41st CHAMPIONSHIP, 2027: MATHEMATICAL AND LOGIC GAMES
FSJM Quarter final

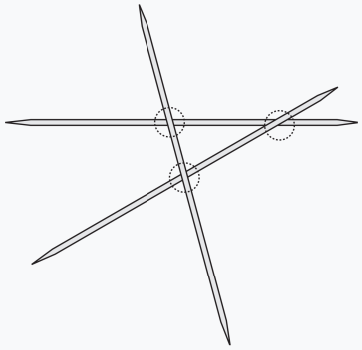
Information and results at http://www.fsjm.ch/

START FOR ALL PARTICIPANTS

1. JACKSTRAWS (coefficient 1)

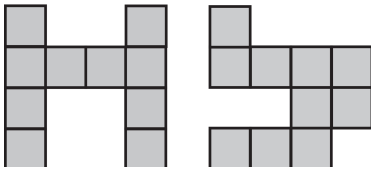
Matilda and Matthew are playing Jackstraws on the living room sofa. No two sticks may be placed against each other.

With 3 sticks, there is a maximum of three points of contact between the sticks.



What would be the maximum number of contact points with 4 sticks?

2. THE TEN SQUARES (coefficient 2)



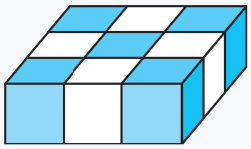
What is the minimum number of squares that must be moved in the figure on the right to obtain a figure identical to the one on the left?

3. 2027 (coefficient 3)

How many 4-digit numbers can be formed using each of the digits 2, 0, 2, and 7 exactly once?

No number may begin with 0. The number 2027 is to be included in the count of solutions.

4. MATILDA'S TOWER (coef. 4)



Matilda has a large number of white cubes and blue cubes.

She has built a base using 9 cubes (4 white and 5 blue) arranged as shown in the figure.

She then adds 8 more layers to this base, resulting in a total of 9 layers. All the layers have the same shape as the base, following this rule: every cube (blue or white) added to the structure must be placed on top of a cube of a different colour.

In total, including the cubes in the base, how many blue cubes did she use?

5. OAK AND SPRUCE (coefficient 5)



Trees grow in a circle at the edge of the playground: 3 oaks and a few spruces.

Bertram made the first drawing. But he couldn't finish it because he spotted an empty swing in the playground and ran towards it.

Then Alice arrived and also drew trees to make the second drawing. Alice didn't finish her drawing because her friends called her over to play soccer.

Next, Corinne came along and made the third drawing for her mother. She didn't finish it either, because it was lunchtime.

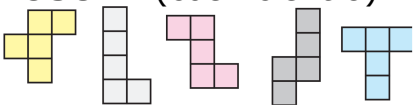
How many spruces are growing around the playground, assuming the three drawings are accurate?

END FOR CE PARTICIPANTS

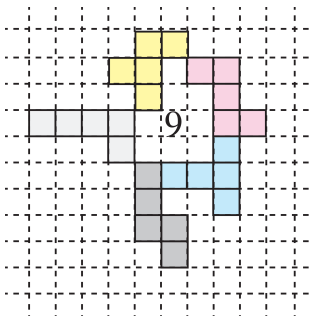
6. BAG OF MARBLES (coefficient 6)
After a game of marbles between Matilda and Bernardo, Matilda, who won, draws marbles at random from Bernardo's bag, one by one, stopping only when she has at least one marble of each colour. Bernardo's opaque bag contains 36 marbles: 6 of each colour (blue, white, red, green, black, and yellow).
What is the maximum number of marbles Bernardo could lose?

7. MATTHEW'S PIGGY BANK(coef. 7)
In his piggy bank, Matthew has five €2 coins, eight €1 coins, and four €0.50 coins.
He uses his money to buy a puzzle magazine costing €8.50.
In how many different ways can he pay for the magazine using coins from his piggy bank?

