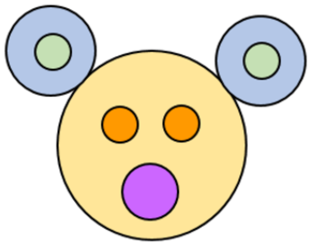
Pre-Ecolier

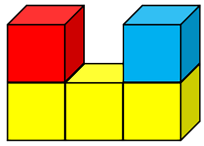
3 points

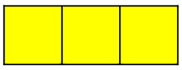
1. How many circles are there in the figure?



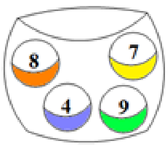
(**A**) 5
(**B**) 6
(**C**) 7
(**D**) 8
(**E**) 9

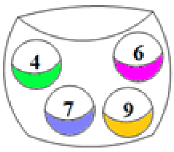
2. The picture shows 5 cubes viewed from the front. What is the view from above?

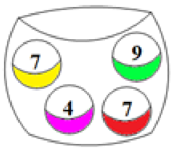


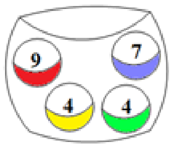
(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

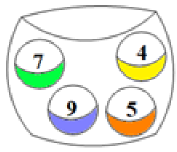
3. Each bowl contains four numbered balls as shown. In which bowl is the sum of all the numbers largest?

(**A**) 

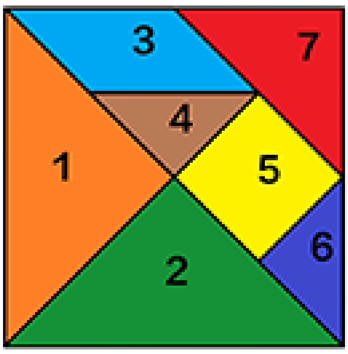
(**B**) 

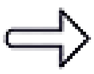
(**C**) 

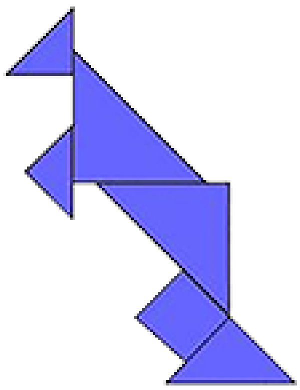
(**D**) 

(**E**) 

4. Mr Beaver rearranges the pieces to make a kangaroo figure.







Which piece is missing?

(**A**) 3 (**B**) 4 (**C**) 5 (**D**) 6 (**E**) 7

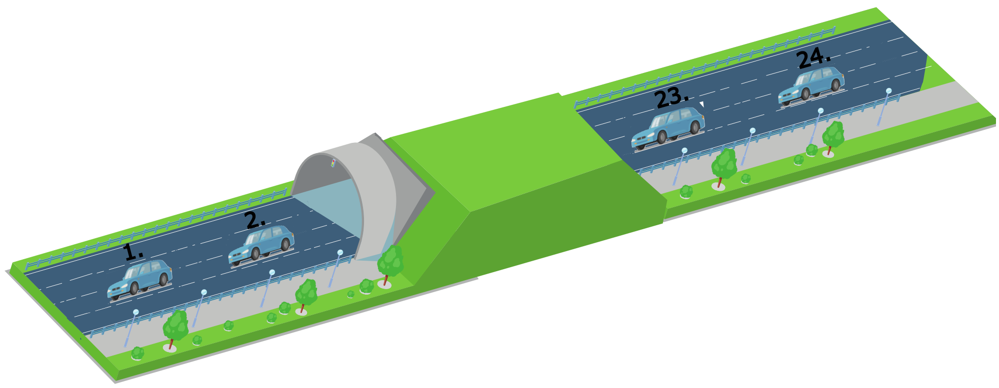
5. My boat has more than 1 circle. It also has 2 more triangles than squares. Which boat is mine?

(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

6. This is my grandfather's birthday cake. A large candle counts for 10 years and a small one for 1 year. How old is my grandfather?

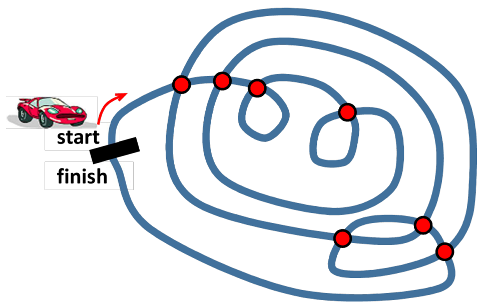
(**A**) 65 (**B**) 66 (**C**) 76 (**D**) 77 (**E**) 78

7. Pablo puts 10 toy cars on this racetrack. How many cars are in the tunnel?



(**A**) 5 (**B**) 6 (**C**) 7 (**D**) 8 (**E**) 9

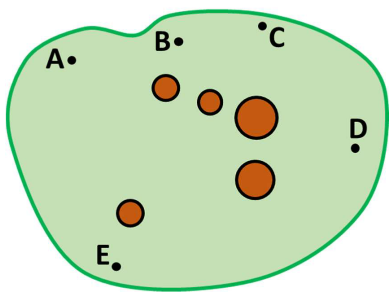
8. Steven drives from X to Y. At each crossing, he stops before going straight ahead. In total, how many times does he stop at a crossing?



(**A**) 11 (**B**) 12 (**C**) 13
(**D**) 14 (**E**) 15

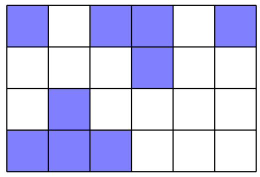
4 points

9. There are 5 trees in a park. A beaver can see only two of the trees because all the others are hidden behind other trees. At which of the marked points is the beaver standing?



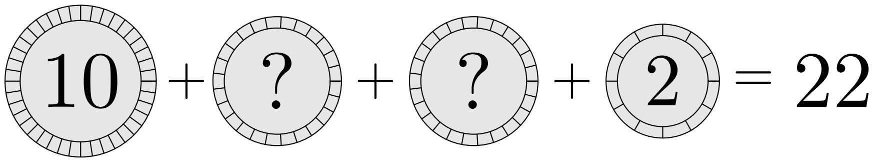
(**A**) at A (**B**) at B
(**C**) at C (**D**) at D
(**E**) at E

10. There are 24 squares in the picture. Suchit has coloured some of the squares. How many more squares need to be coloured so that half of the squares are coloured?



(**A**) 1 (**B**) 2 (**C**) 3
(**D**) 4 (**E**) 5

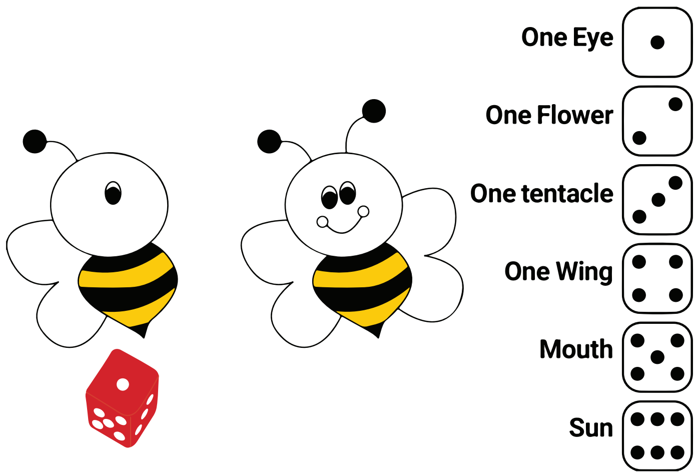
11. The two tokens with the question mark have the same number. What is each missing number so



that the sum is 18?

(**A**) 1 (**B**) 2 (**C**) 3 (**D**) 4 (**E**) 5

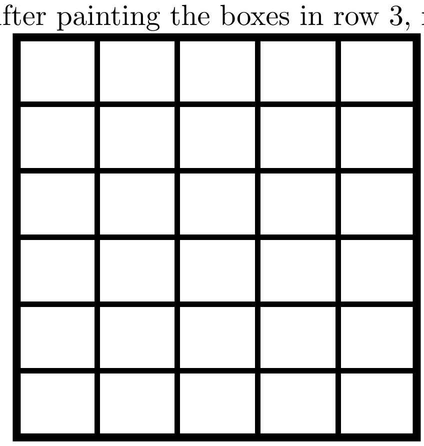
12. Raha wants to finish the bee on the right according to the model on the left.



Raha needs to win points to unlock parts of the bee. How many points does she have to win to complete the bee?

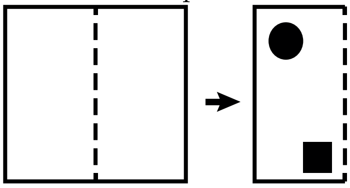
(**A**) 9 (**B**) 10 (**C**) 11 (**D**) 12 (**E**) 13

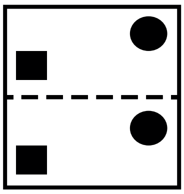
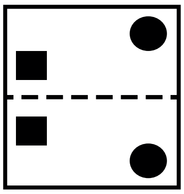
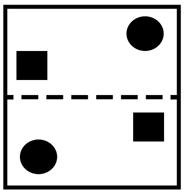
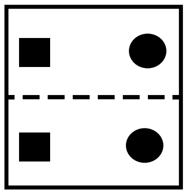
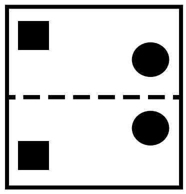
13. The table has 30 boxes. After painting the boxes in row 3, row 6, column C and column D, how many boxes will be unpainted?



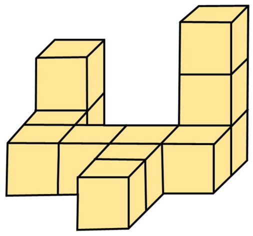
(**A**) 8 (**B**) 10 (**C**) 12 (**D**) 18 (**E**) 22

14. A sheet of paper is folded in half. Square and round holes are punched. How does the sheet look after it is unfolded again?



