Ex 1 : Retour à la ligne (7 pts)

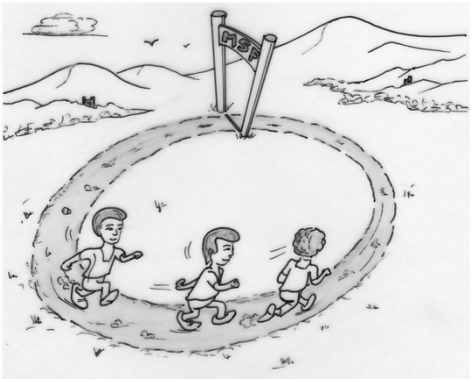
Trois enfants marchent sur une piste circulaire de 250 m de circonférence.

Ils sont partis en même temps sur la ligne de départ.

Le premier avance à la vitesse constante de 5 km/h, le deuxième à 4 km/h et le troisième à 3 km/h.

Dans combien de minutes vont-ils se retrouver tous les trois sur la ligne de départ

pour la première fois ? Justifier.



Tre bambini corrono su una pista circolare la cui lunghezza è di 250 m.

Sono partiti contemporaneamente dalla riga di partenza. Il primo procede con velocità costante di 5 km/h, il secondo con velocità costante di 4 km/h e il terzo con velocità costante di 3 km/h.

Dopo quanto tempo si ritrovano tutti e tre assieme sulla linea di partenza? Giustificate la vostra risposta.

Drei Kinder laufen auf einer runden Bahn vom Umfang 250 m im Kreis. Sie sind gleichzeitig an der Startlinie losgelaufen. Alle laufen mit konstanter Geschwindigkeit: Das erste Kind läuft 5 km/h, das zweite 4 km/h und das dritte 3 km/h.

Wie viele Minuten nach dem Start befinden sich alle drei zum ersten Mal gleichzeitig auf der Startlinie? Begründet eure Antwort.

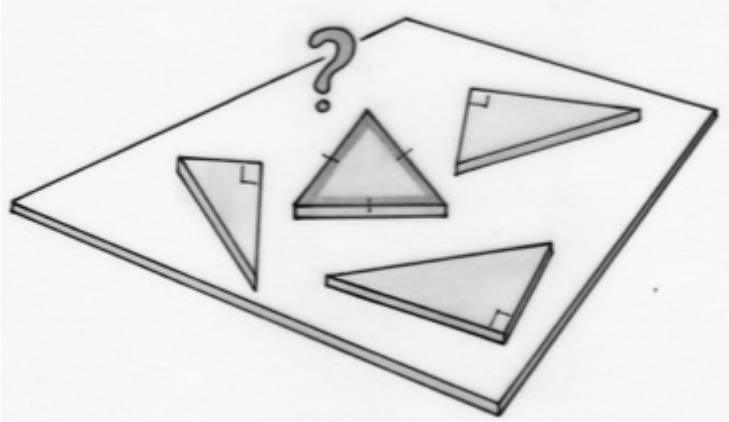
Tres niños corren por una pista circular cuya circunferencia es de 250 m. Se fueron al mismo tiempo desde la línea de salida. El primero avanza a una velocidad constante de 5 km/h, el segundo a 4 km/h y el tercero a 3 km/h.

¿En cuántos minutos estarán los tres en la línea de salida por la segunda vez? Justificar.

Ex 2 : All For One (5 pts)

A right-angled triangle is placed on each side of an equilateral triangle. The resulting shape is a new right-angled triangle.

