

# Mathématiques Sans Frontières

## Discovery Edition 2022

- ✓ Use only one answer sheet per exercise.
- ✓ Any attempted answer will be marked.
- ✓ The care, the quality of the writing, and the precision of the reasoning will be taken into account.

### Exercise 1 7 pts EN CUISINE

Write the solution in German, French, Spanish or Italian with a minimum of 30 words.

Marie-Christine e Richard ricevono questa domenica la loro famiglia e devono, pertanto, organizzarsi in cucina per preparare in anticipo il pranzo.

Marie-Christine, cuoca raffinata, ha previsto d'iniziare con del pesce, a seguire dei petti di pollo farciti, per terminare con la speciale ciambella "kougelhopf" come dolce, ma questi piatti richiedono tutti l'uso dello stesso forno, separatamente, in momenti diversi.

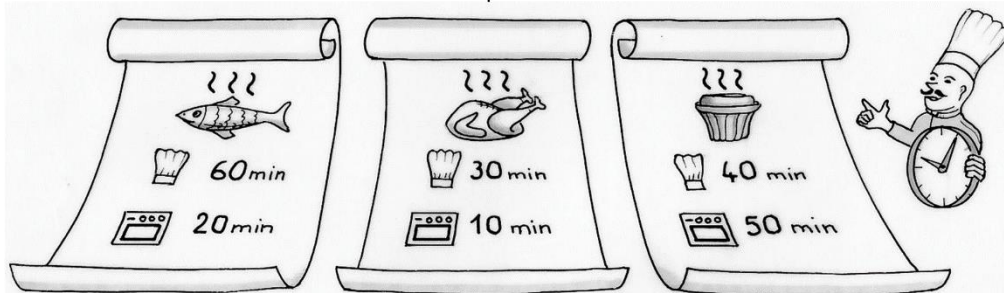
Non può che cucinarli uno alla volta, preparandoli integralmente prima d'infornarli. Richard l'informa che può realizzare tutto in 2 h e 20 minuti.

**Illustrate come Marie-Christine si organizza per riuscire a realizzare i tre piatti in questo tempo.**

Marie-Christine y Richard reciben a toda la familia este domingo y tienen que organizarse en la cocina para preparar la comida con antelación.

En efecto, Marie-Christine, una cocinera refinada, tiene previsto pescado como entrante, pechugas de pollos rellenas y un "kougelhopf" como postre, pero estos tres platos necesitan ser horneados en el mismo horno, pero en distintos momentos, cada uno se cocina por separado. Solo puede preparar un plato a la vez y cada plato tiene que estar totalmente preparado antes de hornearlo. Richard le dice que en 2 h 20 min puede hacerlo todo.

**Explica cómo tiene que arreglársela Marie-Christine para preparar estos tres platos en 2 h 20 min.**



Bei Marie-Christine und Richard kommt am Sonntag die ganze Familie zu Besuch zum Mittagessen. Marie-Christine, eine hervorragende Köchin, hat ein Menü geplant: Es gibt Fisch zur Vorspeise, gefüllte Hähnchenbrust als Hauptgericht und einen Gugelhupf zum Nachtisch.

Marie Christine möchte alles schon vorher zubereiten, aber alle Gerichte müssen getrennt voneinander im selben Ofen zubereitet werden.

Marie-Christine möchte immer jeweils ein Gericht komplett für den Ofen vorbereiten, bevor sie mit der Zubereitung des nächsten Gerichts beginnt.

Richard sagt, dass alles in 2 Stunden und 20 Minuten fertig sein kann.

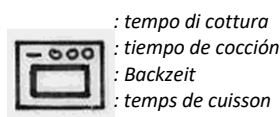
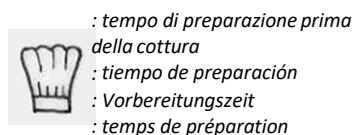
**Erklärt, wie Marie-Christine das gesamte Menü in 2 Stunden und 20 Minuten zubereiten kann.**

Marie-Christine et Richard reçoivent toute leur famille ce dimanche et doivent s'organiser en cuisine pour préparer le repas en avance.

En effet, Marie-Christine, fine cuisinière, a prévu un poisson en entrée, des blancs de poulet farcis et un kougelhof en dessert, mais ces trois plats nécessitent tous l'usage du même four à des moments différents, chacun cuit séparément.

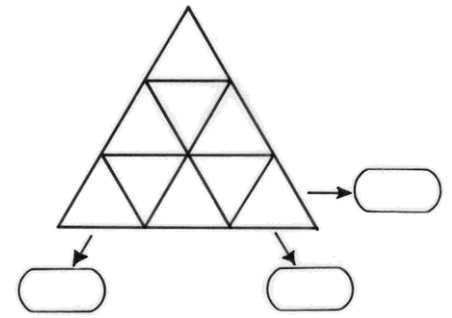
Elle ne peut réaliser qu'une préparation à la fois. Après avoir lu les trois recettes, Richard lui dit qu'en 2 h 20 min elle peut tout faire.