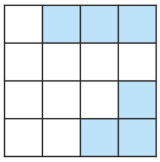
(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

15. A student made the shape shown using 12 cubes. He put one drop of glue between any two cubes that share a common face. How many drops of glue did he use?

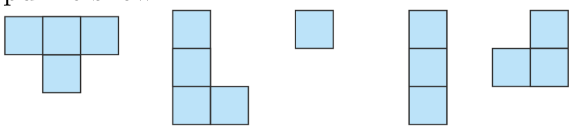


(**A**) 8 (**B**) 9 (**C**) 10
(**D**) 11 (**E**) 12

16. Max wants to complete the puzzle shown.



He has 5 different pieces shown.

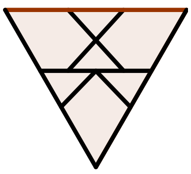


Which pieces does he have to use to complete the puzzle?

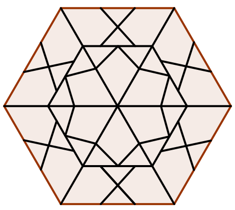
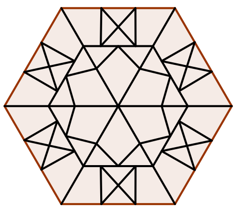
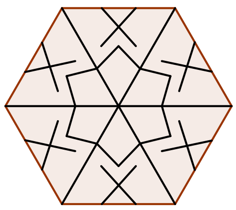
(**A**) $1, 2, 3$ (**B**) $1, 2, 4$ (**C**) $1, 2, 5$ (**D**) $3, 4, 5$ (**E**) $1, 4, 5$

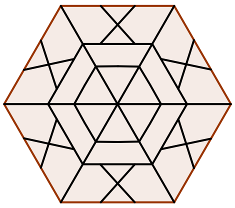
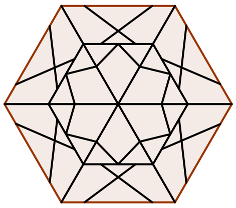
5 points

17. Elvis has 6 identical triangles like this.

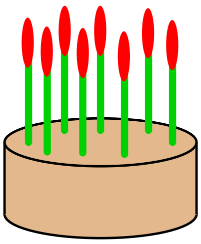
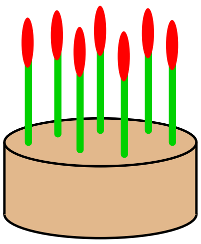
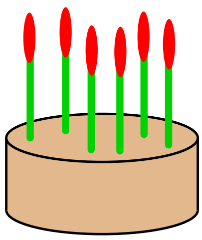
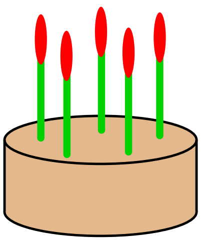
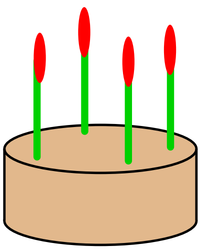


Which of the following pictures can he make?

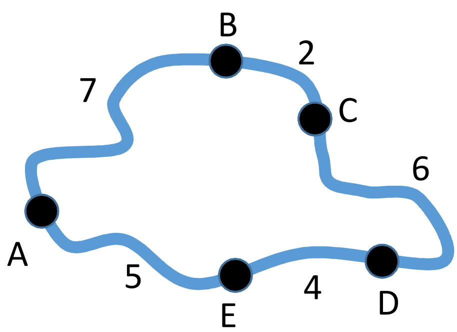
(**A**)  (**B**)  (**C**) 

(**D**) 
(**E**) 

18. Five children share a birthday and each child has their own cake. Lea is two years older than Jose, but one year younger than Ali. Vittorio is the youngest. Which is Sarah's cake?

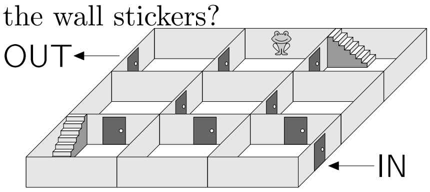
(**A**) 
(**B**) 
(**C**) 
(**D**) 
(**E**) 

19. The map shows five villages A, B, C, D and E, and the distances in kilometres between them. Only two villages are the same distance apart no matter which route you choose. Which are these two villages?

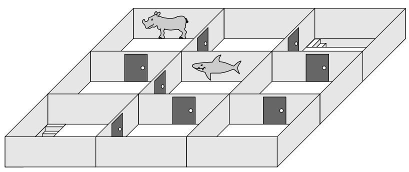


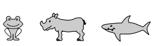
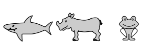
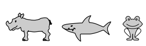
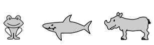
(**A**) B and E
(**B**) B and D
(**C**) C and E
(**D**) A and C
(**E**) A and D

20. Sam walks through a two-storey maze from the entrance to the exit. In what order will she find the wall stickers?



ground floor


first floor

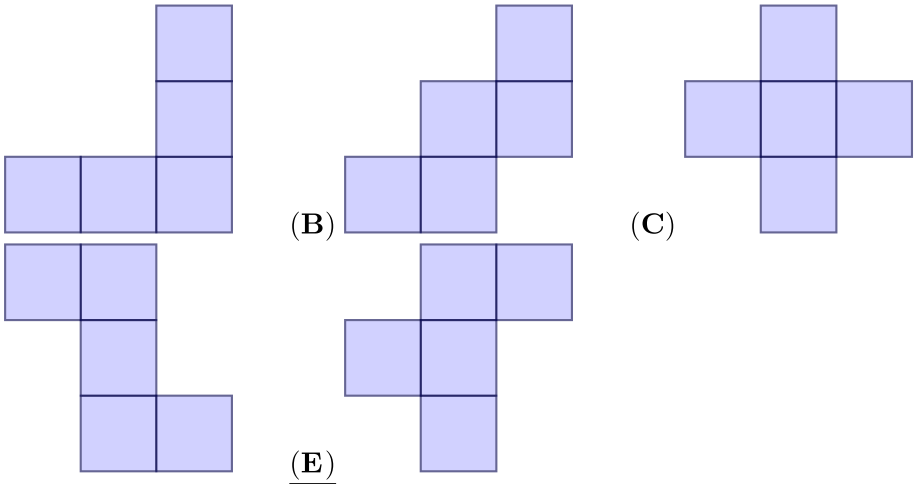
(**A**) 
(**B**) 
(**C**) 
(**D**) 
(**E**) 

21. Emma finished third in a solo dance competition. There were three dancers between her and last place. In total, how many dancers were competing?

(**A**) 4 (**B**) 5 (**C**) 6 (**D**) 7 (**E**) 8

22. Malik places one of the five pieces on the grid. He cannot rotate or flip the pieces. Which piece should he use to cover the numbers with the largest sum?

1	4	7
9	5	6
2	8	3

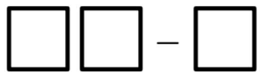


(**A**) (**B**) (**C**) (**D**) (**E**)

23. Three frogs live in a pond. Each night, one of the frogs sings a song to the other two. After 9 nights, one of the frogs had sung 2 times. Another frog had listened to 5 songs. How many songs had the third frog listened to?

(**A**) 7 (**B**) 6 (**C**) 5 (**D**) 4 (**E**) 3

24. Digits 1, 1, 2 and 3 are printed on four different cards. Three cards are laid out to make a subtraction as shown in the picture. How many different results can we make?

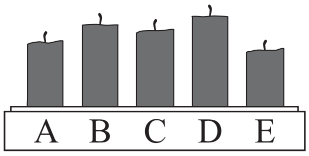


(**A**) 6 (**B**) 8 (**C**) 10 (**D**) 12 (**E**) 24

Ecolier

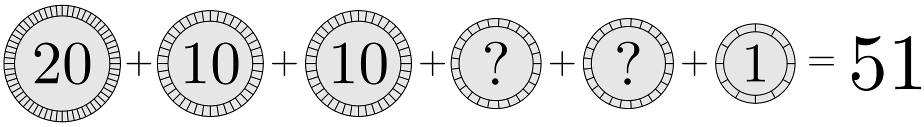
3 points

1. Five identical candles were lit at the same time.
They stopped burning at different times and now look as shown in the picture.
Which candle stopped burning first?



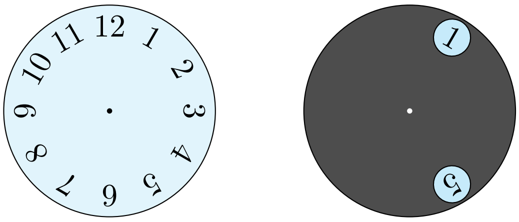
(**A**) A (**B**) B (**C**) C (**D**) D (**E**) E

2. The two kangaroo coins with the question mark on have the same value. What is this value?



(**A**) 1 (**B**) 2 (**C**) 5 (**D**) 10 (**E**) 20

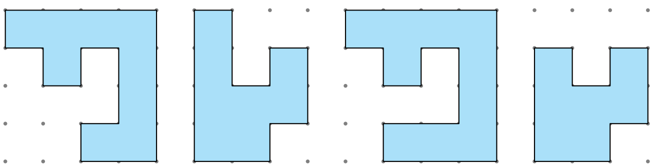
3. A gray circle with two holes in it is put on top of a clock-face, as shown.



The gray circle is turned around its center. Which two numbers is it possible to see at the same time?

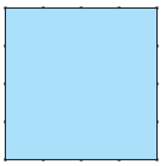
(**A**) 4 and 9 (**B**) 5 and 10 (**C**) 5 and 9 (**D**) 6 and 9 (**E**) 7 and 12

4. Alice has these puzzle pieces:



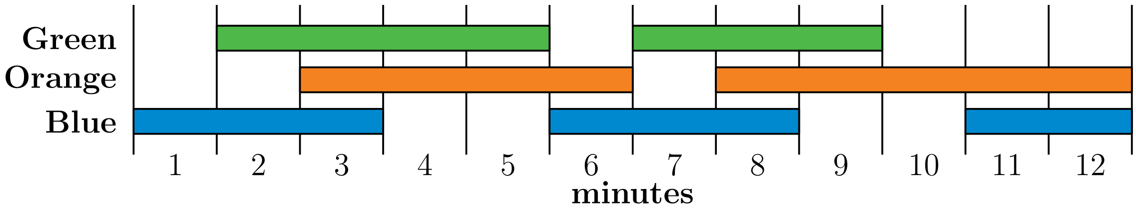
1 2 3 4

Which two pieces can she put together to form this square?