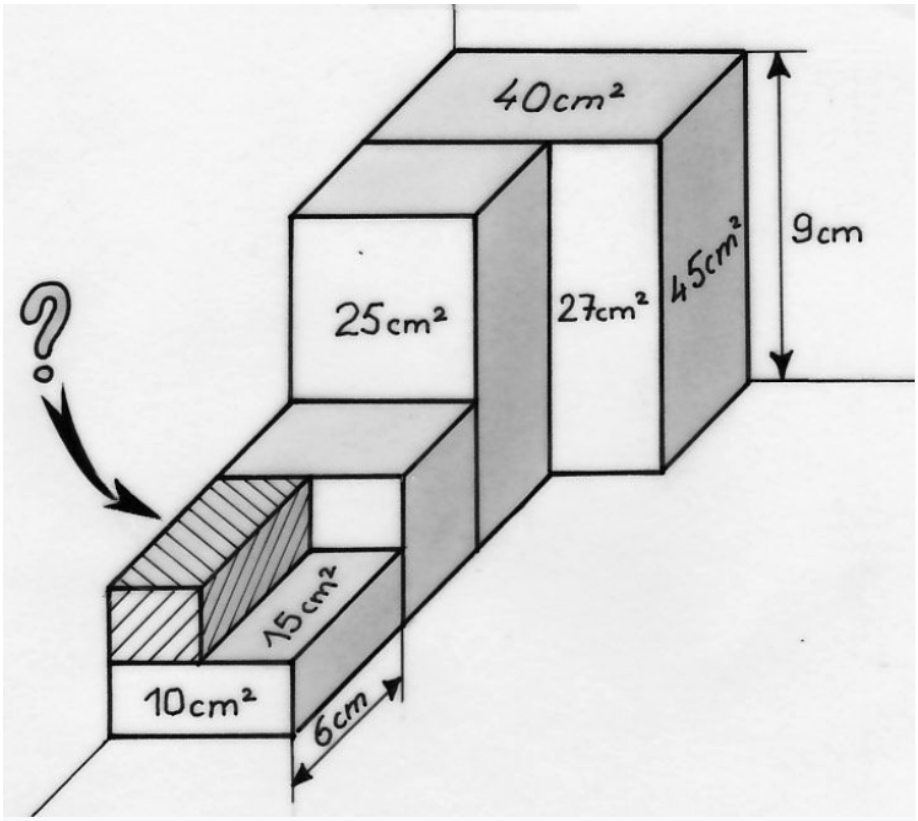
Glue such an assembled shape on the answer sheet and indicate the size of every angle of all the triangles.



Ex 3 : From Stone to Stone (7 pts)

Five cuboid stones are assembled in one corner. Two lengths and six areas are shown in the diagram.

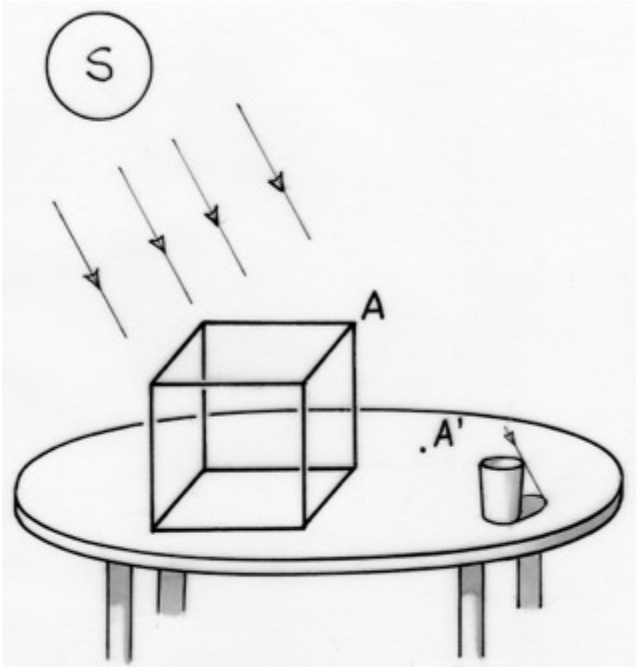
Determine the volume of the shaded stone, showing your calculations.



Ex 4 : Here's the Shadow (5 pts)

A wire cube is lying flat on a table on a sunny day. The shadow of point A is point A'.

Draw the projected shadow of the cube on the table on the attached sheet.