8. ENCLOSURE (coefficient 8)



You can form an enclosure using these five pieces by placing them on a grid (each square of a piece must be placed on a square of the grid).
In the example below, the area inside the enclosure corresponds to 9 small squares.

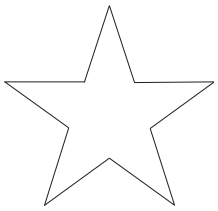


But you can do much better!
What is the largest area, measured in small squares, that can be enclosed using these five pieces?

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).

9. CUTTING UP A STAR (coefficient 9)
An obtuse triangle is a triangle that has an obtuse angle, that is, an angle strictly greater than a right angle.
Mathilde has completely cut this five-pointed star into a certain number of triangles, none of which are obtuse.



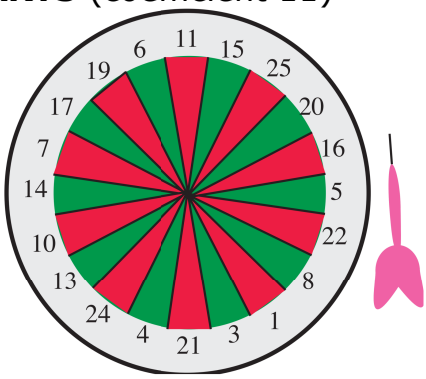
What is the minimum number of triangles in Mathilde's dissection?

10. CRYPTARITHM OF THE YEAR (coefficient 10)

2027 + AVEC = JOIE

In this operation, the same letter always represents the same digit, and the same digit is always represented by the same letter. Furthermore, we know that JOIE is a multiple of 9.
What is the value of JOIE?

11. DARTS (coefficient 11)



On this particular dartboard, when throwing 3 darts, you must achieve a total score of 30 by adding the values of the sectors where the darts land.
• No two darts may land in the same sector or in adjacent sectors.
• The 3 darts cannot all land in sectors of the same colour.
Suppose the first dart scores 8.

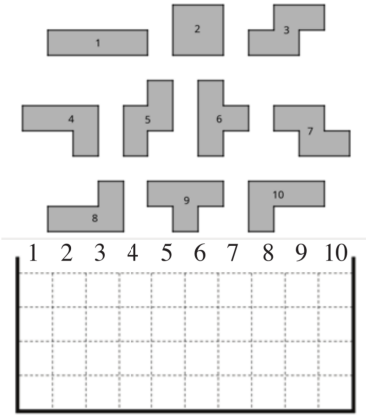
What would be the values of the sectors for the last two darts?
List the values in ascending order, separated by a semicolon. Example: 1;3

END FOR C1 PARTICIPANTS

For the following problems, note that: π ≈ 3.1416; √2 ≈ 1.414; √3 ≈ 1.732.

12. ABC (coefficient 12)
The 6-digit integer written as *abcabc* is a multiple of 7 and 11, regardless of the values of *a*, *b*, and *c*.
Find a 3-digit integer *abc* with distinct, non-zero digits such that *abc* is a perfect square and *abccba* is also a multiple of 7 and 11.

13. TETRIS (coefficient 13)

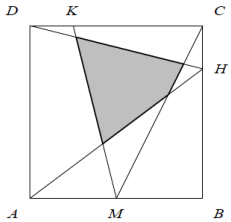


We want to place these 10 Tetris pieces into the container. The pieces are placed one after another in the order of their numbers from 1 to 10, without rotating or flipping them. Each new piece must rest entirely on the bottom of the container or on pieces already placed, without leaving a gap. In the end, the container is completely filled, and no piece protrudes.
In which column(s) will the rightmost small square of piece 1 and piece 10 be located?
Provide the column number for the first piece followed by that for the last piece, separated by a semicolon. Example: 10;6.