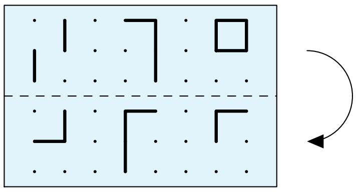
(**A**) 1 and 2 (**B**) 1 and 3 (**C**) 2 and 3 (**D**) 2 and 4 (**E**) 1 and 4

5. A light engineer in the theatre turns the lights on and off. She uses the plan shown. How long in total are exactly two of the lights on at the same time?

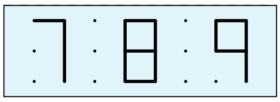


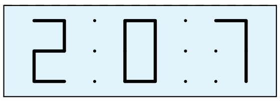
(**A**) 2 (**B**) 6 (**C**) 8 (**D**) 9 (**E**) 10

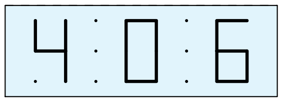
6. Kristoffer folds the transparent paper along the dashed line.

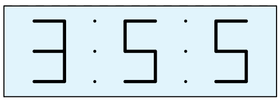


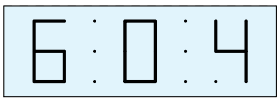
What can he then see?

(**A**) 

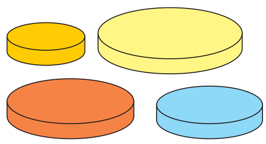
(**B**) 

(**C**) 

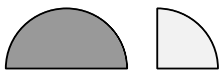
(**D**) 

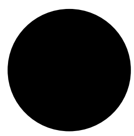
(**E**) 

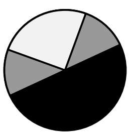
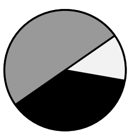
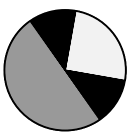
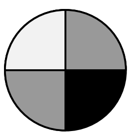
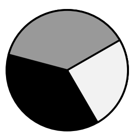
7. Anna has 4 discs of different sizes.
She wants to build a tower of 3 discs so that every disc is smaller than the disc below it.
How many different towers can Anna make?



(**A**) 1 (**B**) 2 (**C**) 4 (**D**) 5 (**E**) 6

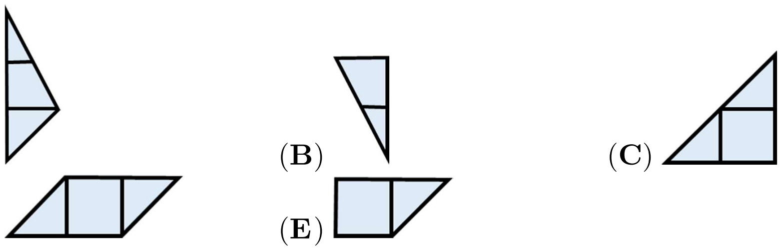
8. Danny glued the 2 pieces of paper  on top of the black circle on the right.
What can he not obtain?

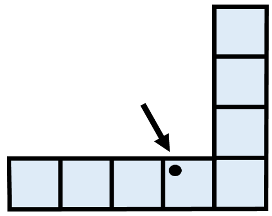


(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

4 points

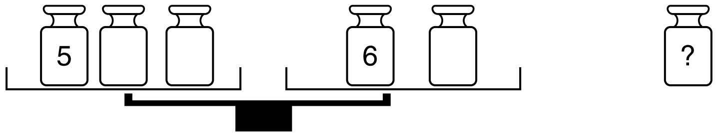
9. The shape on the right is covered with the 5 pieces below.
Which piece will cover the dot?





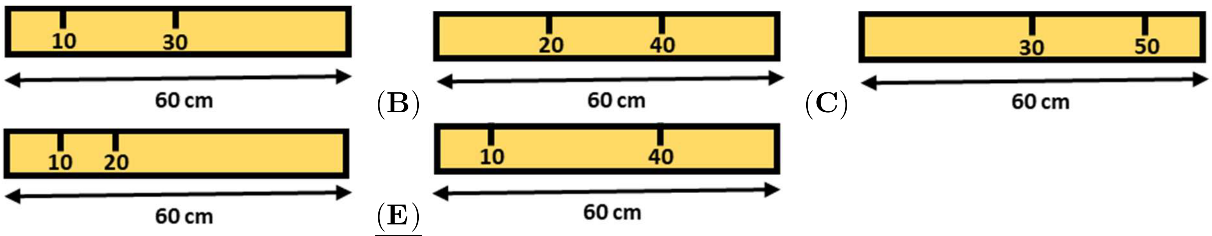
(**A**) (**B**) (**C**) (**D**) (**E**)

10. There are six weights of 1, 2, 3, 4, 5 and 6 kg.
Rossitza puts five of them on the scales and puts one weight aside.
The scales balance.
Which weight did she put aside?



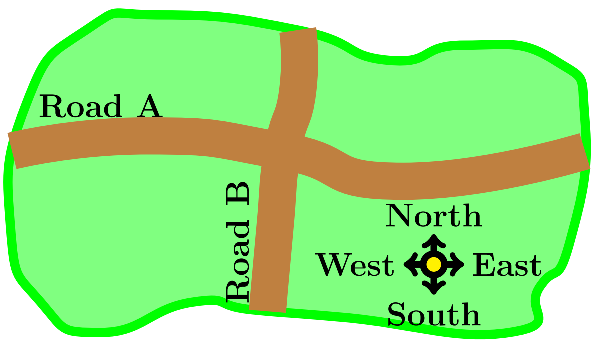
(**A**) 1 kg (**B**) 2 kg (**C**) 3 kg (**D**) 4 kg (**E**) can't be sure

11. Alex has a 60 cm ruler.
Unfortunately, some of the markings have faded away.
He is able to measure any of the lengths 10, 20 , 30 , 40 , 50 and 60 cm using his ruler only once.
Which is Ali's ruler?



(**A**) (**B**) (**C**) (**D**) (**E**)

12. There are 7 houses north of Road A, 8 houses east of Road B and 5 houses south of Road A.
How many houses are west of Road B?

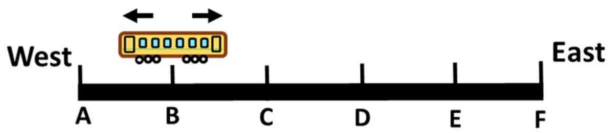


(**A**) 4 (**B**) 5
(**C**) 6 (**D**) 7
(**E**) 8

13. There are 8 cars waiting in a queue for the ferry.
Every car contains either 2 or 3 people.
There are 19 people in total waiting for the ferry.
How many cars contain exactly 2 people?

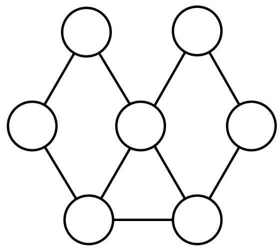
(**A**) 2 (**B**) 3 (**C**) 4 (**D**) 5 (**E**) 6

14. The Metro line has 6 stations, A, B, C, D, E, and F.
The train stops at every station.
When it reaches one of the two end stations, it changes its direction.
The train driver started driving at station B and his first stop was station C.
Which station will be his 96th stop?



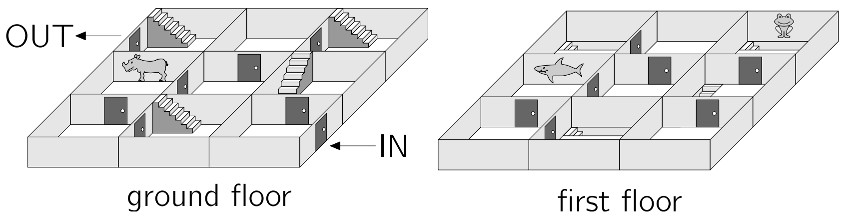
(**A**) A (**B**) B (**C**) C
(**D**) D (**E**) E

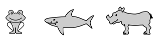
15. Hatice wants to paint the circles in the picture. She wants to paint any 2 circles connected with a line different colours. What is the smallest number of colours she needs?



(**A**) 2 (**B**) 3
(**C**) 4 (**D**) 5
(**E**) 6

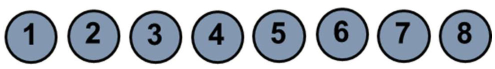
16. Sam walks through the two-storey maze from the entrance to the exit, passing 3 wall stickers. In what order will she see them?



(**A**)  (**B**)  (**C**) 
(**D**)  (**E**) 

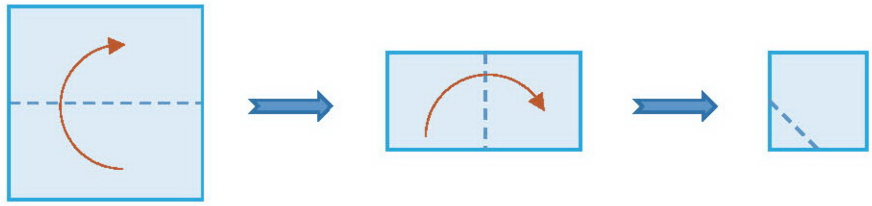
5 points

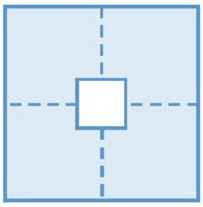
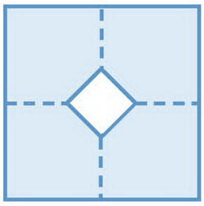
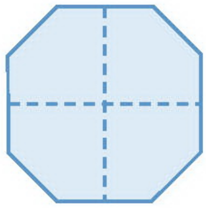
17. 6 beavers and 2 kangaroos are standing in a line. Among any 3 consecutively numbered animals, exactly 1 is a kangaroo. Which numbered animal is a kangaroo?