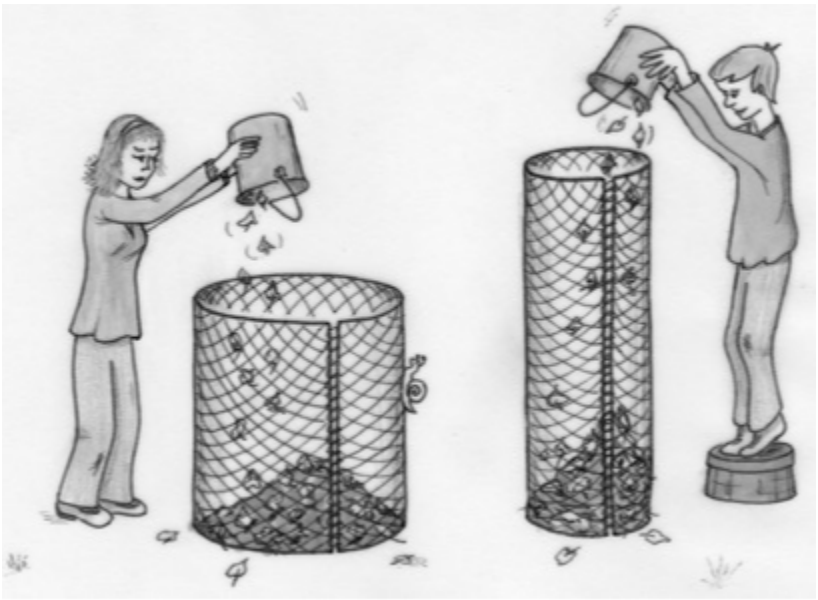


Ex 5 : A Question of Meaning (7 pts)

Olivier has decided to no longer burn or throw away his garden waste, but to compost it. For this purpose, he has a rectangular trellis 1.80 m long and 1.50 m wide. Some fasteners are enough for him to join two opposite sides and obtain a vertical cylindrical tank whose height corresponds to the length of the rectangle.

Rose points out to him that, if he had chosen to join the other two sides of his trellis, his cylinder would be lower, but that it would have 20% more volume.

Is Rose correct ? Justify your answer.

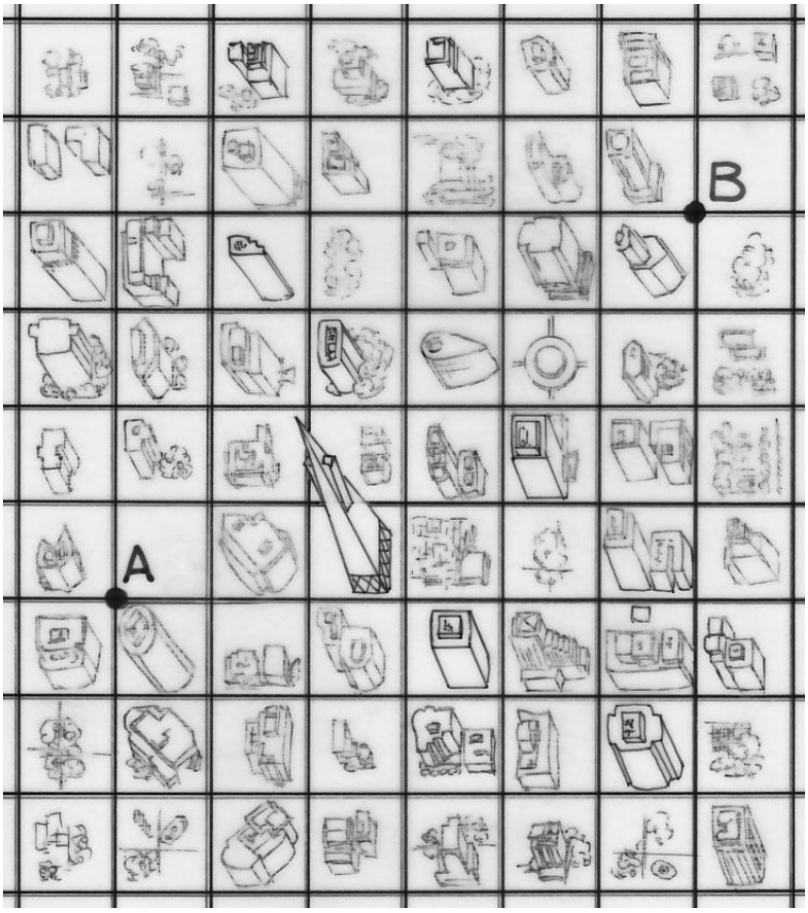


Ex 6 : Metropolice (5 pts)

In some cities, such as New York or Mannheim, the streets form a regular grid.

