

Logic GC : Round 1

Math and Physics Club, IIT Bombay

Time: 80 minutes

Hostel:



Name 1 :

E-mail 1:

Name 2 :

E-mail 2:

Name 3 :

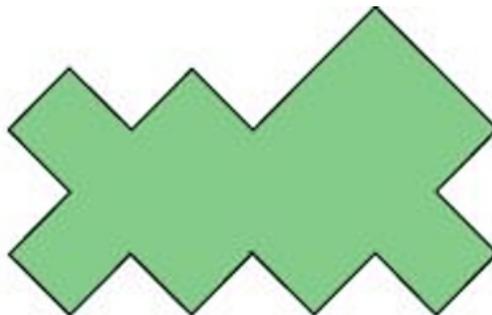
E-mail 3:

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	
Marks																				

All questions are logical, unlike this quote.

1. Cut the Rope!

Add one cut (or draw one line segment), which doesn't need to be straight, that can divide this shape into two identical parts.



2. Let's count chickens...

If a hen and a half lays an egg and a half in a day and a half, how many and a half who lay better by half will lay half a score and a half in a week and a half?

3. SAY MY NAME

A certain word has 13 letters.

1. Each pair of letters below consists of one letter contained in the word and one "other" letter.

A	B	C	D	E	F	G	H	I	J	L	S	Y
V	W	Q	M	K	U	N	P	O	R	X	T	Z

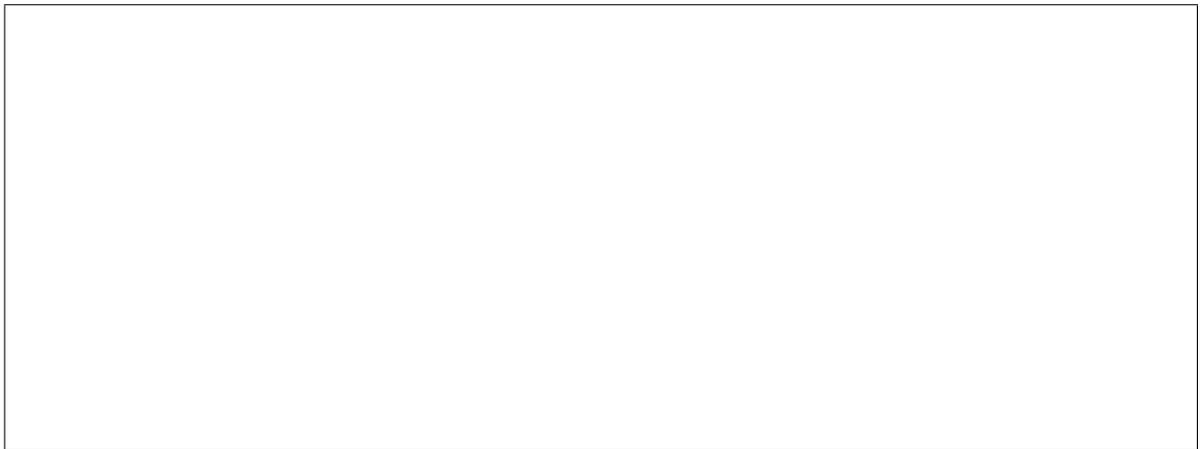
2. When the letters in the word are put in the order in which they appear in the original word, and each "other" letter is put beneath each letter in the word, the "other" letters will appear in alphabetical order.

3. The word has the same number of letters in common with each of the following words:

4. The word need not make grammatical sense.

FACE QUEST QUICK SWITCH WORLD

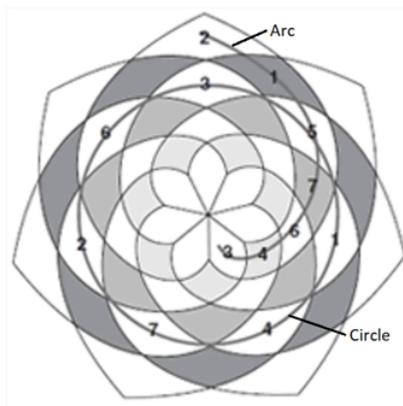
What is the word?



