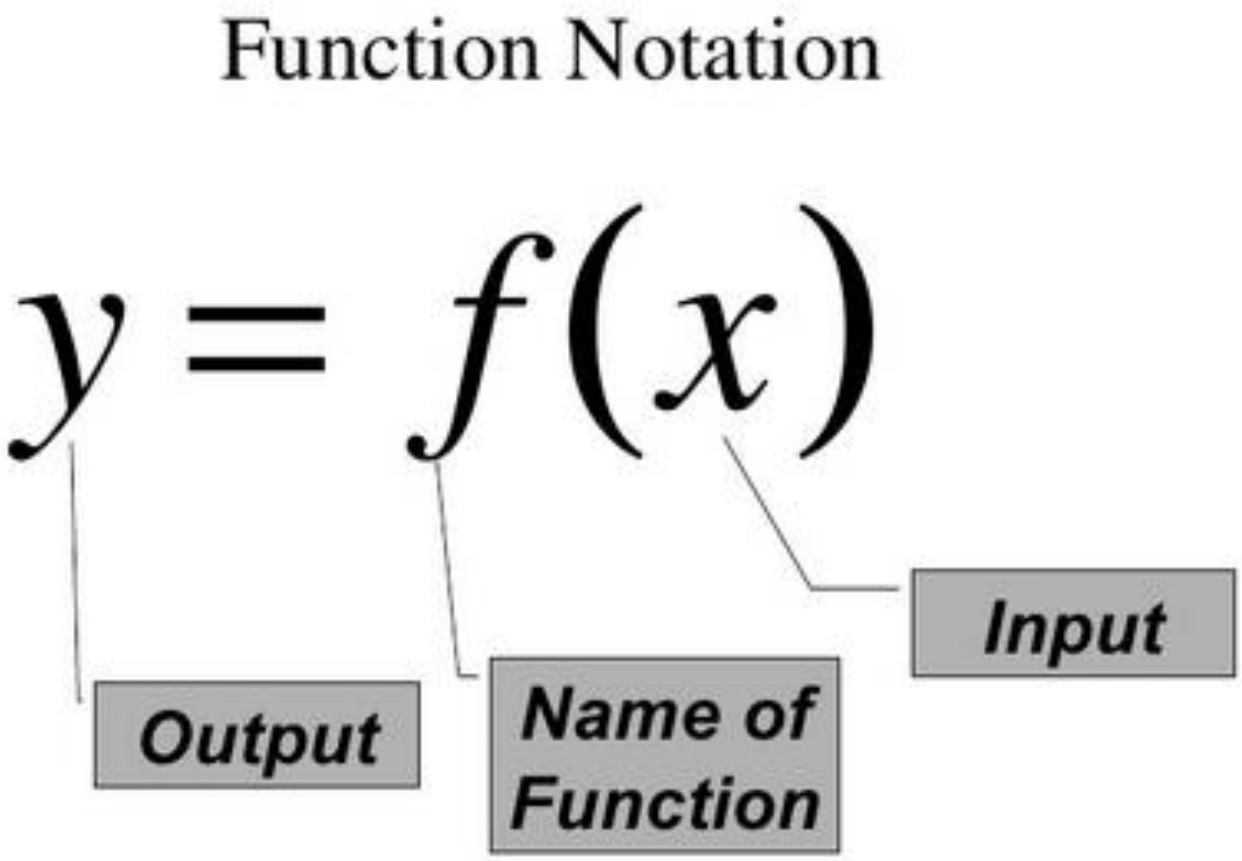
What are functions?