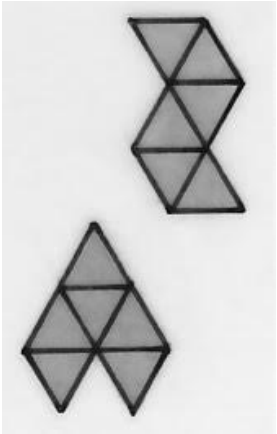
On the map, points A and B represent the two police stations in the city.

Reproduce the grid on your answer sheet. Mark in colour the points of intersection of the streets for which the minimum distance to be traveled by car to reach A or B is the same.



Ex 7 : Hexamant (5 pts)

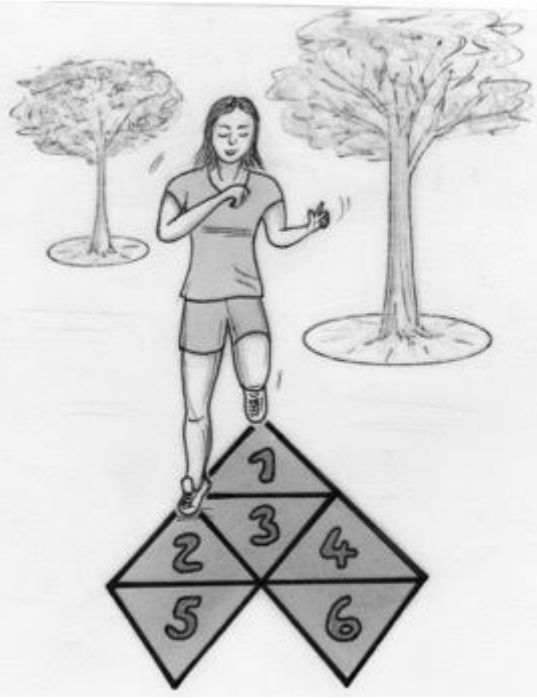
A hexamant is a figure formed by six identical adjacent equilateral triangles. Here are two examples of hexamants:



These two hexamants are different because they cannot be superimposed.

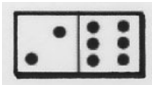
Look for as many different hexamants, that cannot be superimposed, as possible.

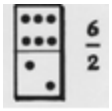
Reproduce them on a triangular mesh.



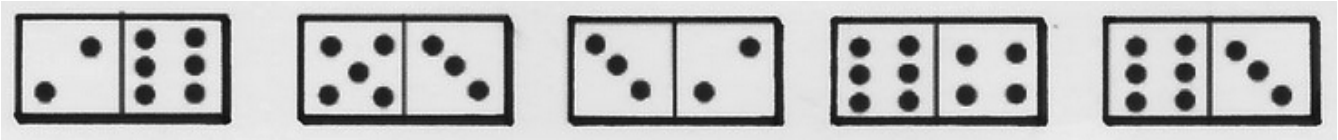
Ex 8 : ... Domineering ... (5 pts)

Each domino can correspond to two fractions.