**Expliquer comment Marie-Christine s'y prend pour réaliser ces trois plats en 2 h 20 min.**



Exercise 2 5 pts  
IN SUM

Position the whole numbers from 1 to 9 in the nine sections drawn in this triangle so that the sum of the five sections positioned on each of the three edges is the same.



Exercise 3 7 pts  
COUPLES

With three non-zero digits  $a$ ,  $b$  and  $c$ , we form the integers  $abc$ ,  $ab$ ,  $bc$  and  $ca$ . For example: with 7, 5 and 8, we form the numbers 758, 75, 58 and 87. We see that  $75 + 58 + 87$  is not equal to 758.

Is there a three-digit number  $abc$  that confirms the relation opposite? Explain your answer.

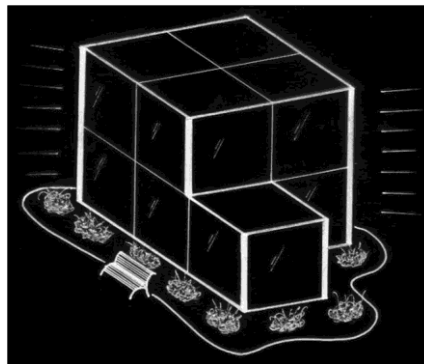
$$\begin{array}{r} ab \\ + bc \\ + ca \\ \hline abc \end{array}$$

Draw the floor space of this store.

Calculate the total length of all vertical edges that will be fitted with fluorescent lights, then the total area of all vertical facades.

Exercise 4 5 pts  
ENLIGHTEN

The drawing opposite shows the construction project for an exhibition store made up of eight cubic blocks, each edge being 5 m long.



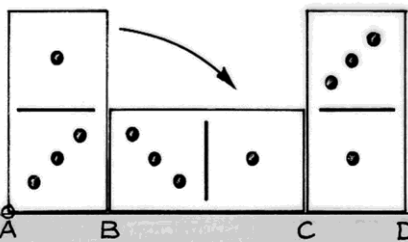
Exercise 5 7 pts  
DOMINO TURNS

A rectangular domino 4 cm long and 2 cm wide is placed on a ruler. On each of the seven rotations the domino undergoes, the domino turns a quarter turn to the right along the ruler.

The centres of the rotations will be successively at B, at C, at D, then at A', at B', at C' and finally at D'.

Draw in full size, the eight successive positions of the domino with its black dots correctly oriented.

Trace the trajectory of point A during these seven rotations. Calculate the actual length of this path to the nearest cm.



Exercise 6 5 pts  
DECORATING

The floor of the entrance to Sacha's house is square. To tile it, he bought five square slabs of 50 cm sides. He keeps one whole and cuts four in the same way according to a segment that joins an edge of a slab to the middle of one of the opposite sides, as in the figure opposite. He now has nine pieces in all. With these nine pieces, he manages to make a square.

Make this assembly on a 1 / 10th scale and glue it on the answer sheet. Calculate the exact length of one side of its square entrance.





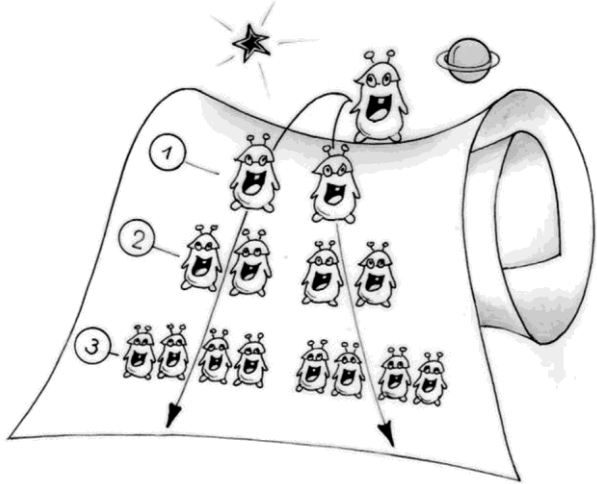
Exercise 7 7 pts  
OFFSET

Aunt Yvonne has two clocks that are not working properly. The first is too fast and gains two minutes per hour. The second is too slow and loses one minute per hour. Aunt Yvonne sets her two old clocks at the same time at noon sharp.