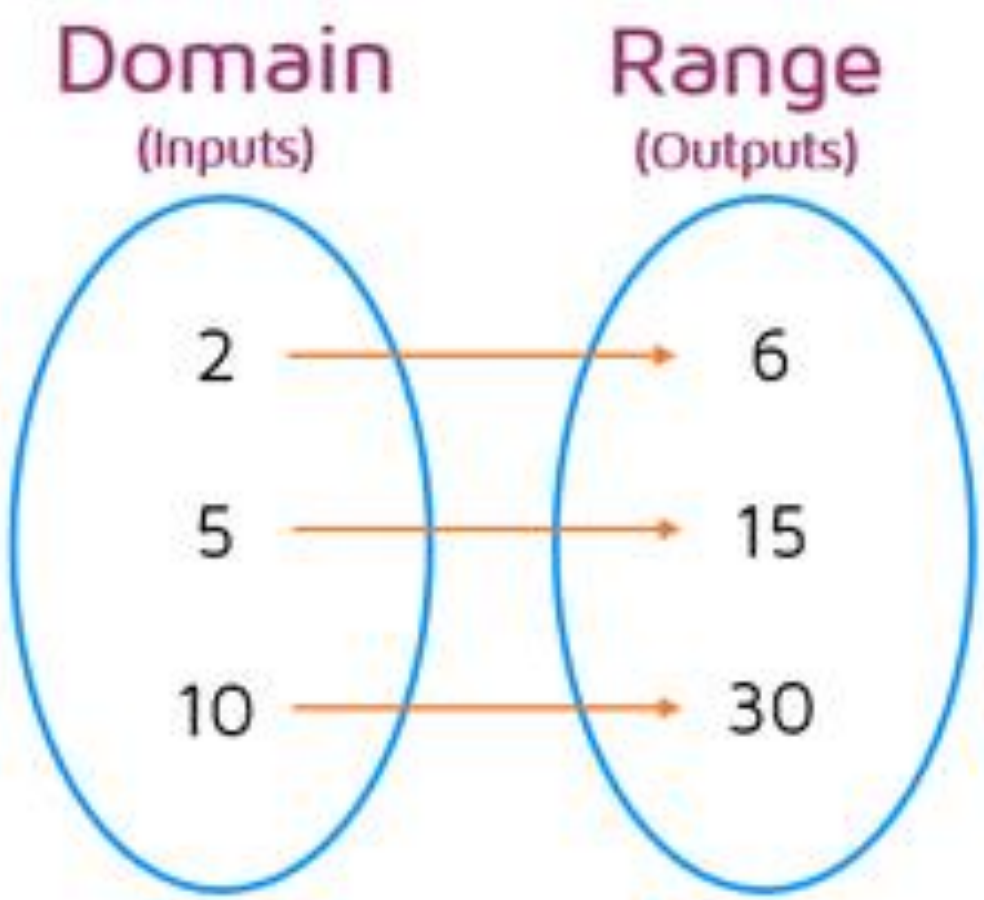
How can we recognise a quadratic function?

How do we solve a quadratic function?

What are the steps to figure out inputs and outputs on the calculator?

Key words





This function takes an input value and multiplies it by 3.