For example :  corresponds to

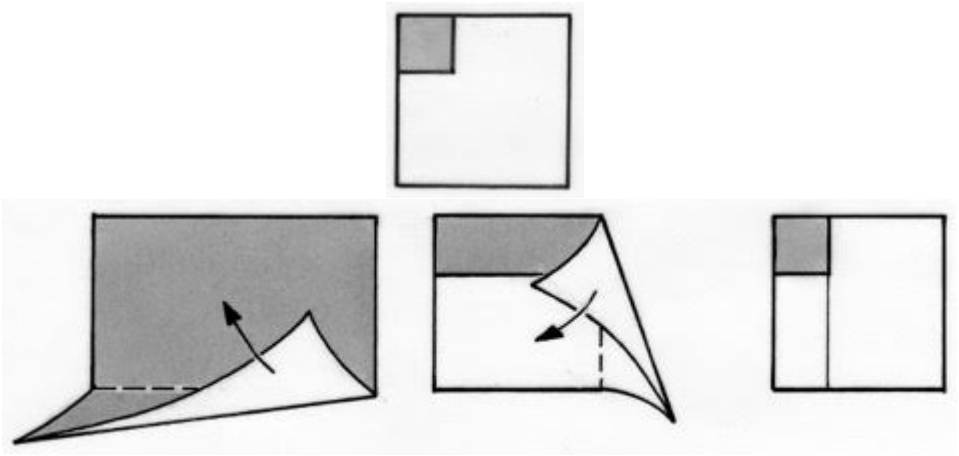
or 

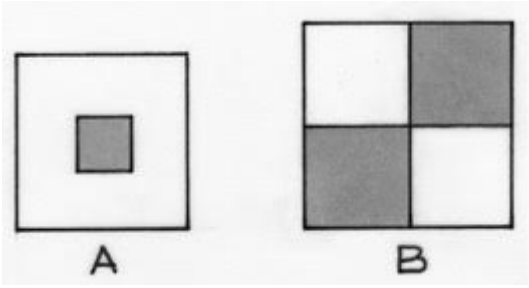
Arrange the next five dominoes such that the sum of the corresponding fractions is equal to a whole number. Propose two solutions which result in two different sums.



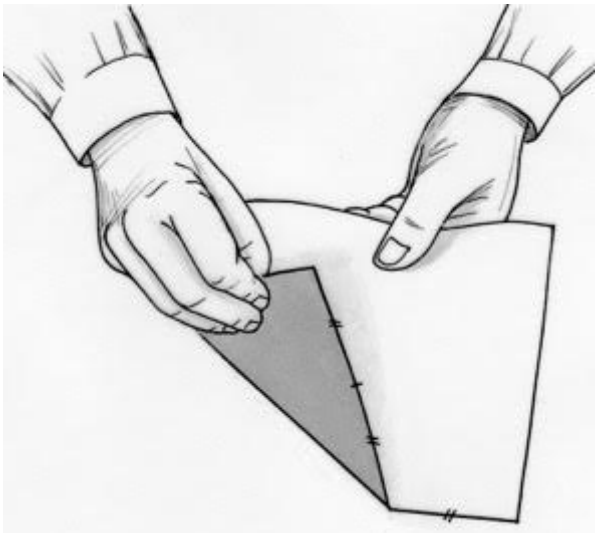
Ex 9 : Downright Folded (7 pts)

Using square sheets of length 15 cm, whose front and back have different colors, we want to obtain the given patterns using a minimum number of folds. Each pattern is to be made is made up of squares. Here is an example of a pattern made using two folds





Make pattern A.
Make pattern B using a minimum number of folds. Here is the first fold for a three-fold solution. Show the manipulations to your teacher.



Ex 10 : More of the Same (7 pts)

Christophe suggests that Yamina chooses at random a four digit number N. Yamina chooses 3275. Then he asks her to apply the following algorithm:

- Calculate the sum of the following 3 numbers :

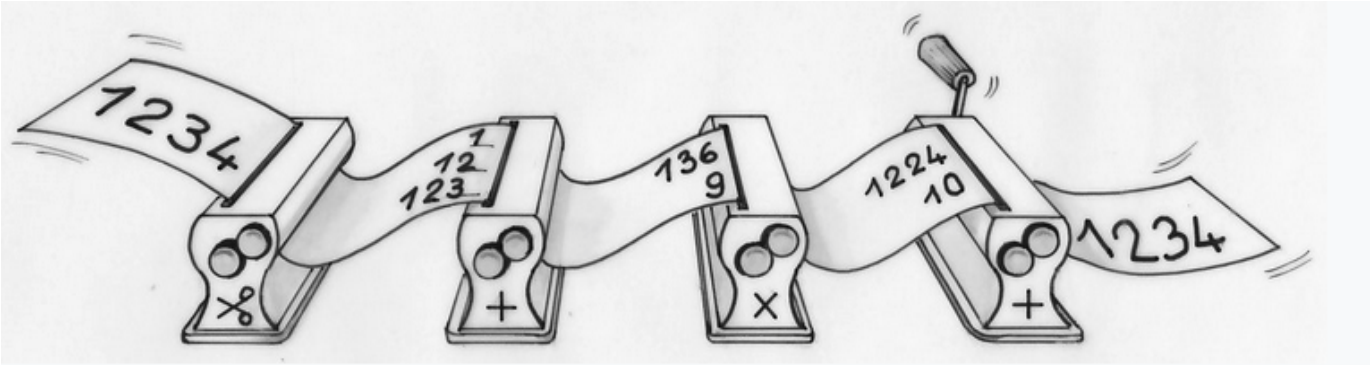
  - first number: the number of thousands in N (for N = 3275, this gives 3)
  - second number: the number of hundreds in N (for N = 3275, this gives 32)
  - third number: the number of tens in N (for N = 3275, this gives 327)