**How long will it take for the two clocks to show the same time? Give the time indicated by the clocks at that time. Explain your answer.**

Exercise 8 5 pts  
CLONING

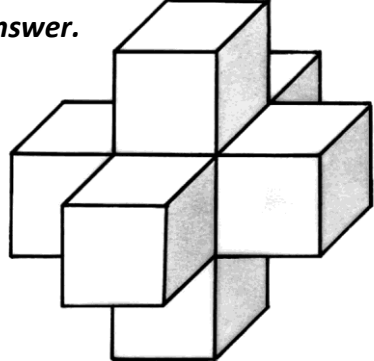
In a universe parallel to ours lives a population of individuals who have a particular mode of reproduction. During each breeding season, each individual splits into two and becomes two individuals. As soon as the population has reached a total number of individuals greater than 18, in the following breeding season, only 18 of them continue to duplicate and the same with each new season. Initially, there is only one individual and no individual dies during the ten seasons.



**Find the number of individuals in this population after ten seasons. Explain your answer.**

Exercise 9 7 pts  
A NET

The object opposite consists of identical cubes. **Give the number of faces of this object.**

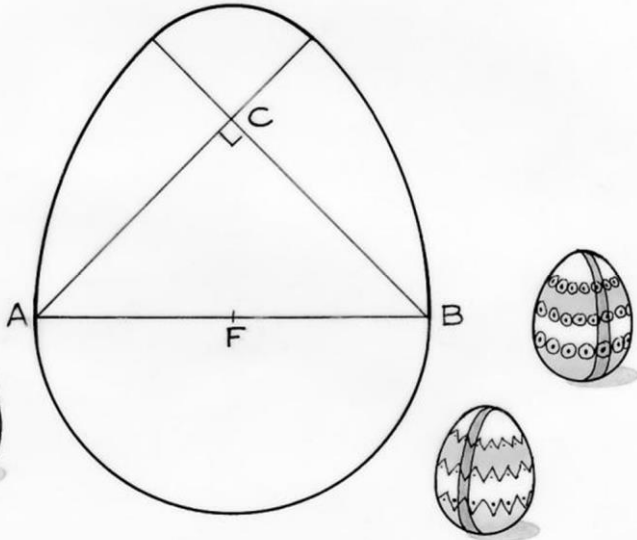


**Draw a one-piece net of this object on an A4 sheet.**

Exercise 10 10 pts  
AN EGG

- the line segment [AB] measures 6 cm and its middle is point F;
- isosceles triangle ABC is right angled at C;
- the egg consists of four arcs of circles with centres F, A, B and C.

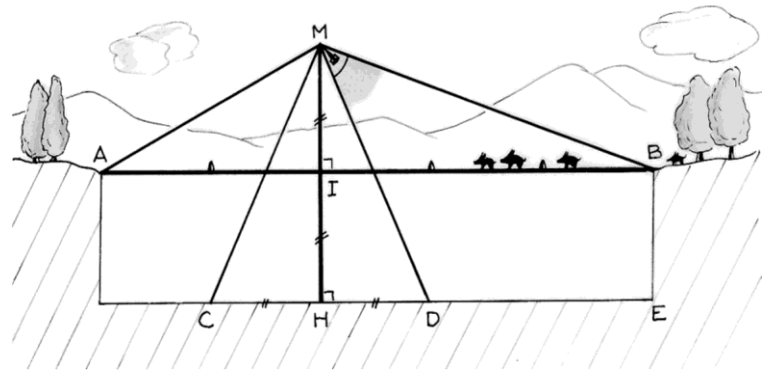
**Reproduce the egg in full size.**  
**Determine a value of its perimeter, approximated to the nearest millimetre.**



# SENIORS ONLY

## Exercise 11 5 pts ACTION!

A landscape architect plans to build an animal walkway. The horizontal footbridge  $[AB]$  is carried by a vertical pylon  $[MH]$  and held by four stay cables  $[MA]$ ,  $[MC]$ ,  $[MD]$  and  $[MB]$ . We know that  $AI = 20$  m and  $IB = 30$  m. In addition:  $MI = IH = CH = HD = 10$  m. A camera is placed at  $M$  and tracks the passage of each animal.



**Calculate the angle  $DMB$  that corresponds to the field of view of the camera. Explain your answer.**

## Exercise 12 7 pts IN ADDITION

Delphine says to Jean:  
 "Find the whole number I am thinking of. If I add 10 to it, I get the square of a whole number.  
 If I add 79 to it, I get the square of another whole number."  
 Jean reflects and says  
 "There is not just one possible number, there are two!"

**Give the two numbers. Explain your answer.**

**M**athématiques  
**SANS**  
 Frontières

## Exercise 13 10 pts RELATED

$ABCD$  is a rectangle of width 10cm. Points  $E$  and  $F$  are on the diagonal  $[AC]$ . The triangles  $ABE$  and  $CFD$  are right-angled at  $E$  and  $F$ . In addition  $AE = EF = FC$ .

**Calculate the exact length of  $[AD]$ .**

**Build the figure in full size.**