Key Words

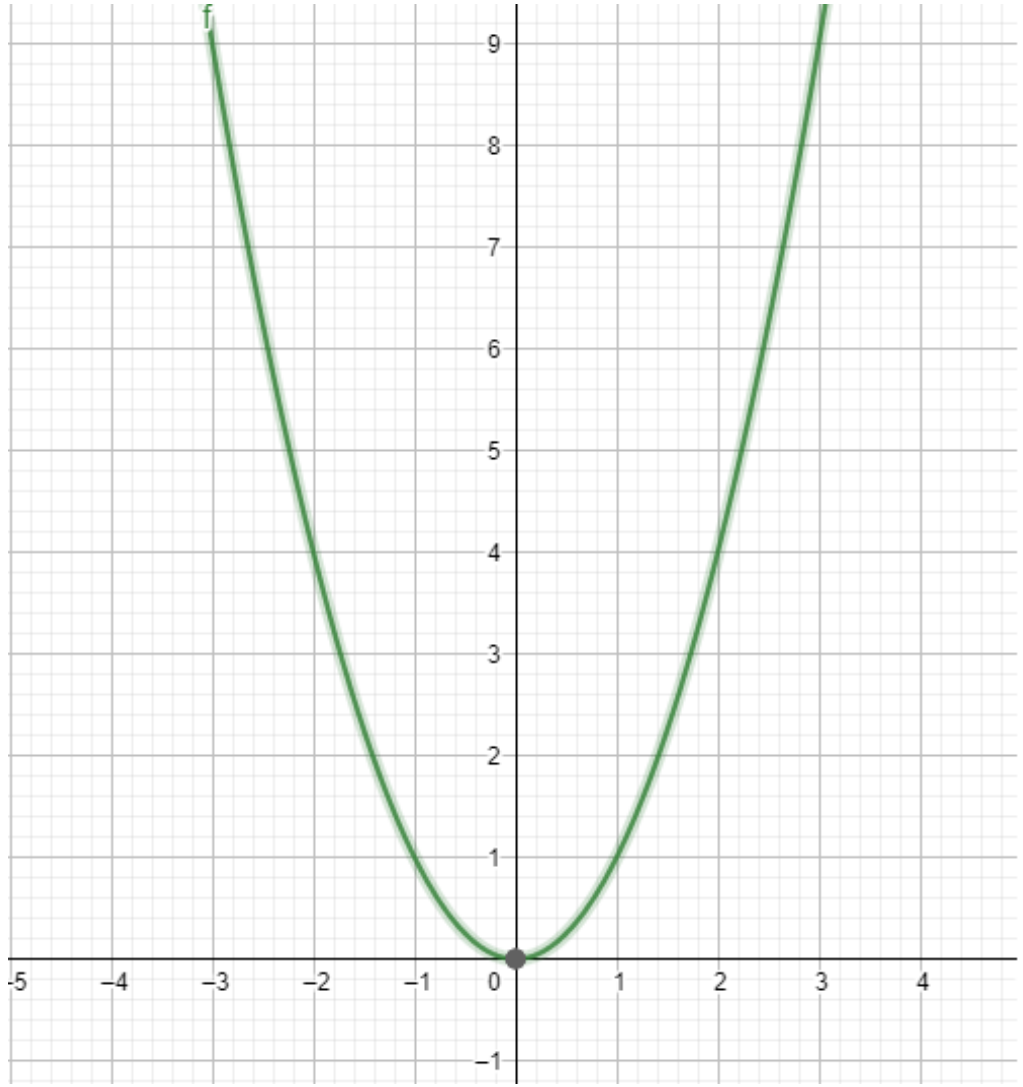
How to Graph a Quadratic Function

- Turn on calculator and press Mode Setup.
- Press 3.
- Then add in x^2 and press equals.
- Once that is done put in the first part of the sum –3.
- Then add in the end 3.
- We will be going up in steps of 1 so press equals.
- Then once that is all done you will have your table of results.
- Then graph your Function.

Example

$$f(x) = x^2$$

x	f(x)
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9




Kahoot!

Group Work

Worked Example

Questions for Functions

Question 14 **(Suggested maximum time: 20 minutes)**

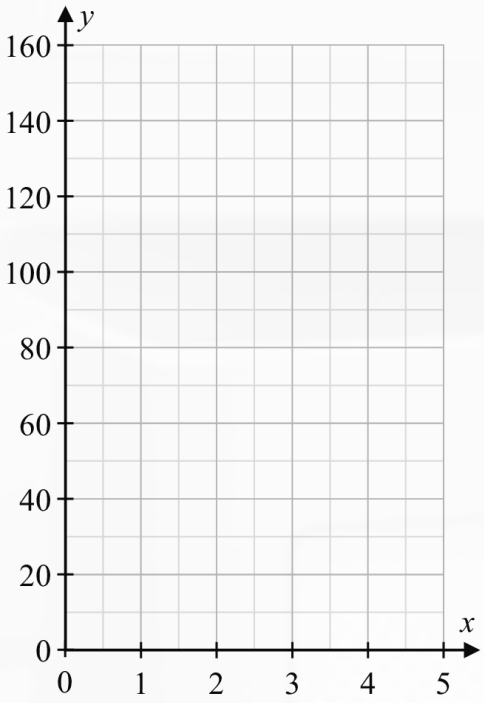
The function $h(x)$ below gives the approximate height of the water at Howth Harbour on a particular day, from 12 noon to 5 p.m.

$$h(x) = 10x^2 - 50x + 130,$$

where $h(x)$ is the height of the water in centimetres, and x is the time in hours after 12 noon.