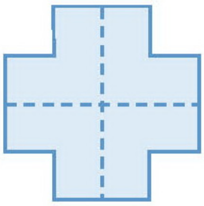
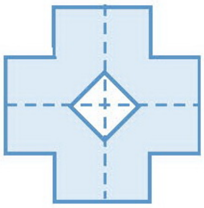


(**A**) 1 (**B**) 2 (**C**) 3
(**D**) 4 (**E**) 5

18. Rebecca folds a square piece of paper twice. Then she cuts off one corner. Next, she unfolds the paper. What does the paper look like once unfolded?



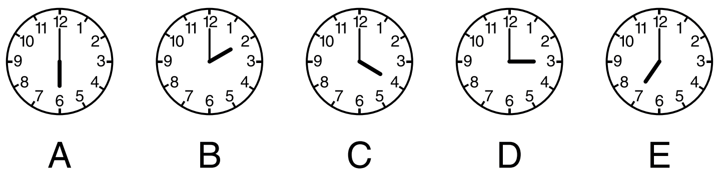
(**A**) 
(**B**) 
(**C**) 

(**D**) 
(**E**) 

19. Hermione, Harry and Ron always walk into the common room one at a time. Hermione is never first, Harry is never second and Ron is never third. In how many different orders could they walk in?

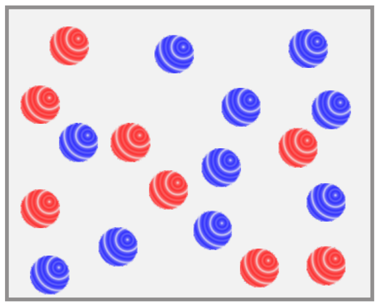
(**A**) 1 (**B**) 2 (**C**) 3 (**D**) 4 (**E**) 6

20. There are five clocks on the wall. It is known that one clock is an hour fast, one clock is an hour slow, one clock shows the correct time and two clocks have stopped. Which clock shows the correct time?



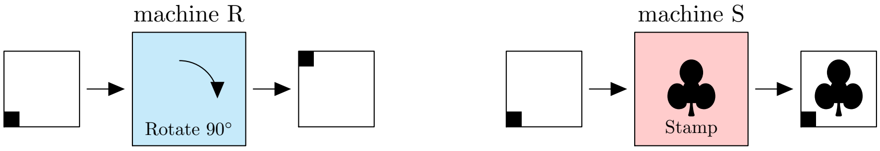
(**A**) A (**B**) B (**C**) C (**D**) D (**E**) E

21. Adam and Brenda have 9 marbles each. Together, they have 8 red and 10 blue marbles. Brenda has twice as many blue marbles as red marbles. How many blue marbles does Adam have?

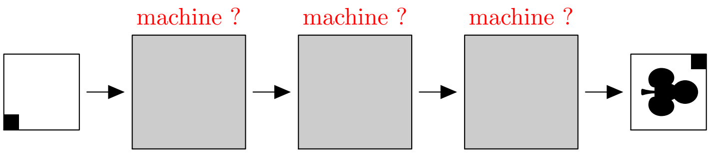


(**A**) 3
(**B**) 4
(**C**) 5
(**D**) 6
(**E**) 0

22. Else has two machines. When she puts a square sheet of paper in machine R, it turns the paper 90° clockwise, as shown in the picture. When she puts the paper in machine S, it stamps the paper with a .

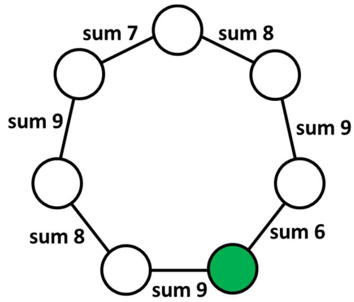


In which order are the machines used to produce the result shown?



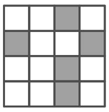
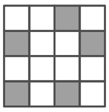
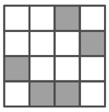
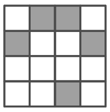
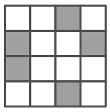
(**A**) SRR (**B**) RSR (**C**) RSS (**D**) RRS (**E**) SRS

23. The teacher wants to write the numbers 1 to 7 inside the circles, one number per circle. She wants the sum of two circles that are next to each other to be as shown. What number must she write inside the green circle?



(**A**) 1 (**B**) 2
(**C**) 3 (**D**) 4
(**E**) 5

24. Maria has shaded exactly 5 cells in a 4x4 grid. She challenges 5 of her friends to guess which cells she has shaded. The grids they have drawn are shown below.
Maria looks at them and says: "One of you is right and each of the rest of you has four cells correct."
Which is the correct answer?

(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

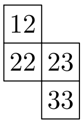
Benjamin

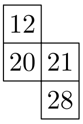
3 points

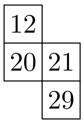
1. Holger fills the rest of the table with the numbers up to 40 following the system shown:

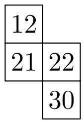
1	2	3	4	5	6	7	8
9	10	11	12				

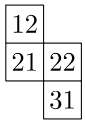
What piece could he cut from the table?

(**A**) 

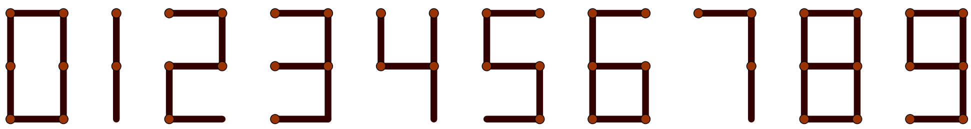
(**B**) 

(**C**) 

(**D**) 

(**E**) 

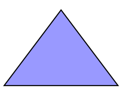
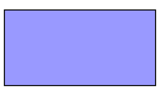
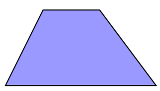
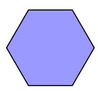
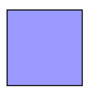
2. Matchsticks can be placed to build numbers as shown. For example, to build the number 15, one needs 7 matchsticks, and one needs the same number of matchsticks to build the number 8.



What is the largest positive number that can be built with seven matchsticks?

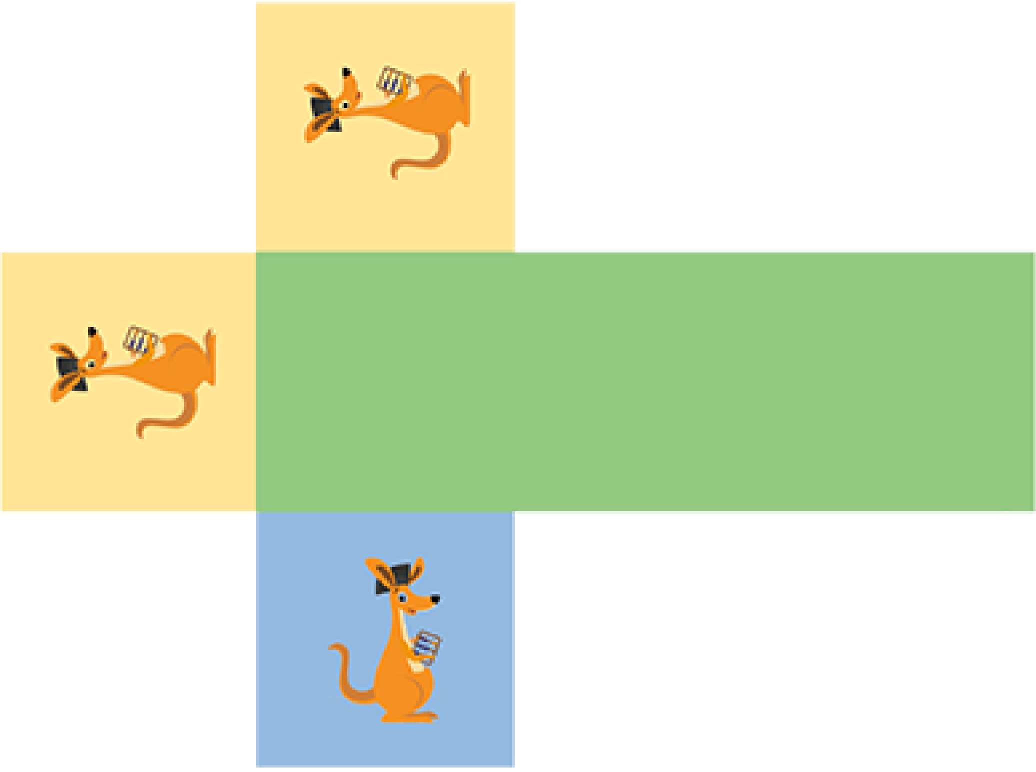
(**A**) 31 (**B**) 51 (**C**) 74 (**D**) 711 (**E**) 800

3. Which of the following shapes can not be divided into two triangles by a single straight line?

1)  2)  3)  4)  5) 

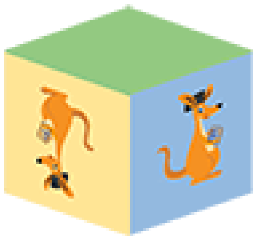
(**A**) only 1 (**B**) only 1 and 2 (**C**) only 1, 2 and 3
(**D**) only 1, 2, 3 and 5 (**E**) only 2, 3, 4 and 5

4. Rosalinde has a piece of paper which she folds into a cube.

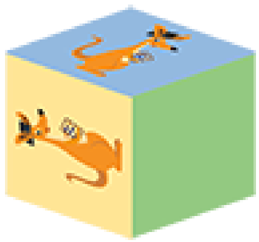


Which of the following five cubes can she get from this paper?

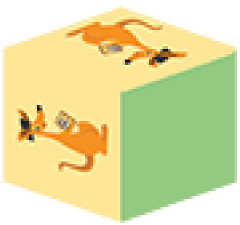
(**A**)



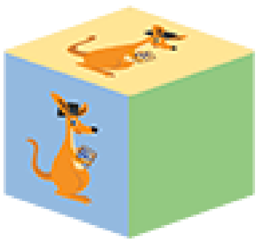
(**B**)



(**C**)

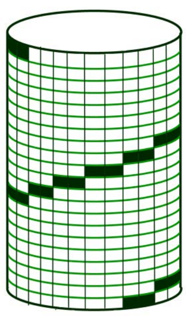


(**D**)



(**E**)

5. A person goes from the bottom to the top of a cylindrical tower. The steps are all equal sized. Nine steps are visible. How many steps are not visible?