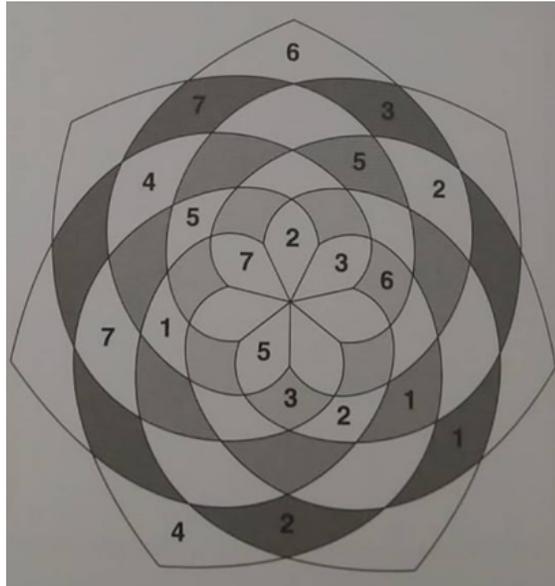
4. If you like it, put a picture on it

Rules for solving the sudoku:

1. Each arc must contain the numbers 1-7.
2. Each ring of shaded petals must contain the numbers 1-7.
3. Each ring of white petals must contain the numbers 1-7.
4. No number can be repeated in any arc or ring.



Solve the following lotus:



5. The Curious Case of the missing Digit

$$\begin{array}{r}
 ABCD \\
 + \quad BCD \\
 \hline
 EFGHI
 \end{array}$$

In the addition above, each letter represents a different digit. Which one of the 10 digits is missing?

6. Let's paint the town red

A solid cube is painted yellow, blue and black such that opposite faces are of the same color. The cube is then cut into 36 cubes of two different sizes such that 32 cubes are small and the other four cubes are Big. None of the faces of the bigger cubes is painted blue. How many cubes have only two faces painted?

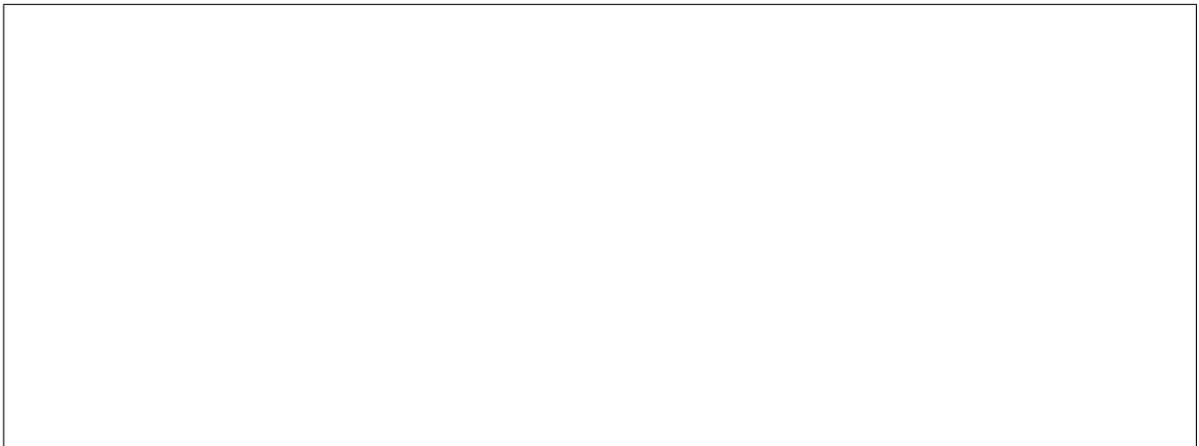


7. Gettin' all Texas

You have just arrived to Wild West and you have already got in trouble. Buffalo Bill and Killer Kid are aiming at each other with colts. They accept you to death match with pleasure. They agree on the following rules:

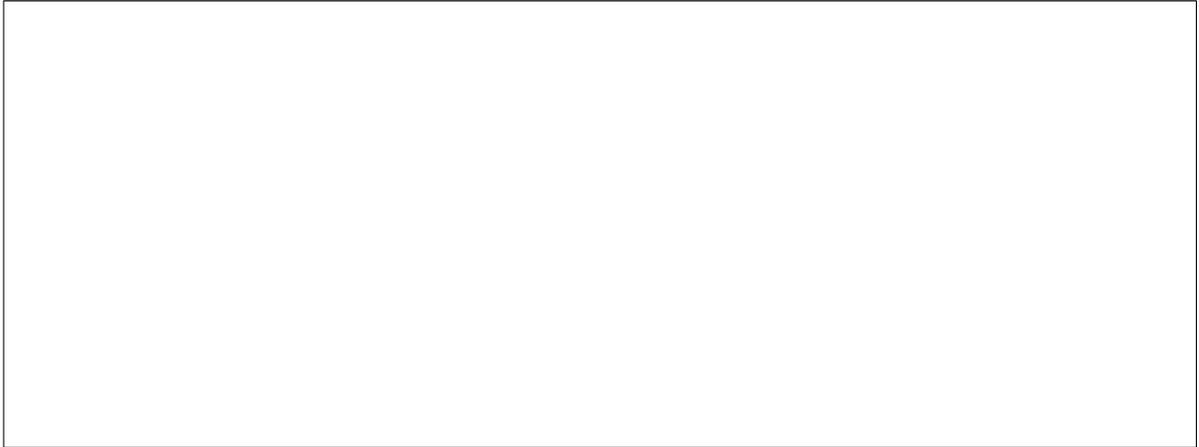
1. Participants shoot anywhere in the given order until only one survives.
2. Everyone shoots only once when it's his turn.
3. If someone is injured the others finish him off with iron rod.
4. The worst shooter (you) shoots first the best shoots last.

What is the best strategy for you to win if you know that you hit about every third shot, Bill has around 50% chance and Immortal Kid never miss? Justify your answer. (Please don't shoot yourself)



8. Kowalski, analysis!

Find the sum of the values of A, B and C if $ABC=A!+B!+C!$ where ABC is a 3-digit number



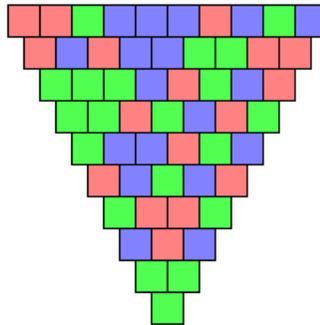
9. Making Pascal Proud

Form an inverted triangle of boxes, with 10 boxes in the top row. Colour the boxes in the top row using the colours red, green and blue, in any order and combination. Now colour the boxes in subsequent rows as follows:

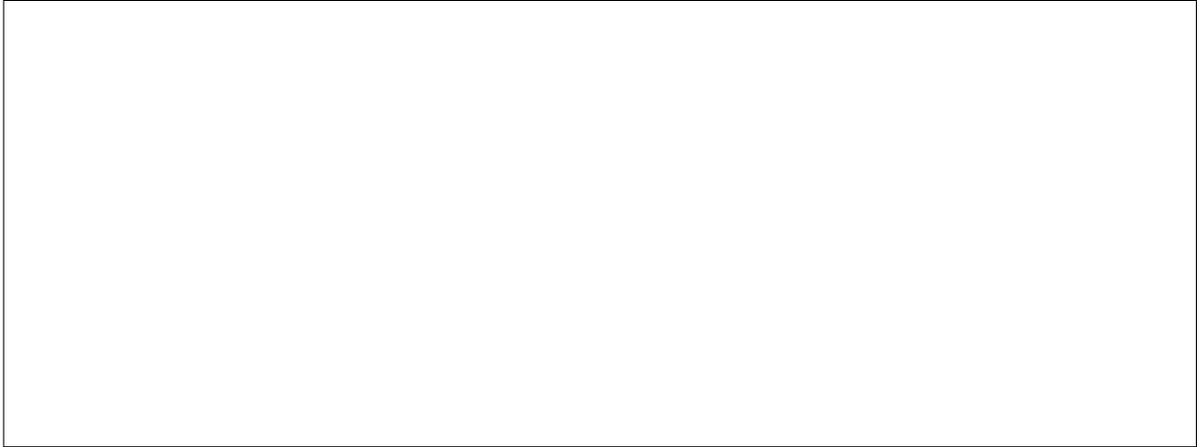
If the two boxes above a box B have the same colour, then use the same colour for B

If the two boxes above a box B have different colours, then use the third colour for B

Continue until the single box in the bottom row is coloured. Here's an example:

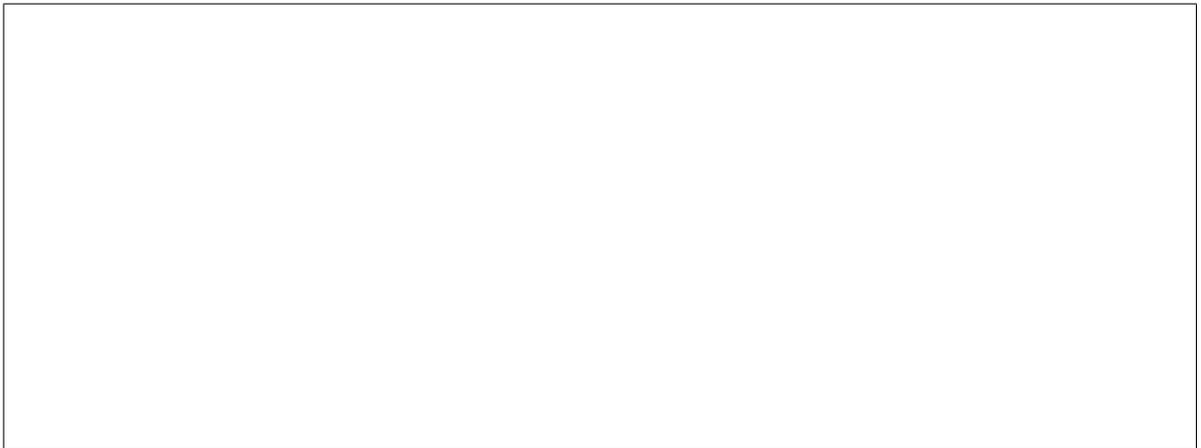


Find a rule that allows you to determine the colour in the bottom box, just by examining the colours in the top row only. Prove it.



10. Don't talk the talk, just walk the walk.

3 Runners participated in a race, namely X, Y and Z. X was the first to start and Z started last. During the race, Z exchanged positions with other contestants 6 times, while X did it 5 times. It is known that Y finished ahead of X. In what order did they finish?



11. Love's just a chemical reaction Morty - Rise above, Focus on Science!

Jan and Maria have fallen in love (via the internet) and Jan wishes to mail her a ring. Unfortunately, they live in the country of Kleptopia where anything sent through the mail will be stolen unless it is enclosed in a padlocked box. Jan and Maria each have plenty of padlocks, but none to which the other has a key. How can Jan get the ring safely into Maria's hands?

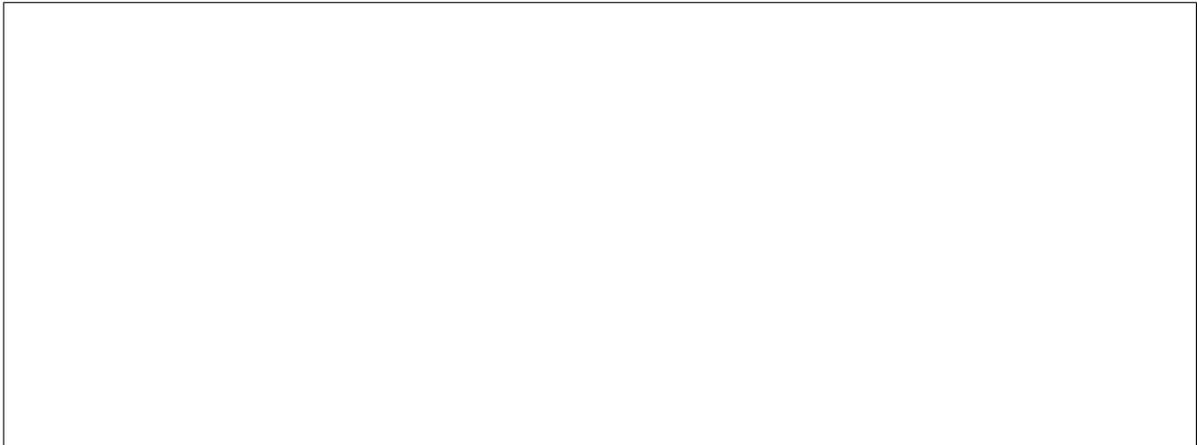


12. One batch, Two batch, Penny and Dime.

A submarine is moving on the real line. At time $t = 0$, it is at an integer point (positive, negative or 0). Its speed is a constant integer number of units (positive, negative or 0) per hour. As a result, it will be at an integer point for each time $t = 0, 1, 2, \dots$

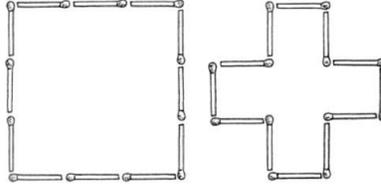
Your task is to sink the submarine. You may fire one missile per hour, targeting it at a single integer. If the submarine is at the same integer at the same time, it is sunk.

What strategy will allow you to sink the submarine, regardless of its initial position and speed?