- Multiply this sum by 9

- Add to the previous result the sum of the digits of the starting number

Yamina is surprised to find that this gives her the number she originally chose. Christophe says it always will be.

Check Yamina's calculations.
Show that Christophe's statement is true regardless of the starting number.



Ex 11 : First in 2021 (5 pts)

Find two prime numbers a and b such that:

$$a + b = 2021 \times \left(\frac{1}{a} + \frac{1}{b}\right)$$

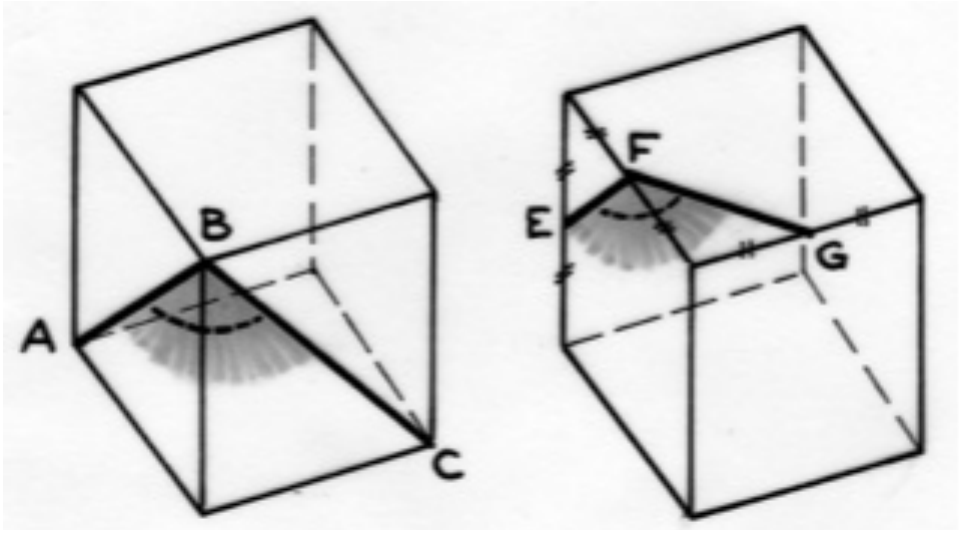
Ex 12 : From the Right-Angle (7 pts)

Jules draws segments on the faces of the following two cubes.

Points A, B and C are three vertices of the first cube.

Points E, F and G are midpoints of edges of the other cube.

State the size of the angles ABC and EFG. Justify your answers.