(**A**) 9

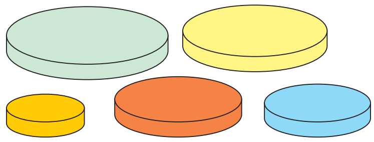
(**B**) 10

(**C**) 11

(**D**) 12

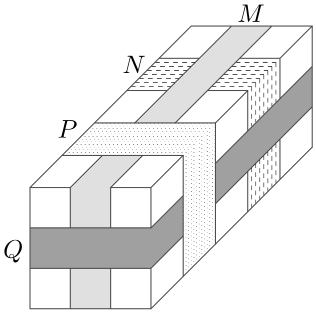
(**E**) 13

6. Anna has five circular discs and all of them are of different sizes. She wants to build towers of four discs whereby every disc must be smaller than the one immediately below it. How many different towers can Anna construct?



(**A**) 4 (**B**) 5 (**C**) 9 (**D**) 12 (**E**) 20

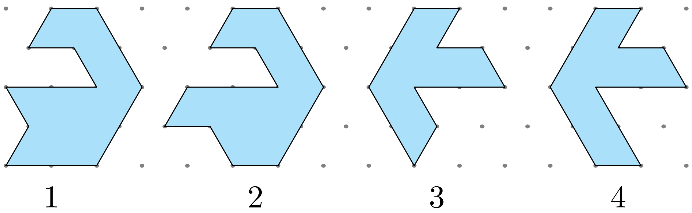
7. In the figure you can see a package around which four tapes, M, N, P and Q were placed.



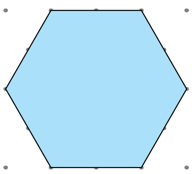
From first to last, in what order were the tapes placed?

(**A**) M, N, Q, P (**B**) N, M, P, Q (**C**) N, Q, M, P
(**D**) N, M, Q, P (**E**) Q, N, M, P

8. Alice has 4 puzzle pieces.

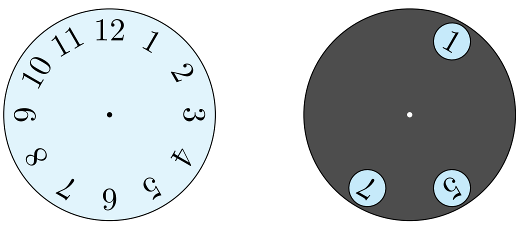


Which pair can be combined to form this hexagon?



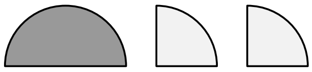
(**A**) 1 and 2 (**B**) 1 and 3 (**C**) 2 and 3 (**D**) 2 and 4 (**E**) 1 and 4

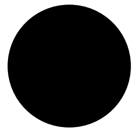
9. The gray circle with three holes is placed on top of the clock.



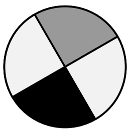
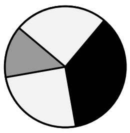
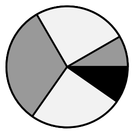
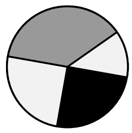
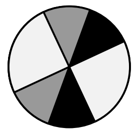
The gray circle is turned around its center. Which numbers is possible to see at the same time?

(**A**) 2, 4 and 9 (**B**) 1, 5 and 10 (**C**) 4, 6 and 12 (**D**) 3, 6 and 9 (**E**) 5, 7 and 12

10. Jonte glued the three pieces of paper  onto the black circle on the right.



Which of the following circles can he not obtain?

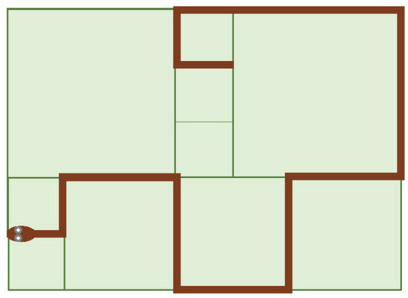
(**A**)  (**B**)  (**C**)  (**D**)  (**E**) 

4 points

11. Francesca wrote down three consecutive 2-digit numbers in their natural order, but instead of the digits she used symbols: □◊, ♡△, ♡□. Which number is next?

(**A**) □♡ (**B**) □□ (**C**) ♡♡ (**D**) ◊□ (**E**) ♡◊

12. The Potters have a patio which is tiled with square tiles of three different sizes. The smallest squares have a perimeter of 80 cm. A snake rests on the patio as shown in the figure. What is the length of the snake?



(**A**) 380 cm (**B**) 400 cm
(**C**) 420 cm (**D**) 440 cm
(**E**) 1680 cm

13. The image of a digital clock in the mirror is:
What will be the image in the mirror 30 minutes later?

(**A**) 

(**B**) 

(**C**) 

(**D**) 

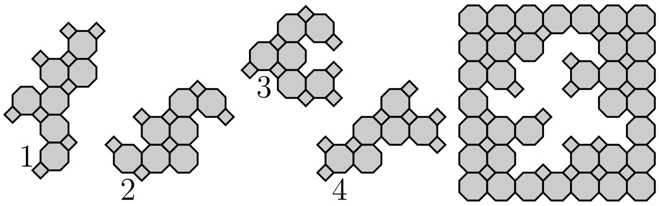
(**E**) 

14. Maria, Peter, Richard and Tina were playing football in the classroom, but it wasn't without consequences. When the principal was trying to figure out who broke the window, she got the following answers: Maria: "It was Peter." Peter: "It was Richard." Richard: "It wasn't me." Tina: "It wasn't me." As it later came out, only one child was telling the truth. Who broke the window?

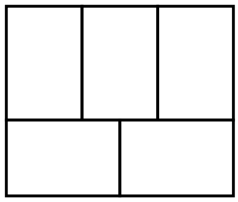
(**A**) Maria (**B**) Tina (**C**) Peter (**D**) Richard
(**E**) can't be determined with certainty

15. Which two tiles complete the puzzle?

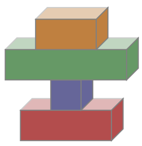
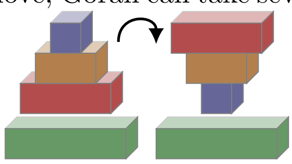
(**A**) 1 and 2 (**B**) 1 and 4
(**C**) 2 and 3 (**D**) 2 and 4
(**E**) 3 and 4

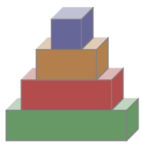


16. In the figure on the right you see 5 rectangles. Lukas wants to color the rectangles with the colors red, blue, and yellow. Two adjacent rectangles should be colored differently. In how many different ways can Lukas do this?



(**A**) 3 (**B**) 4 (**C**) 5 (**D**) 6 (**E**) 7

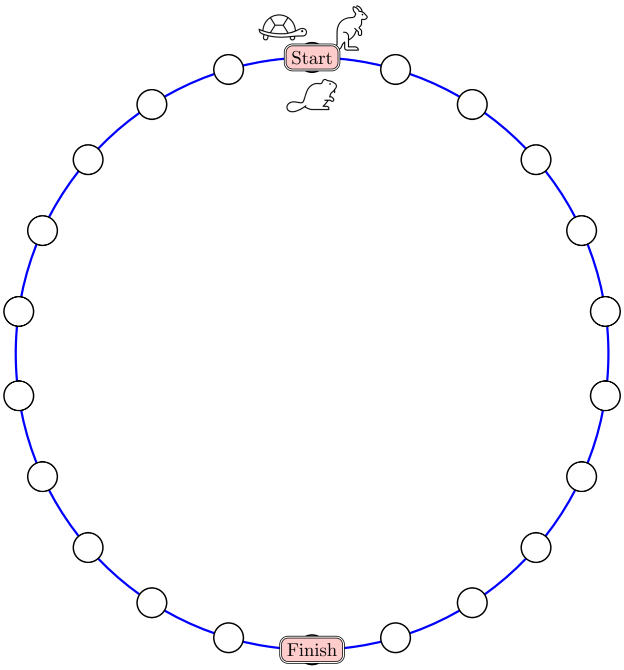
17. Goran has four blocks, stacked as in the figure.  In a single move, Goran can take several (some or all) blocks from the top and place them upside down, as shown. 

At the end the blocks should be stacked in this order: 

What is the minimum number of moves needed to get to the final arrangement?

(**A**) 2 (**B**) 3 (**C**) 4 (**D**) 5 (**E**) 6

18. A rabbit, a beaver and a kangaroo compete. The beaver moves one field at a time, the rabbit always leaves out one field and jumps onto the next and the kangaroo even leaves out 2 fields and only jumps on every third. They all start at the field START and whoever can land exactly on the field FINISH in the smallest number of moves, wins. Who wins the competition?



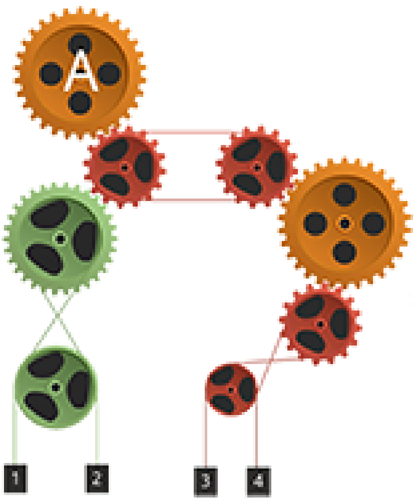
(**A**) the beaver (**B**) the rabbit (**C**) the kangaroo
(**D**) the kangaroo and the rabbit (**E**) the kangaroo and the beaver

19. Adding up the numbers in the white cells should give the same result as adding up the numbers in the grey cells of the figure. Which two cells have to switch colors?