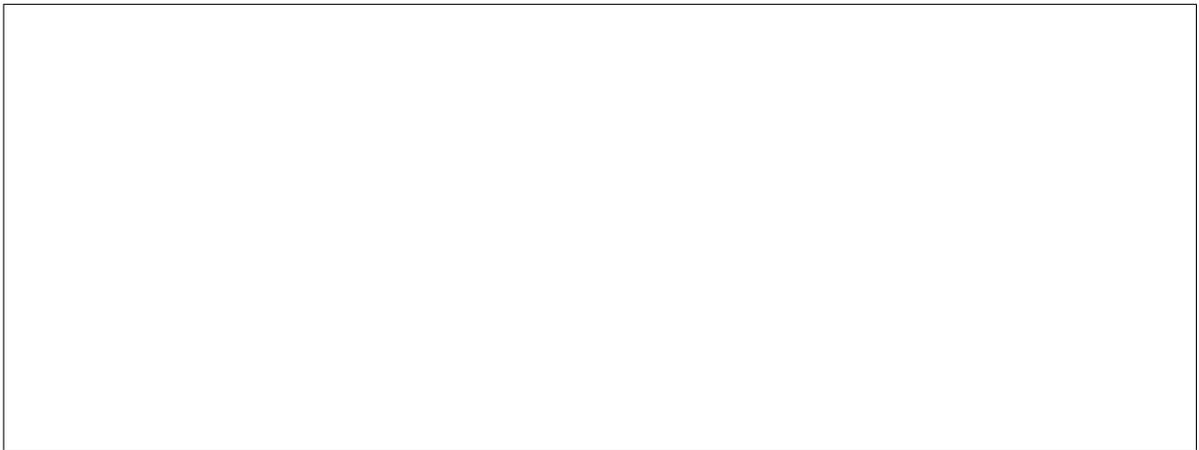


15. The 12 Matches

Assuming that a matchstick is of unit length, it is possible to place 12 matchsticks on a plane in various ways to form polygons with integral areas. The illustration shows two such polygons: a square with an area of nine square units and a cross with an area of 5 square units.



Use all 12 matchsticks to form in similar fashion, the perimeter of a polygon with an area of exactly
i) 4 square units ii) 3 square units.

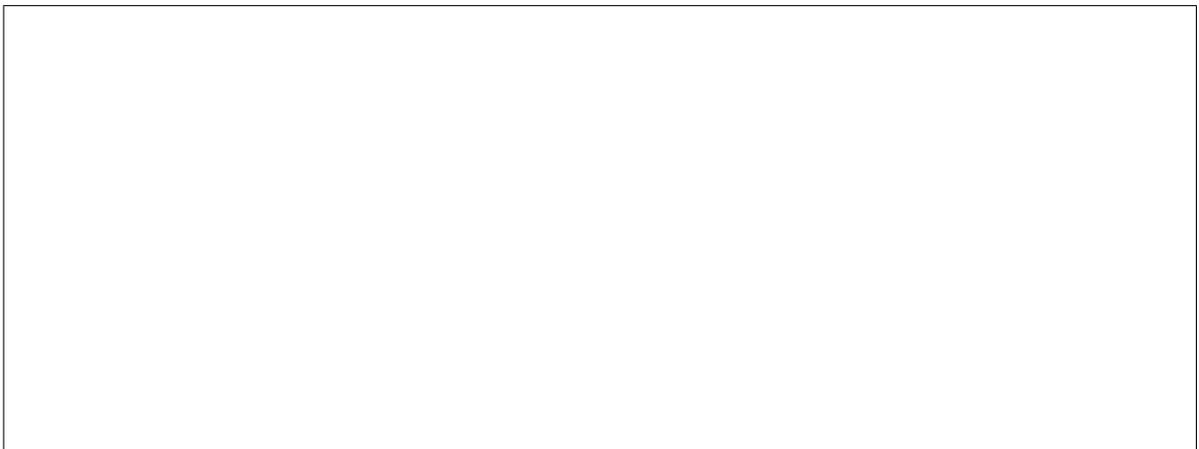


16. Cryptology Unlocked

Substitute numbers for the letters so that the following mathematical expressions are correct.