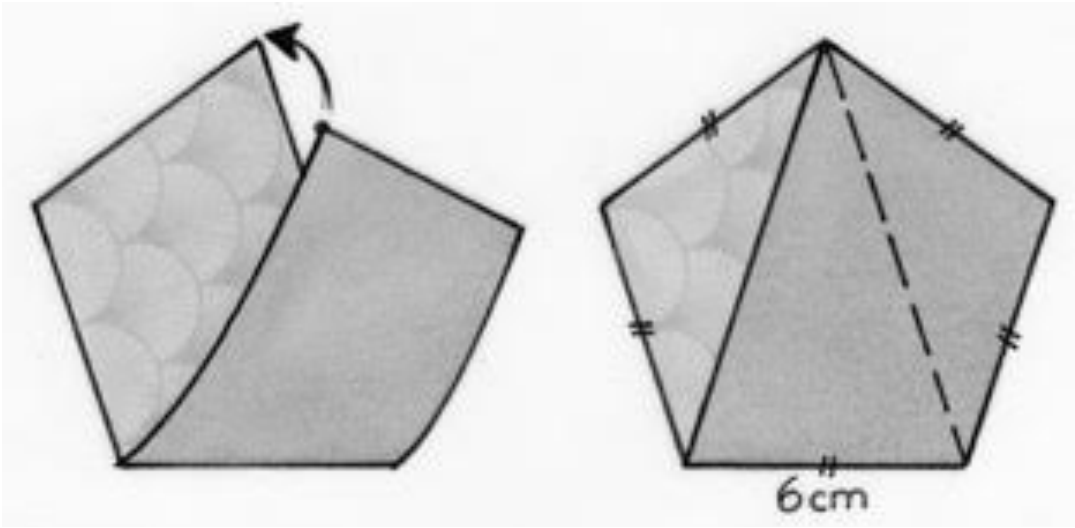


Ex 13 : Penta-ply (10 pts)

Elisabeth took a sheet in the shape of a quadrilateral and folded it in half, bringing one corner to the opposite corner of her sheet. She obtained a regular pentagon with sides of length 6 cm.

Calculate the angles and dimensions of the quadrilateral sheet used by Elisabeth. Specify the nature of this quadrilateral.

Make, by folding, such a regular pentagon with a side of 6 cm and glue it on the answer sheet.



Ex 13bis : Crack the code (10 pts 2nde PRO)

Pauline has two safes installed in her house. Opening these safes is done by entering a code. She has made a list of 20 rows of numbers. The first three rows of numbers are shown in the sketch.

Pauline has devised a process tnhat allows you to move from one line to the next :

• a number in one row is obtained by adding or subtracting two numbers from the previous row;

• all the numbers in a column are calculated in the same way.