14. SEASIDE (coefficient 14)
Matilda is kayaking along the coast connecting Mathopolis-on-Sea to Thales-Baths, passing through the small village of Parallax located between the two towns.
The coastline is perfectly straight and runs parallel to the footpath bordering the beach and the main road located a short distance away.
At one moment, Mathilde is about to pass a sign by the footpath reading "Parallax 12.3 km" and notices that, directly behind it, a sign by the road reads "Thales-Baths 37.5 km." However, looking ahead at the same moment, she sees a sign by the footpath a little further along reading "Parallax 12 km," and, aligned behind it in the same direction, a sign by the road reading "Thales-Baths 37 km." She continues in a straight line, remaining parallel to the coast. A short while later, she spots a sign "Parallax 5.2 km" by the footpath and, directly behind it, a sign "Thales-Baths 30 km" by the road.
What distance (in km) did she travel between these two moments?
If your answer is a decimal value, the integer part and the decimal part must be separated by a comma.

END FOR C2 PARTICIPANTS

15. TRIANGLES IN THE SQUARE (coefficient 15)



The square ABCD shown in the figure contains the two triangles AHD and KMC. We know that M is the midpoint of side AB, CH = ⅓ BH, and DK = ⅓ CK.
What is the ratio of the area of the grey quadrilateral to the area of square ABCD?
Give the answer as an irreducible fraction in the form a/b.

16. SETTLERS OF MATHAN

(coefficient 16)

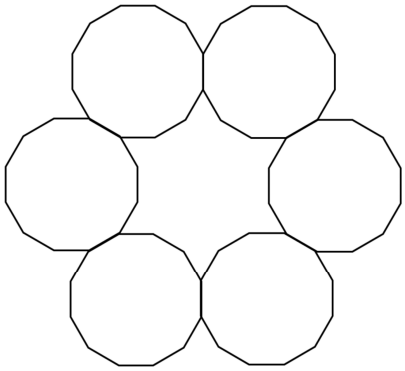
The residents of Mathville love board games. This year, they decided to organize a "Settlers of Mathan" Masters tournament. The rules require three players per game. 2,027 people signed up. Given the rules (three players per game), this number does not allow every participant to play exactly one game against every other player.

What is the minimum number of additional players needed so that every participant can play exactly one game against every other participant in the tournament?

END FOR L1, GP PARTICIPANTS

17. MYSTERY STAR (coefficient 17)

Six regular dodecagons with a side length of 1 cm are joined as shown in the figure: each dodecagon shares a side with its immediate neighbours.



What is the area (in cm², rounded to the nearest tenth) of the star-shaped region enclosed by the six dodecagons?

Separate the integer part and the decimal part by a comma.

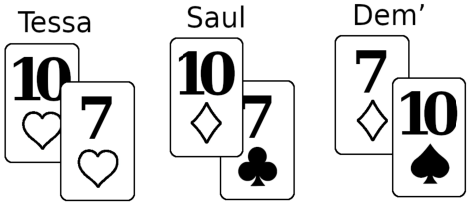
18. TESSA, SAUL, DEM' (coef. 18)

Demian is playing poker with Tessa and Saul. The deck consists of 52 cards, comprising 13 ranks across 4 suits (spades, hearts, diamonds, and clubs). Each player starts by being dealt two of these 52 cards at random, and it is already possible to assess whether one player has an advantage over another.

For the hands of two or more players to be considered equivalent, meaning no player holds an advantage over another, a first essential condition is that their two cards must be of the same two ranks, regardless of suit.

However, a second condition is also required: either every player holds two cards of the same suit, or no player holds two cards of the same suit.

In the example shown in the figure, everyone appears to hold equivalent cards—a 10 and a 7 (satisfying the first condition). However, Tessa has an advantage over Saul and Dem' because her two cards belong to the same suit (failing the second condition).



What is the probability that three players are dealt truly equivalent hands?

Give the answer as an irreducible fraction in the form a/b.

END FOR L2, HC PARTICIPANTS