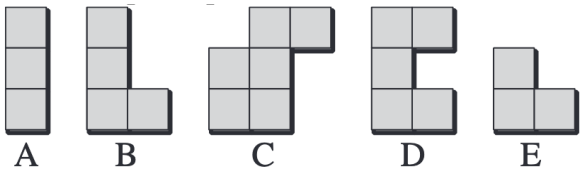
CHAMPIONSHIP: MATHEMATICAL AND LOGIC GAMES
FBJM Quarter final

START FOR ALL PARTICIPANTS

1. FOUR FOR A SQUARE (coeff. 1)
Four of these five wooden pieces can be put together to form a square.

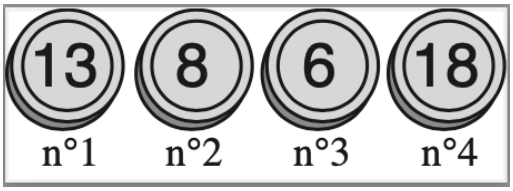


Which part will not be used?

2. STAMPS (coefficient 2)
In Mathland, the currency is the ludic. There are two kinds of stamps: 2 ludic stamps and 5 ludic stamps.

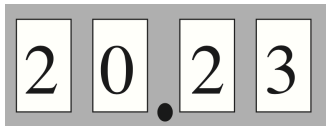
A parcel should be stamped at 41 Ludics.
How many different ways can you stamp it if you have enough stamps of each type?

3. TOKENS (coefficient 3)
On these four tokens, we can see the numbers 13, 8, 6 and 18.



On the other side, they carry the same four numbers but no token has the same number on both sides.
Matthew: "Does token n°4 have one of the numbers 6 or 8 on its other side? »
Matilda, who saw the other side of the tokens: "no".
Matthew: "Does token no. 2 have the number 18 on its other side? »
Matilda: "yes".
What number is on the other side of token #1?

4. CLOCK RADIO (coefficient 4)
On this clock radio, the display has just changed to 20:23.



How many minutes will pass before the display shows only one digit repeated four times?

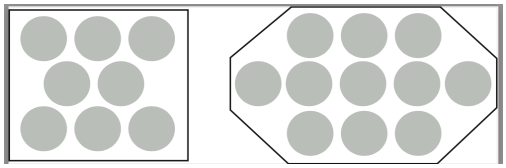
5. MAGIC SQUARE (coefficient 5)
Complete this magic square with natural whole numbers all different from the numbers already placed so that:

9		5	4
7	2	11	*a*
12	13		1
b	3	10	15

• the sums of the numbers in each row, each column and each diagonal are equal;
• the largest number in the square is the smallest possible.
What numbers will be written in the two shaded boxes?

END FOR CE PARTICIPANTS

6. APPLES (coefficient 6)
Matilda picked less than 100 apples. She has the choice between storing them all in boxes of 8 apples or storing them all in boxes of 11 apples.



In both cases, after filling identical boxes, she would have 2 apples left.
How many apples did she pick?

7. DATE DIVISORS (coefficient 7)
The number 2023 has the particularity of being divisible by the sum of its digits (which is equal to 7 for 2023).
How many years between the year 2000 and the year 2023 have this same feature?
Note: we will count, if this is the case, 2000 and 2023.

8. REPEATING DATES (coefficient 8)
Chloe was born on November 20, 2011, which is written as 20.11.2011. We can therefore read the digits 2, 0, 1, 1 twice in this order. She wonders if there will be other dates written the same way (ab.cd.abcd).
How many will there be after 2011?

END FOR CM PARTICIPANTS

Problems 9 to 18: beware! For a problem to be completely solved, you must give both the number of solutions, AND give the solution if there is only one, or give any two correct solutions if there are more than one. For all problems that may have more than one solution, there is space for two answers on the answer sheet (but there may still be just one solution).

9. SIX SQUARES FOR A RECTANGLE (coefficient 9)
A rectangle is made up of 6 squares with sides 1 cm, 4 cm, 5 cm, 6 cm, 7 cm, the sixth having a side equal to that of one of the other five squares.
What is the perimeter of this rectangle?

10. LEA GOES TO LIMA (coef. 10)

$$\begin{array}{r} \text{LEA} \\ +\ \text{AMI} \\ +\ \text{MIL} \\ +\ \text{EIL} \\ \hline =\ \text{LIMA} \end{array}$$

In this coded addition, the same letter always replaces the same digit and two different letters always replace two different digits. Moreover, the first digit of a multi-digit number is never 0.
What number is LIMA?