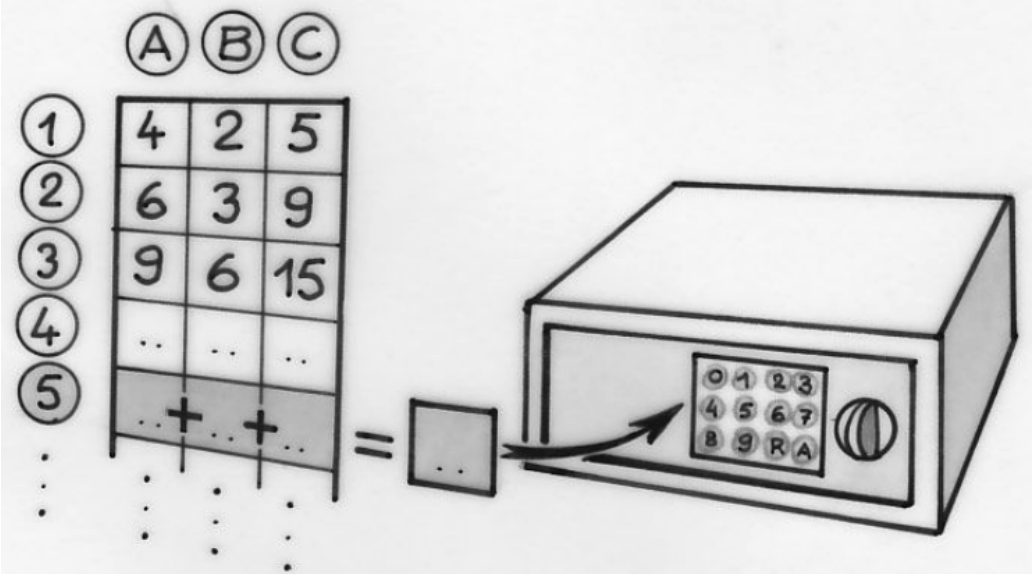
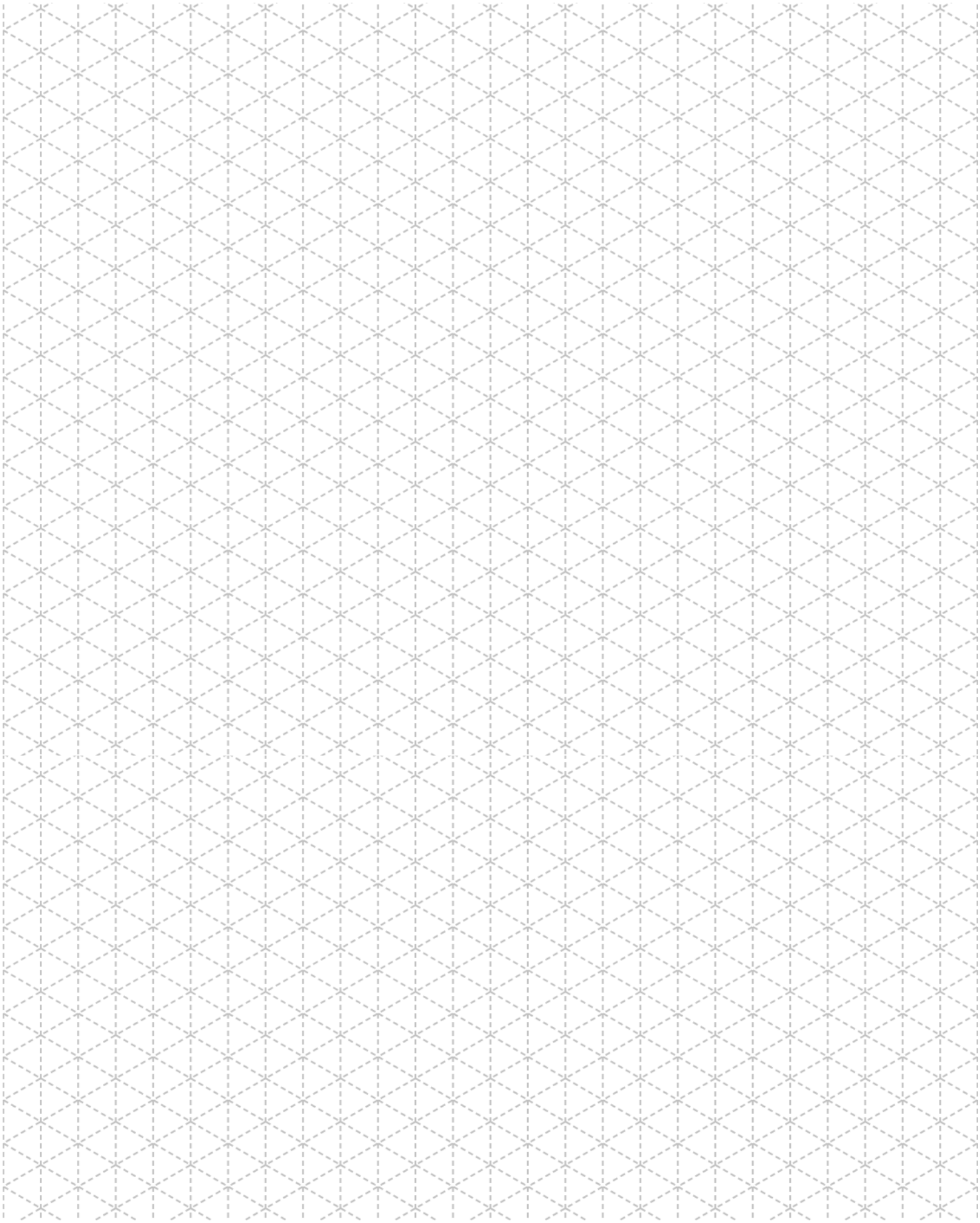
The code allowing the safe to be opened is obtained by adding the three numbers in the same row.

Obtain the numbers in the fifth row of the table such that the code will allow the small safe to be opened. See the figure below.

Pauline's daughter wants to take a look in the big safe. She knows that her mother has chosen a code she obtained using the big numbers in row 20.

Obtain this code.

This problem is to be solved using the computer-based tool. Describe the process used.



APPENDIX – Exercise 7: Hexamant