1	3	5	2	13
7	4	6	8	11

(**A**) 1 and 11 (**B**) 2 and 8 (**C**) 3 and 7 (**D**) 3 and 13 (**E**) 7 and 13

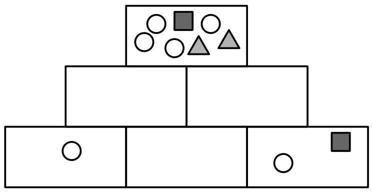
20. If the gear *A* is turned clockwise, which box will go up?

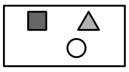
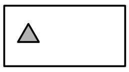


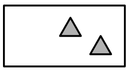
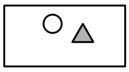
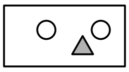
(**A**) 1 and 4 (**B**) 2 and 3 (**C**) 1 and 3
(**D**) 2 and 4 (**E**) It cannot be determined

5 points

21. Tian draws figures in the six boxes of the pyramid. Each box must contain exactly all the figures from the two boxes directly below it. Which figures belong in the box in the middle of the bottom row?

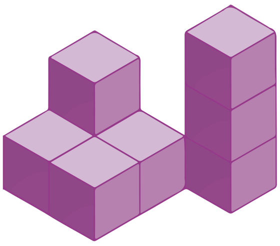


(**A**) 
(**B**) 

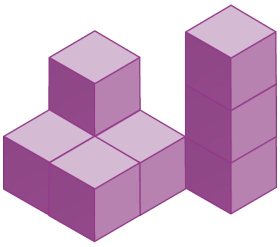
(**C**) 
(**D**) 
(**E**) 

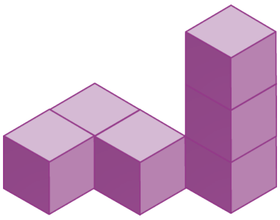
22. Martha chose one of the five structures below and combined it with the structure on the right.

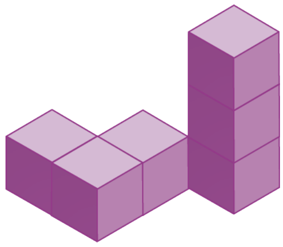
3	2	3
2	1	2
1	0	1

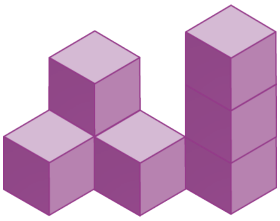


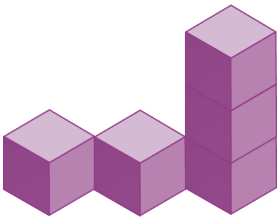
The table shows the number of cubes in each column in the combined structure seen from above. Which of the five structures did Martha choose?


(**A**)

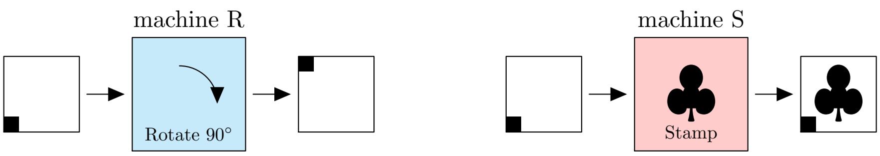

(**B**)


(**C**)

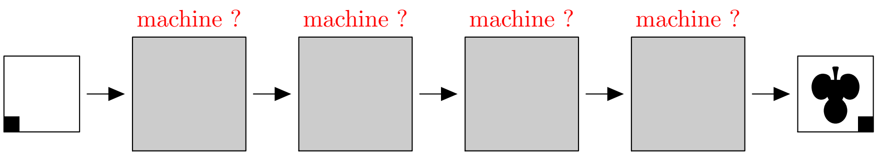

(**D**)


(**E**)

23. Else has two machines. Machine R rotates the paper 90° clockwise. Machine S stamps the paper with a .

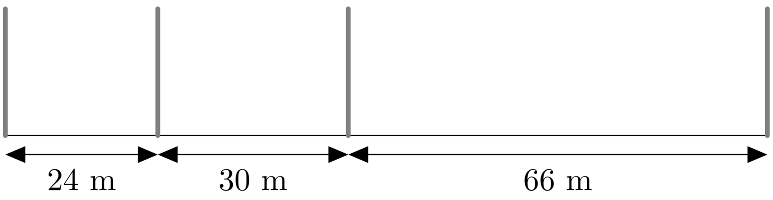


In which order are the machines used below?



(**A**) SRRR (**B**) RSRR (**C**) SRSR (**D**) RRRS (**E**) SRRS

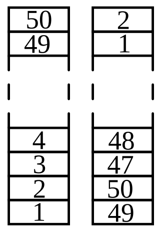
24. On the 120 m long school run, 4 stakes are placed along a straight line.



At least how many stakes should be added so that the route is divided into equal sections?

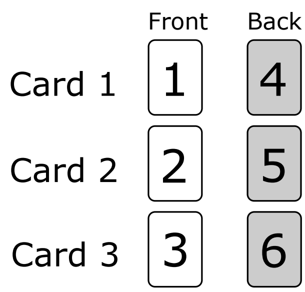
(**A**) 12 (**B**) 15 (**C**) 17 (**D**) 20 (**E**) 37

25. On a table there is a tower made of blocks numbered from 1 to 50. Emma builds a new tower in the following way. She takes two blocks from the top of the original tower and puts them on the table as a base of the new tower. She continues by taking two top blocks from the original tower and puts them on the top of the new tower as seen in the picture. Which of the following numbers are on adjacent blocks in the new tower?



(**A**) 29 and 28 (**B**) 34 and 35 (**C**) 29 and 26 (**D**) 31 and 33 (**E**) 27 and 30

26. Martin has three cards with numbers written on both sides. The card with the number 1 has the number 4 on the opposite side, 2 has 5 on the opposite side and 6 has the number 3 on the opposite side.
Martin randomly places three cards on the table and adds up the three numbers he sees.
How many different sums can Martin get?



(**A**) 3 (**B**) 4 (**C**) 5 (**D**) 6 (**E**) 10

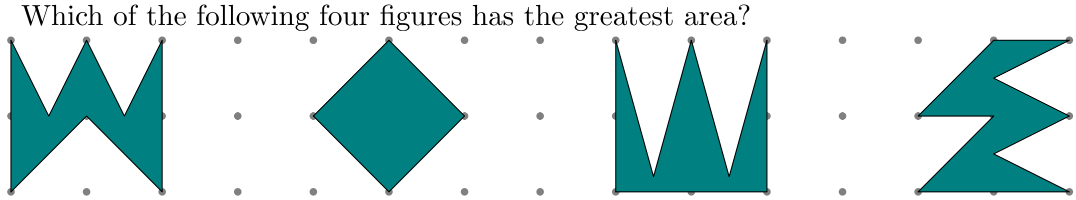
27. In a second hand shop, two hats are sold for five skirts, three skirts for eight t-shirts and two t-shirts for three caps. Which of the following collections is most valuable?

(**A**) a hat and five skirts
(**B**) a hat, three skirts and a t-shirt
(**C**) eight skirts and six t-shirts
(**D**) thirty-seven caps
(**E**) three skirts and three caps

28. Robert and Sonia are playing the following game. They can alternately take 1, 2, 3, 4 or 5 tiles from a pile. Whoever takes the last or last tiles loses. At this point there are 10 tiles in the pile and it's Robert's turn. How many tiles should Robert leave to Sonia to be sure that Robert will win?

(**A**) 9 (**B**) 8 (**C**) 7 (**D**) 6 (**E**) 5

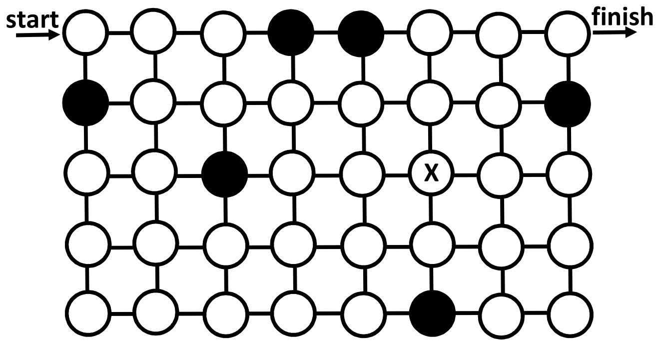
29. Which of the following four figures has the greatest area?



W diamond the crown lightning

(**A**) W (**B**) diamond (**C**) the crown (**D**) lightning
(**E**) they all have the same area

30. An explorer wants to find a path from the point 'start' to the point 'finish'. She can only pass through the white circles, and she can move only horizontally or vertically. She has to pass through all white circles exactly once. What will her next move be, when she reaches the circle with the X?



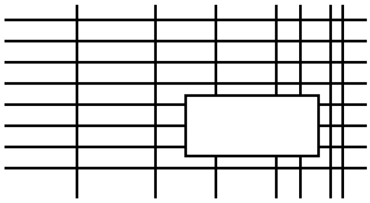
(**A**) ↑ (**B**) ↓ (**C**) → (**D**) ←

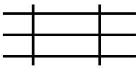
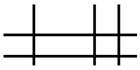
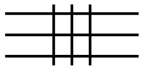
(**E**) there is no such path

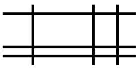
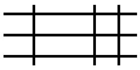
Cadet

3 points

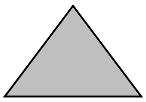
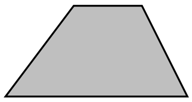
1. The diagram shows a set of horizontal and vertical lines with one part removed. Which of the following could be the missing part?

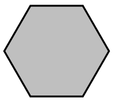
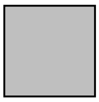


(**A**)  (**B**)  (**C**) 

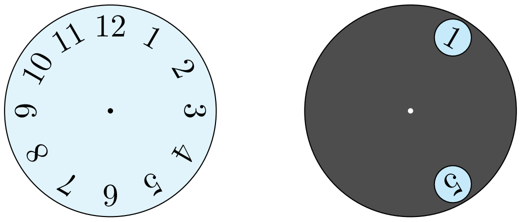
(**D**)  (**E**) 

2. Which of the shapes below cannot be divided into two trapezia by a single straight line?

(**A**)  triangle (**B**)  rectangle (**C**)  trapezium

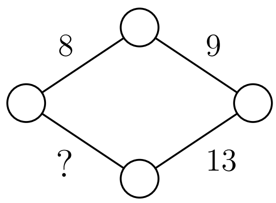
(**D**)  regular hexagon (**E**)  square

3. A grey circle with two holes is placed on top of a clock-face, as shown.
The grey circle is turned around its centre such that an 8 appears in one hole. Which two numbers could be seen in the other hole?