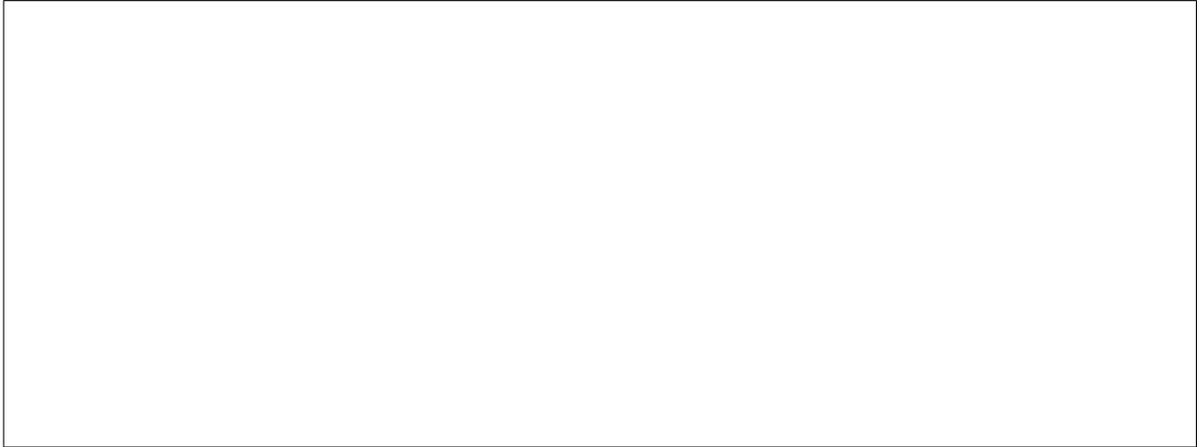
$$ZYX/3 = LQ, PQR/6 = LQ, JKL/9 = LQ$$

Note that the same number must be used for the same letter whenever it appears.



17. Painting troubles again

A straight line is colored with two colors. Prove that there are three points A,B,C of the same color such that $AB=BC$.



18. Mom, can we have some numbers at home?

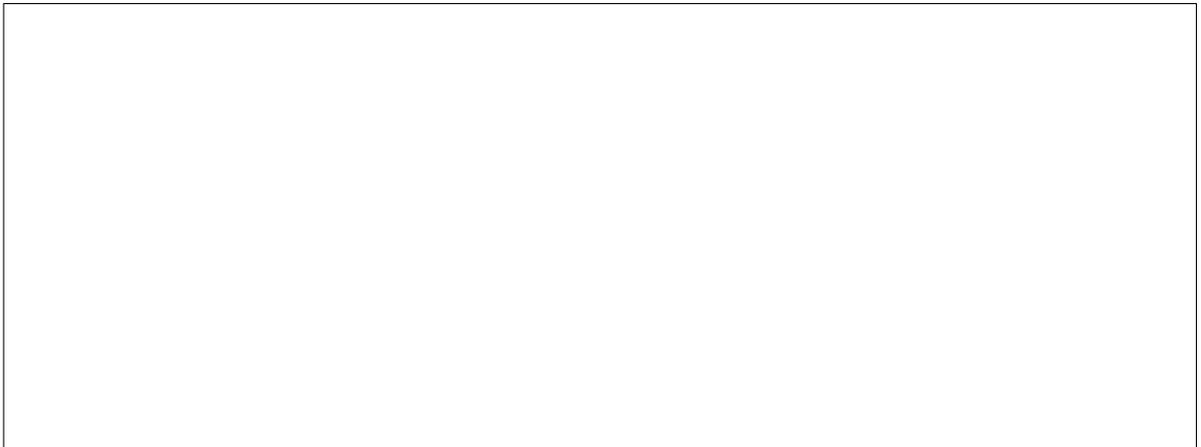
Can you find values for p and q so that

$$p^q - q^p = 1927?$$

To make it perfectly clear, we will give an example for the year 1844, where $p = 3$, and $q = 7$:

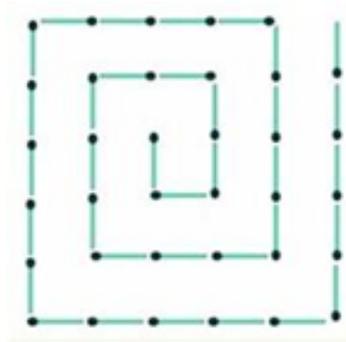
$$3^7 - 7^3 = 1844.$$

Can you express 1927 in the same curious way?



19. Show me some moves

Move 4 matchsticks to make 3 squares of different sizes.



20. No questions asked

Find the next number in the series

2 9 3 1 8 4 3 6 5 7 ?