Source: www.theirishlandscape.com. Altered.

(a) Draw the graph of the function $h(x) = 10x^2 - 50x + 130$ on the axes below, for $0 \leq x \leq 5$, $x \in \mathbb{R}$.



(b) Use your graph in part **(a)** to answer the following questions.

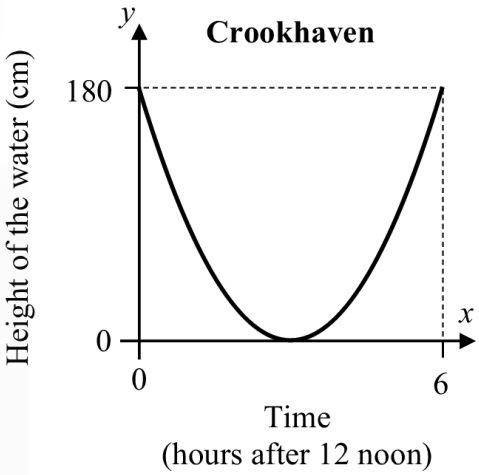
(i) Find the height of the water at 12 noon.

(ii) Estimate the height of the water at its lowest point.

(iii) After 12 noon, how long did it take before the water was at its lowest point?

The graph on the right shows the approximate height of the water in centimetres at Crookhaven on a different day, from 12 noon to 6 p.m. The graph is symmetrical.

On this day, the height of the water at 12 noon was 180 cm, and the height of the water at the lowest point on the graph was 0 cm.



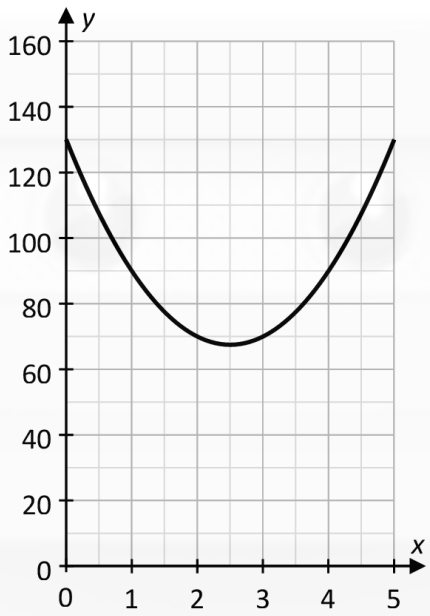
(c) Taking x as the time in hours after 12 noon, this graph is given by the function

$$g(x) = ax^2 + bx + c,$$

where $a, b, c \in \mathbb{Z}$, and $x \in \mathbb{R}$.

(i) Find the value of c.

(ii) Hence, or otherwise, find the value of a and the value of b.

Q14	Model Solution – 45 Marks	Marking Notes
(a)		**Scale 15D (0, 4, 9, 13, 15)** Accept correct graph without work. Award a linear graph at most *Low Partial Credit*. *Low Partial Credit* • Some work of merit, e.g. some correct substitution for x in $h(x)$. *Mid Partial Credit* • $h(x)$ evaluated correctly for any three values of $x \in \{0,1,2,3,4,5\}$ (Accept points shown on the graph) *High Partial Credit* • 6 points on the graph of $h(x)$ plotted correctly. • 5 points on the graph of $h(x)$ plotted and joined correctly *Full Credit –1* • Curve with a flat bottom, otherwise correct
(b)	(i) 130 cm (ii) 67.5 cm (iii) 2·5 hours	**Scale 15C (0, 5, 12, 15)** Accept correct answers without work. Accept answers taken from either the graph or the function In (ii), tolerance of ± 3 units on *y*-axis, but not in next box up or down. *Low Partial Credit* • 1 part correct • Relevant line on graph (either a vertical line from the lowest point or a horizontal line from the lowest point) *High Partial Credit* • 2 parts correct *Full Credit –1* • Unit(s) incorrect or omitted, otherwise fully correct