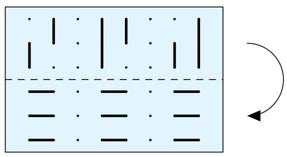
(**A**) 4 and 12 (**B**) 1 and 5 (**C**) 1 and 4
(**D**) 7 and 11 (**E**) 5 and 12

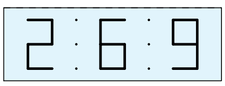
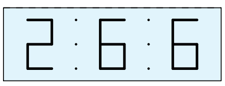
4. Werner wants to write a number at each vertex and on each edge of the rhombus shown. He wants the sum of the numbers at the two vertices at the ends of each edge to be equal to the number written on the edge. What number will he write instead of the question mark?

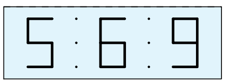
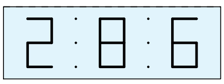
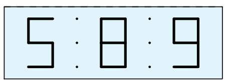


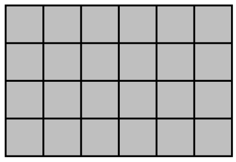
(**A**) 11 (**B**) 12 (**C**) 13 (**D**) 14 (**E**) 15

5. Kristina has a piece of transparent paper with some lines marked on it. She folds it along the dashed line.
What can she now see?

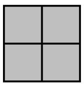
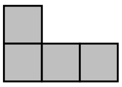
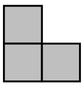


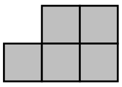
(**A**)  (**B**) 

(**C**)  (**D**)  (**E**) 



6. A tiler wants to tile a floor of dimensions 4 m × 6 m using identical tiles. No overlaps or gaps are allowed. Which of the following tiles could not be used?

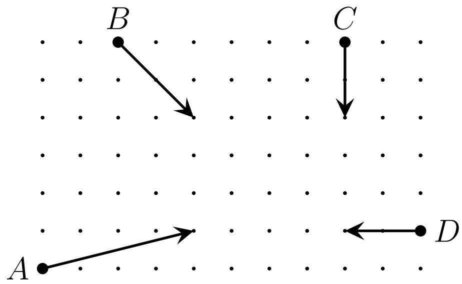
(**A**) 　(**B**) 　(**C**) 

(**D**) 　(**E**) 

7. John has 150 coins. When he throws them on the table, 40% of them show heads and 60% of them show tails. How many coins showing tails does he need to turn over to have the same number of heads as tails?

(**A**) 10　(**B**) 15　(**C**) 20　(**D**) 25　(**E**) 30

8. The diagram shows the initial position, the direction of travel and how far four bumper cars move in five seconds. Which two cars will collide?

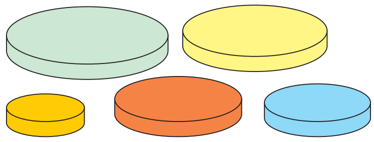


(**A**) A and B　(**B**) A and C

(**C**) A and D　(**D**) B and C

(**E**) C and D

9. Anna has five circular discs, each of a different size. She decides to build a tower using three of her discs so that each disc in her tower is smaller than the disc below it. How many different towers could Anna construct?



(**A**) 5　(**B**) 6　(**C**) 8　(**D**) 10　(**E**) 15

10. Evita wants to write the numbers 1 to 8 in the boxes of the grid shown, so that the sums of the numbers in the boxes in each row are equal and the sums of the numbers in the boxes in each column are equal. She has already written numbers 3, 4 and 8, as shown. What number will she write in the shaded box?

	4		
3		8	

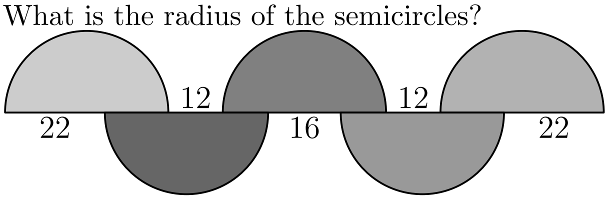
(**A**) 1　(**B**) 2　(**C**) 5　(**D**) 6　(**E**) 7

4 points

11. Theodorika wrote down three consecutive whole numbers in order, but instead of digits she used symbols so wrote □◊◊, ♡△△, ♡△□.
What would she write next?

(**A**) ♡♡◊　(**B**) □♡□　(**C**) ♡△◊　(**D**) ♡◊□　(**E**) ♡△♡

12. The diagram shows five equal semicircles and the lengths of some line segments.
What is the radius of the semicircles?

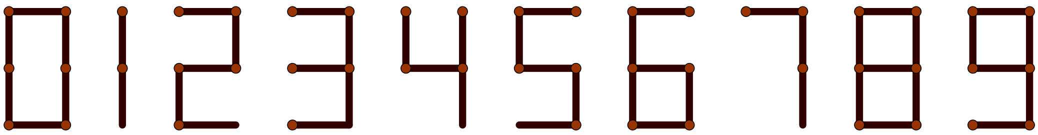


(**A**) 12 (**B**) 16 (**C**) 18 (**D**) 22 (**E**) 36

13. Some edges of a cube are to be coloured red so that every face of the cube has at least one red edge. What is the smallest possible number of edges that could be coloured red?

(**A**) 2 (**B**) 3 (**C**) 4 (**D**) 5 (**E**) 6

14. Matchsticks can be used to write digits, as shown in the diagram.



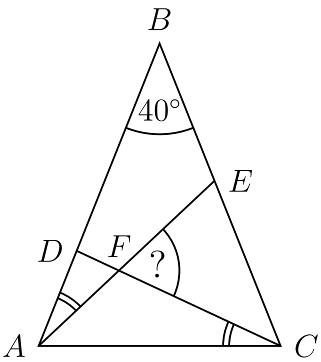
How many different positive integers can be written using exactly six matchsticks in this way?

(**A**) 2 (**B**) 4 (**C**) 6 (**D**) 8 (**E**) 9

15. The edges of a square are 1 cm long. How many points on the plane are exactly 1 cm away from two of the vertices of this square?

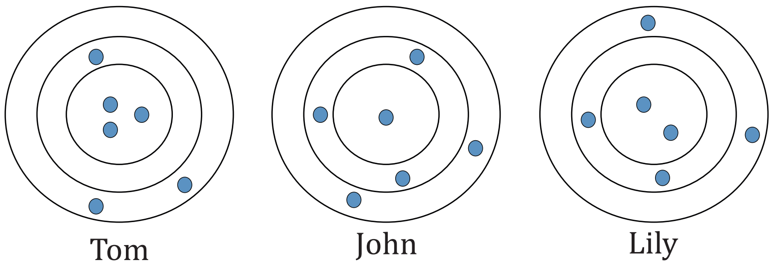
(**A**) 4 (**B**) 6 (**C**) 8 (**D**) 10 (**E**) 12

16. Triangle ABC is isosceles with $\angle ABC = 40°$. The two marked angles, $\angle EAB$ and $\angle DCA$, are equal. What is the size of the angle $\angle CFE$?



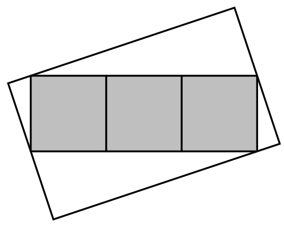
(**A**) 55°
(**B**) 60°
(**C**) 65°
(**D**) 70°
(**E**) 75°

17. Tom, John and Lily each shot six arrows at a target. Arrows hitting anywhere within the same ring score the same number of points. Tom scored 46 points and John scored 34 points, as shown. How many points did Lily score?



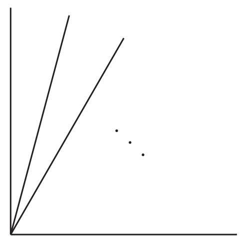
(**A**) 37 (**B**) 38 (**C**) 39 (**D**) 40 (**E**) 41

18. The diagram shows a rectangle made from three grey squares, each of area 25 cm^2, inside a larger white rectangle. Two of the vertices of the grey rectangle touch the mid-points of the shorter sides of the white rectangle and the other two vertices of the grey rectangle touch the other two sides of the white rectangle.
What is the area, in cm^2, of the white rectangle?



(**A**) 125 (**B**) 136 (**C**) 149 (**D**) 150 (**E**) 172

19. Angelo drew two lines meeting at a right-angle. What is the smallest number of extra lines he could draw inside his right-angle, as shown, so that for any of the values 10°, 20°, 30°, 40°, 50°, 60°, 70° and 80°, a pair of lines can be chosen with the angle between them equal to that value?



(**A**) 2 (**B**) 3 (**C**) 4
(**D**) 5 (**E**) 6

20. The sum of 2023 consecutive integers is 2023. What is the sum of digits of the largest of these integers?

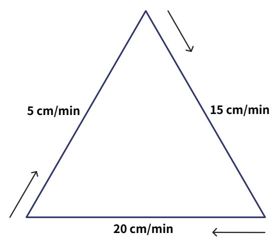
(**A**) 4 (**B**) 5 (**C**) 6 (**D**) 7 (**E**) 8

5 points

21. Some beavers and some kangaroos are standing in a circle. There are three beavers in total and there are no two beavers who are standing next to another beaver. There are exactly three kangaroos who are standing next to another kangaroo. What is the largest possible amount of kangaroos in the circle?

(**A**) 4 (**B**) 5 (**C**) 6 (**D**) 7 (**E**) 8

22. An ant is walking along the sides of an equilateral triangle. The speeds at which it travels along the three sides are 5 cm/min, 15 cm/min and 20 cm/min, as shown. What is the average speed, in cm/min, at which the ant walks the whole perimeter of the triangle?

