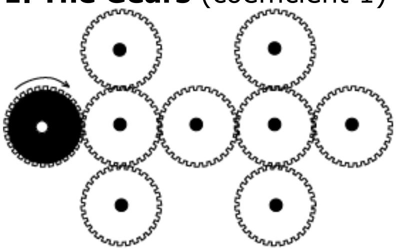
FBJM –Quarter Finals 2021

Information at fbjm.be

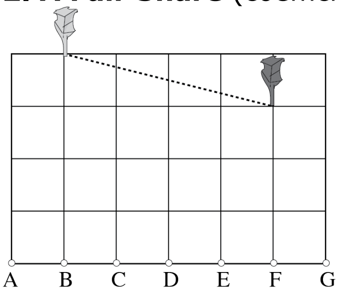
START for ALL PARTICIPANTS

1. The Gears (coefficient 1)



Spin the black wheel clockwise. **How many white wheels will turn in the same direction as the black wheel?**

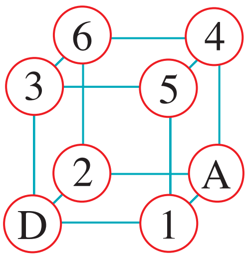
2. A Fair Share (coefficient 2)



Father Matthew wants to divide his rectangular field into two parts of the same area. A fence is already placed between two trees (dotted on the drawing). Matthew will put a second fence between the dark grey tree and one of the seven points A, B, C, D, E, F or G.
Which of these seven points should he connect to the dark grey tree?

3. The Cubes (coefficient 3)
Matilda glued together 27 identical small cubes to form a cube three times the size. Matthew walks over to the cube which is on a table.
From his position, without moving, how many small cubes can he see, at most?
Note: When you see two or three sides of the same small cube, it counts as one cube.

4. The Spider (coefficient 4)



A spider moves along the edges of a wire cube from vertex D (start) to vertex A (finish). On each of the other vertices, the number of insects trapped there has been indicated.
If the spider never passes the same vertex twice, how many insects can it eat, going from D to A?

5. Magic Square (coefficient 5)

1				5
	3		1	
4				
	1		4	
3		2		1

In this square, each horizontal or vertical row contains all the numbers from 1 to 5.
Complete this square.

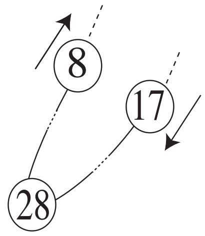
END for CE PARTICIPANTS

6. The Multiple of the Year (coefficient 6)

7	7	7	7	4

By rearranging these five counters, form a multiple of 2021.

7. The Chairlift (coefficient 7)
The seats of this chairlift are regularly spaced



along a cable forming a closed loop, and they are numbered in order, starting from no.1 until the last seat located next to the seat no.1 and whose number corresponds to the total number of seats.
When seat no.28 is at the bottom of the chairlift, seat no.8, which is going up, is passing seat no.17, which is going down.
How many seats does the chairlift have?

8. The Year's Digits (coefficient 8)
The year 2021 is written using only the digits 0, 1 and 2.
How many vintages, from the year 1000 up to and including the year 2021, use these three digits and only these, with one of these digits repeated?
Note: a number representing a year is called a vintage.

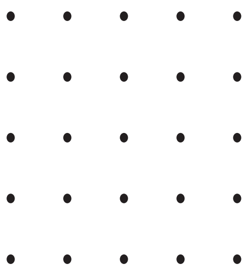
END for CM PARTICIPANTS

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. An Uncertain Sequence (coefficient 9)
An ordinary deck of cards consists of 52 cards of four suits (hearts, spades, diamonds and clubs), and 13 values: in order 2, 3, 4, 5, 6, 7, 8, 9, 10, jack, queen, king and ace.
How many cards can you draw at most from a deck of 52 cards without obtaining any 5 cards of consecutive value (regardless of suit)?
Note: In the card value scale, the ace follows the king, but it is not followed by the 2.

10. Harry's Horses (coefficient 10)
Harry raises horses. He has some electric fencing wires, each 30m long. Using one of these wires, he can create a rectangular enclosure of 30m perimeter. He realizes that with dimensions equal to whole numbers of metres, the width always being at least 2m, he can create all the different possible enclosures and that the number of enclosures would correspond exactly to the number of his horses he has.
How many horses does Harry have?

11. The Rectangles (coefficient 11)



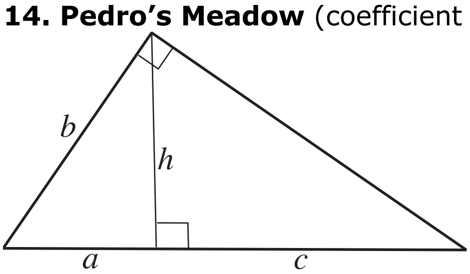
How many rectangles of all sizes and in all orientations can we draw by connecting points of this network?
Two rectangles of the same dimensions connecting different points are counted as two different rectangles.
Be careful, squares are special rectangles; they must therefore be counted.

END for C1 PARTICIPANTS

12. The Fractions (coefficient 12)
We write the 2020 fractions 1/2021; 2/2021; 3/2021; ....; 2020/2021.
How many of them can be simplified?
A fraction is simplifiable if it is not irreducible.

13. Scrooge's Gold (coefficient 13)
Scrooge has 2'021 gold coins.
He divides them into piles containing consecutive numbers of coins.
Given that there are more than two piles, how many coins does the highest pile have?

14. Pedro's Meadow (coefficient 14)



Pedro owns a meadow shaped like a right-angled triangle. The height h from the vertex of the right angle divides the hypotenuse into two segments of lengths a and c such that a = b + c.
If c = 10 m, what is the length a?
The answer must be given in metres, possibly rounded to the nearest metre.
Note: The figure does not respect the proportions.

END for C2 PARTICIPANTS

15. Reconstructing a rectangle (coeff. 15)
Matilda, while searching the attic, found an old puzzle. It consisted of nine squares of respective sides: 18; 15; 14; 10; 9; 8; 7; 4 and 1.
Only one instruction was given: "using these nine squares, piece together a rectangle."
Matilda succeeded with the puzzle, with five squares being in contact with the square of side 10.
What are the side lengths of these five squares?
Give these five lengths in ascending order.

16. The Sum of the Year (coefficient 16)
We calculate the integer part* of each of the products $n \times 47/43$, for n varying from 1 to 43, then we add all these integer parts.
What result will we get?

* The integer part of a number is the largest whole number less than or equal to that number.

END for L1, GP PARTICIPANTS

17. Five Points and Some Planes (coeff. 17)
Choose five points in space such that no three of them are colinear and no four of them are coplanar.
If we consider all the planes containing any three of these five points, and the intersections of all these planes taken two by two, how many lines will we obtain, at most?

18. Cedars in the Arboretum (coefficient 18)
Within the arboretum, three hundred-year-old cedars are located at the vertices of an isosceles right-angled triangle which has two sides each of 51m. Mathias is standing a non-zero distance less than 30m from the nearest of these cedars. The three distances between these cedars and Mathias are all whole numbers of metres.

What is the sum of these three distances?
Note: We do not take into account the diameters of the trees, or of Mathias, all considered to be points on a plane.

END for L2, HC PARTICIPANTS