Q14	Model Solution – 45 Marks	Marking Notes
(c) (i)&(ii)	**Method 1** *Part (i)* (0, 180): $a(0)^2 + b(0) + c = 180$ [E1] $\Rightarrow \quad c = 180$ *Part (ii)* (3, 0): $a(3)^2 + b(3) + 180 = 0$ [E2] $\Rightarrow \quad 9a + 3b = -180$ $\Rightarrow \quad 3a + b = -60$ (6, 180): $a(6)^2 + b(6) + 180 = 180$ [E3] $\Rightarrow \quad 36a + 6b = 0$ $\Rightarrow \quad 6a + b = 0$ E3 – E2: $\Rightarrow \quad 3a = 60$ $\Rightarrow \quad a = 20$ E2: $b = -60 - 3(20)$ $\Rightarrow \quad b = -120$ **OR** **Method 2** Quadratic has 2 roots at $x = 3$ $\Rightarrow \quad g(x) = a(x-3)^2$ $= a(x^2 - 6x + 9)$ $= ax^2 - 6ax + 9a$ (0, 180): $a(0)^2 - 6a(0) + 9a = 180$ $\Rightarrow \quad a = 20$ $\Rightarrow \quad g(x) = 20x^2 - 120x + 180$ i.e. $a = 20,\ b = -120,\ c = 180$ **OR**	**15D (0, 4, 9, 13, 15)** Accept correct answers without work. *Low Partial Credit* • Work of merit, e.g. identifies (0,180), (3,0), or (6,180); relevant substitution in $g(x)$; relates c to y-intercept; attempt at relevant shifting of graph; *Mid Partial Credit* • Finds $c = 180$ • Finds E1 and E2 and E3 • Finds $a = 20$ • $(x-3)^2$ *High Partial Credit* • Finds c and E2 and E3 • $20(x-3)^2$ • Finds a or b, having found c

Q14	Model Solution – 45 Marks	Marking Notes
(c) (i)&(ii) cntd	**Method 3** The shifted quadratic graph through (0,0) and (3,180) is of the form $y = ax^2$ $\Rightarrow \quad a\,(3)^2 = 180$ $\Rightarrow \quad a = 20$ Shift quadratic 3 units back to the right: $\Rightarrow \quad g(x) = 20\,(x-3)^2$ $= 20\,(x^2 - 6x + 9)$ $= 20x^2 - 120x + 180$ i.e. $a = 20,\ b = -120,\ c = 180$	*See previous page.*

Our Lesson Plan

Key words

- We decided to start the lesson by recapping key words, so that the students know which words they need to know for the lesson

Evaluation:

It was good to tell the students what the key words are so they would be able to know what to expect.

We could have included more key words.

Matching Game

- We used GeoGebra to graph the functions for the matching game

- We decided to use this to start our lesson to see what prior knowledge that the students had of the topic

Evaluation:

It was a fun way to get them interacting and working together.

However, one of the graphs was wrong.

Graphing Functions

- Graphing Functions was next in our class, we decided to add this as a follow on from the matching game
- We decide to make it into a race to add excitement to the class

Click to add text

Evaluation:

It made everyone get involve and it was a different method of graphing functions for them.

We could have used graph paper and make sure they graph the function correctly, by plotting the points.

Kahoot

- We added in the Kahoot to test the student's knowledge on what we have taught them during the lesson
- We also thought that it would be a bit of fun!

Evaluation:

It was a fun way to assess what they had learned from the lesson.

If we had laptops or phones we could have had a winner.

Worked Example

- We added in the worked example to relate what we were teaching to real life examples
- It also allowed the students to recap what we had taught during the lesson

Evaluation:

It was a real-life example and their answers showed us what they had learned.

We could have swapped the Kahoot and the worked example around to finish the lesson on a fun activity.