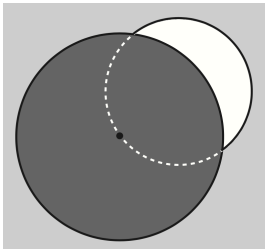
11. DOMINOES (coefficient 11)
Matilda and Matthew play the following game.
In turn, they place a domino on two free squares of a square chessboard of 64 squares. When one of the two can no longer place a domino, (s)he has lost. During a game, the two of them placed a maximum of 32 dominoes.
But how many did they play, at a minimum?

END FOR C1 PARTICIPANTS

12. CUNEGONDE'S CUBE (coef. 12)
Cunegonde has a pretty alabaster cube whose volume she calculated, in cubic millimetres, and which she then noted in her notebook. Her brother, who was passing by, made three spots on the notebook which each hid a digit and left only three visible digits of Cunegonde's result:

The length of the edge of the cube is an integer number of millimetres.
What is it, precisely?

13. ECLIPSE (coefficient 13)
The image depicts a photograph taken during an eclipse of the star Amathla by the planet Krypton.
In this photo, the circle corresponding to the star has a diameter of 14 cm and passes through the centre of the disc corresponding to the planet, which has a diameter equal to $14\sqrt{2}$ cm.

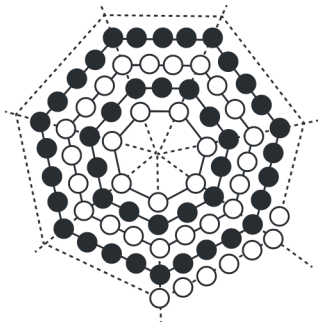


What is, on the photograph, the area in mm² of the part of the star that remains visible?
Note: if necessary, take $\pi \approx 3.1416$ *and* $\sqrt{2} \approx 1.414$

14. PARALLELEPIPEDS (coef. 14)
The decomposition of 2023 into the product of prime factors is:
2023 = 7 × 17 × 17 and the sum of these three factors is equal to 41.
We build a parallelepiped with a square base whose dimensions in cm are these three prime factors 7, 17 and 17.
How many different parallelepipeds with a square face, including one whose dimensions are 7 cm, 17 cm and 17 cm, could one build whose dimensions are also three prime numbers whose sum is also equal to 41?

END FOR C2 PARTICIPANTS

15. NECKLACE (coef. 15)

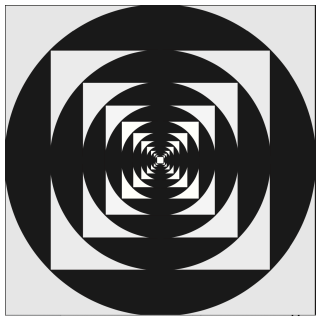


The diagram is a view of the central part of a necklace made up of nested heptagons that alternate rows of white pearls and rows of black pearls. The outermost heptagon is complete and is composed of white pearls.
In total there are exactly 2023 white pearls.
How many black pearls does this necklace have?

16. GOLD NUGGETS (coefficient 16)
Scrooge bought 100 nuggets from a gold panner. He knows that one nugget, and only one, is fake. But he doesn't know which one.
If Scrooge were to present a group of the nuggets to Ruby Wring, the well-known jeweller, the latter would tell him whether the fake nugget is one of the group or not. If it is one of the group, Scrooge pays her 600 dollars, otherwise he pays her 400 dollars.
The group presented might be just a single nugget.
If Scrooge applies the best possible strategy, then, at most, what will be the total of the dollars that he will pay in order to identify the fake nugget?
Note: the fake nugget might not belong to any of the groups presented to Ruby.

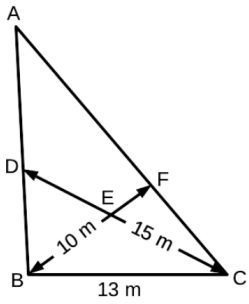
END FOR L1, GP PARTICIPANTS

17. KALEIDOSCOPE (coef. 17)



In this kaleidoscope, each circle is internally tangent to a square, and each square except the largest has its four vertices on a circle.
We suppose that we have thus constructed an infinity of smaller and smaller circles and squares.
The total area of the black areas represents what percentage of the area of the kaleidoscope?
Give the answer in % rounded to the nearest 1%.
Note: if necessary, take $\pi \approx 3.1416$ *and* $\sqrt{2} \approx 1.414$

18. PAPA SLEA'S PATCH (coef. 18)



Papa Slea's vegetable patch is a triangle ABC whose vertex angle B is slightly obtuse and whose side [BC] measures 13 metres. The patch is divided into four parts by two paths [BF] and [CD] which measure respectively 10 and 15 metres and intersect at E.
The lengths AD, AF, BD, BE, CE and CF are all whole numbers of metres.
What is, in square metres rounded to the nearest, the area of the vegetable garden?
Note: if necessary, take $\sqrt{3} \approx 1.732$.

END FOR L2, HC PARTICIPANTS

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