

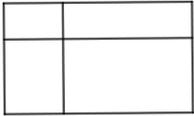
FSJM – SEMI-FINAL- 24 MARCH 2018

Information and results at <http://fsjm.ch/>

START for ALL PARTICIPANTS

1. RECTANGLES (coefficient 1)

How many rectangles are there in the figure below?



2. SOME TOTAL! (coefficient 2)

Anne writes the numbers from 1 to 18 next to each other, and thus forms a very large number of 27 digits.

What is the sum of the digits in this number?

3. PIN CODE (coefficient 3)

Marc does not remember the exact code to unlock his mobile phone: he knows

- it has 4 digits of which 2 are the same,
- it starts with a 3 and ends with a 0 and
- that there is a 6.

How many codes must he try on his phone to be sure to find the right one?

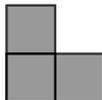
4. 2018 (coefficient 4)

Zoe enjoys mental arithmetic: she tries to think of the largest number possible by using each of the four digits 2, 0, 1 and 8 once, together each of the +, - and x operators used once.

What is the largest number she can make?

5. PENTOMINOS (coefficient 5)

Lucy has a box of trominos (figures formed of 3 cubes glued by a face) all identical to this model.



She also has many isolated cubes that she would like to glue to the existing trominos to form pentominos (figures with 5 cubes that can be laid flat on the table) all different.

How many different pentominos (not identical, even after rotation or reflection) can she build?

END for CE PARTICIPANTS

6. STEP COUNTER (coefficient 6)

At midnight on the night of February 26 to 27, 2018, Max sees on his step counter that he has an average for the month of February of 7998 steps per day.

How many steps will it take on average during the last days of February for the average over the whole month of February to be 8000 steps per day?

7. TRAINING SESSION (coefficient 7)

Philip is playing with his electric train. It takes three no.221 curved rails to make a quarter turn. The no.222 curved rail turns three quarters of the angle of no.221.

How many no.222 rails does Philip need to make a complete circle?

8. AT THE OLYMPICS (coefficient 8)

At the 2006 Olympic Winter Games, the 10 alpine ski events represented more than one-tenth of the total number of events, which was exactly 7 times the number of cross-country ski events, as well as a multiple of the 4 acrobatic ski events, and of the 3 ski jumping events.

How many events were there at the 2006 Olympics?

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. ELEVENSES (coefficient 9)

The sum of the digits of the number 2018 is equal to 11, but 2018 is not a multiple of 11.

Which years between 1900 and 2100 satisfy both conditions: to be a multiple of 11 and to have a sum of the digits which is also a multiple of 11?

10. HOW OLD? (coefficient 10)

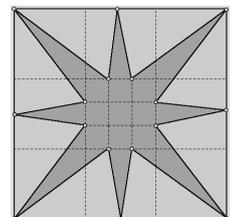
Fred and Jamie both celebrate their birthdays today and Fred says:

- If we remove two digits from the current year (2018), we are left with my age.
- It's the same for my age, and it was also the same last year, answers Jamie.

If Jamie is older than Fred, what is his age, knowing that a number cannot start with the digit 0?

11. THE MYSTERY STAR (coefficient 11)

The large light grey square is divided into 9 identical middle-sized squares, then the central middle-sized square into 9 identical small squares. The dark grey star, which connects certain vertices or midpoints of small squares or middle squares, is then drawn. The large light grey square is of area 111 cm².



What is the area of the star in cm²?

END for C1 PARTICIPANTS

12. **HOOPS** (coefficient 12)

During gymnastics, Mathias likes to arrange hoops (all identical) on the floor of the gym: they can overlap. These hoops thus define regions on the floor. Mathias notes that, after he has arranged the hoops, there are 7 regions formed, but they are of only 3 different areas. This means that some regions have exactly the same area.

How many hoops did Mathias arrange on the floor?

Warning: The area outside the hoops does not count as a region.

13. **TRANSFER** (coefficient 13)

Antoine has two spherical bottles filled with water (we neglect the volume of the neck). Their diameters are 24 cm and 84 cm. Antoine transfers the contents of these two bottles into n other spherical bottles, all identical, so that there is nothing left in the two original bottles of and that the n new bottles are full.

What is the diameter of the new spheres, knowing that it is a whole number of cm?

14. **SPECTACULAR BIRTHDAY** (coefficient 14)

A birthday is spectacular if the number of the day (in the year), the number of the day in the month, the number of the month, and the age of the person are all factors of the year.

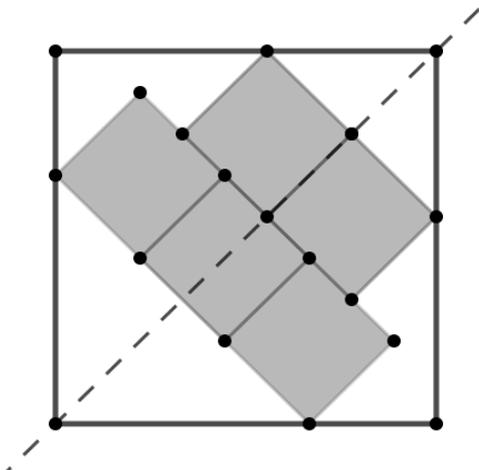
For example, someone born on May 11, 1947 had a spectacular birthday on May 11, 1980, because age (33), number of the month (5), day (11), and day in the year (132) are all factors of 1980.

Marc is participating again this year in the FSJM contest. On the day of the semi-final (March 24), he is still 19 years old. But at the time of the final (May 26) he will have reached twenty years old. The organizers of the final note that Marc had a spectacular birthday in the past.

What is Marc's date of birth?

END for C2 PARTICIPANTS

15. **BOXED IN** (coefficient 15)



Five small identical square boxes (grey in colour) are arranged in a large square box (white in colour) as shown in the figure, which has an axis of symmetry shown as a dashed line. The bottom of the big box has an area equal to 405 cm^2 .

What, in cm^2 , is the area of the bottom of a small box?

16. **MOSAIC** (coefficient 16)

Cathy would like to make, on a rectangle of 4 squares by 5, a mosaic in black and white containing 4 pieces all of different shapes.

There are two black pieces, one of 4 squares and one of 6 squares, and 2 white pieces, one of 4 squares and one of 6 squares. Two pieces of the same colour cannot touch side to side, but possibly can have a common vertex.

How many different solutions can she create?

A mosaic obtained by symmetries and/or change of colours is considered identical to the original.

END for L1, GP PARTICIPANTS

17. **QUOTIENTS** (coefficient 17)

Benjamin's calculator only displays 5 digits after the decimal point and rounds the result to the nearest number it can display.

Typing 1 divided by a prime number p smaller than 100, we can read the result: 0.02439.

Which positive integer n , not equal to 1, when divided by the same number p gives on the calculator a quotient smaller than 1 which has the same digits as the division of 1 by p ?

18. **STORAGE UNIT** (coefficient 18)

Mathias has 2016 items stored in a storage unit shaped as steps, one object per box (as in the figure). It is completely filled.



Mathilde, on the other hand, would like to store her 2018 items in a storage unit shaped as a square of boxes. Unfortunately, there are some empty boxes. In order to fill Mathilde's unit, Mathias decides to offer her some of his items.

This turns out well!!

Mathias' remaining items now fill exactly the first n columns (from height 1 to n) of his unit.

How many items did Mathias give to Mathilde?

END for L2, HC PARTICIPANTS