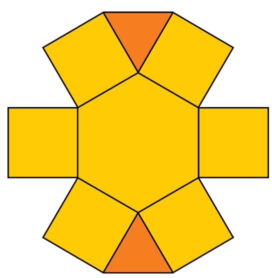


(**A**) 10 (**B**) $\frac{80}{11}$ (**C**) $\frac{180}{19}$ (**D**) 15 (**E**) $\frac{40}{3}$

23. Snow White organised a chess competition for the seven dwarves, in which each dwarf played one game with every other dwarf. On Monday, Grumpy played 1 game, Sneezy played 2, Sleepy 3, Bashful 4, Happy 5 and Doc played 6 games. How many games did Dopey play on Monday?

(**A**) 1 (**B**) 2 (**C**) 3 (**D**) 4 (**E**) 5

24. Elizabetta wants to write the numbers 1 to 9 in the regions of the shape shown so that the product of the numbers in any two adjacent regions is not more than 15. Two regions are said to be adjacent if they have a common edge. In how many ways can she do this?

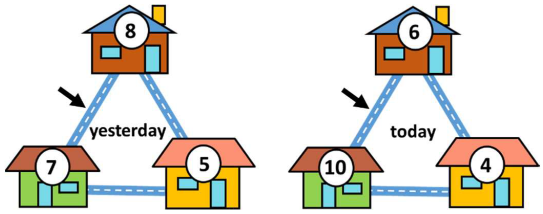


(**A**) 12 (**B**) 8 (**C**) 32
(**D**) 24 (**E**) 16

25. Martin is standing in a queue. The number of people in the queue is a multiple of 3. He notices that he has as many people in front of him as behind him. He sees two friends, both standing behind him in the queue, one in 19th place and the other in 28th place. In which position in the queue is Martin?

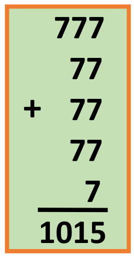
(**A**) 14 (**B**) 15 (**C**) 16 (**D**) 17 (**E**) 18

26. Some mice live in three neighbouring houses. Last night, every mouse left its house and moved to one or the other of the other two houses, always taking the shortest route. The numbers in the diagram show the number of mice per house, yesterday and today. How many mice used the path shown by the arrow?



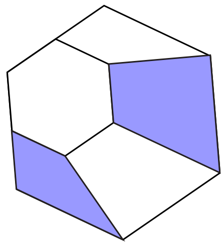
(**A**) 9 (**B**) 11 (**C**) 12 (**D**) 16 (**E**) 19

27. Bart wrote the number 1015 as a sum of numbers using only the digit 7. He used a 7 a total of 10 times, as shown. Now he wants to write the number 2023 as a sum of numbers using only the digit 7, using a 7 a total of 19 times. How many times will he use the number 77?



(**A**) 2 (**B**) 3 (**C**) 4 (**D**) 5 (**E**) 6

28. A regular hexagon is divided in four quadrilaterals and one smaller regular hexagon. The area of the shaded region and the area of the small hexagon are in the ratio $\frac{4}{3}$. What is the ratio $\frac{\text{area small hexagon}}{\text{area big hexagon}}$?



(**A**) $\frac{3}{11}$ (**B**) $\frac{1}{3}$ (**C**) $\frac{2}{3}$
(**D**) $\frac{3}{4}$ (**E**) $\frac{3}{5}$

29. Jake wrote six consecutive numbers onto six white pieces of paper, one number on each piece. He stuck these bits of paper onto the top and bottom of three coins. Then he tossed these three coins three times. On the first toss, he saw the numbers 6, 7 and 8, as shown, and then coloured them red. On the second toss, the sum of the numbers he saw was 23 and on the third toss the sum was 17. What was the sum of the numbers on the remaining three white pieces of paper?

(**A**) 18 (**B**) 19 (**C**) 23
(**D**) 24 (**E**) 30

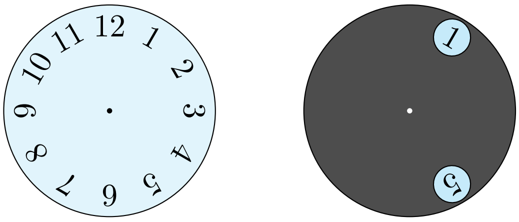
30. A rugby team scored 24 points, 17 points and 25 points in the seventh, eighth and ninth games of the 2022 season. Their average points-per-game was higher after 9 games than it was after their first 6 games. Their average after 10 games was more than 22. What is the smallest number of points that they could have scored in their 10th game?

(**A**) 22 (**B**) 23 (**C**) 24 (**D**) 25 (**E**) 26

Junior

3 points

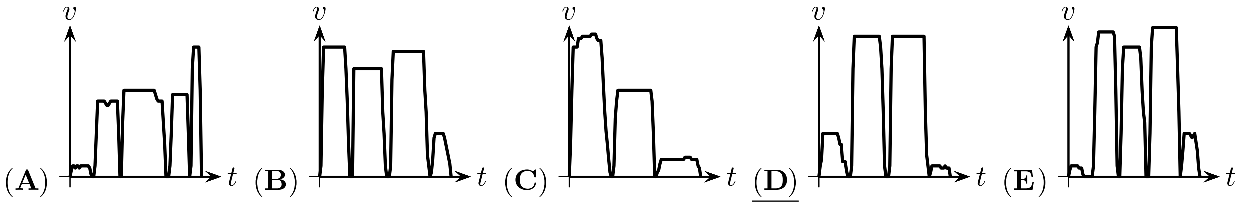
1. A gray circle with two holes is put on top of a clock as shown.



The gray circle is turned around the center such that the number 10 appears in one hole. Which numbers is it possible to see in the other hole?

(**A**) 2 and 6 (**B**) 3 and 7 (**C**) 3 and 6 (**D**) 1 and 9 (**E**) 2 and 7

2. Maria had to run to catch the subway, got off two stops later and then walked to school. Which of the following speed-time graphs would best represent her journey?

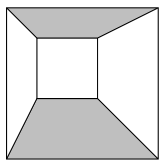


3. The positive integers m and n are both odd. Which of the following numbers is odd?

(**A**) $m(n+1)$ (**B**) $(m+1)\cdot(n+1)$ (**C**) $m+n+2$

(**D**) $m\cdot n+2$ (**E**) $m+n$

4. In a big square with a 10 cm long side is a smaller square with a 4 cm long side as shown in the figure. The sides of the squares are parallel. What percentage of the figure is shaded?



(**A**) 25% (**B**) 30%

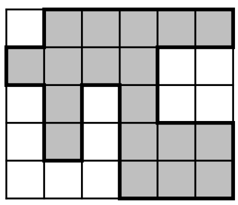
(**C**) 40% (**D**) 42%

(**E**) 45%

5. Today is Thursday. What day will it be in 2023 days?

(**A**) Tuesday (**B**) Wednesday (**C**) Thursday (**D**) Friday (**E**) Saturday

6. The rectangle in the picture is divided into 30 equal squares, as shown. If the perimeter of the shaded region is 240 cm, what is the area of the rectangle?



(**A**) $480\,\text{cm}^2$ (**B**) $750\,\text{cm}^2$ (**C**) $1080\,\text{cm}^2$

(**D**) $1920\,\text{cm}^2$ (**E**) $2430\,\text{cm}^2$

7. The ages of a family of five add to 80. The two youngest are 6 and 8.
What was the sum of the ages of the family seven years ago?

(**A**) 35 (**B**) 36 (**C**) 45 (**D**) 46 (**E**) 66

8. A straight wooden fence is made by vertical beams, each connected to the next one by 4 horizontal beams. Of course, the first and last beams are vertical. Which of the following can be the number of the beams in the fence?

(**A**) 95 (**B**) 96 (**C**) 97 (**D**) 98 (**E**) 99

9. Replace a and b by positive integers such that the equation is correct. How many solutions are there?

$$\frac{a}{5} = \frac{7}{b}$$

(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

10. After having played 200 games of chess, my winning rate is exactly 49%. What is the least number of additional games I should play for my winning rate to increase to exactly 50%?

(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

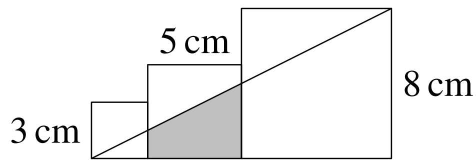
4 points

11. Jenni is trying to save water. She reduced the duration of her shower by one quarter. At the same time, she lowered the water pressure to reduce the water flow by one quarter. By how much did Jenni reduce the total amount of water for showering?

(**A**) by $\frac{1}{4}$ (**B**) by $\frac{3}{8}$ (**C**) by $\frac{1}{16}$ (**D**) by $\frac{5}{12}$ (**E**) by $\frac{7}{16}$

12. The diagram shows three squares of side-length 3 cm, 5 cm and 8 cm. What is the area, in cm^2, of the shaded trapezium?

(**A**) 13 (**B**) $\frac{55}{4}$ (**C**) $\frac{61}{4}$ (**D**) $\frac{65}{4}$ (**E**) $\frac{69}{4}$

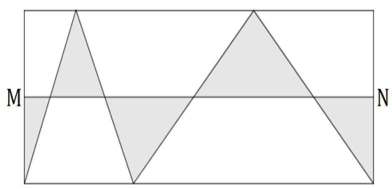


13. A wire of length 95m is cut into three pieces, such that the length of each resulting piece is equal to that of the immediately preceding one, but increased by a factor of a half. What is the length of the largest piece?

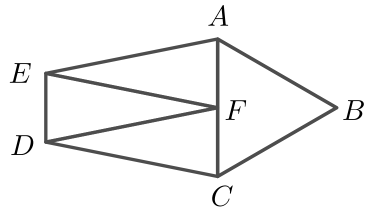
(**A**) 36m (**B**) 42m (**C**) 45m (**D**) 46m (**E**) 48m

14. Points M and N are the midpoints of two sides of the rectangle.
What fraction of the area of the rectangle is shaded?

(**A**) $\frac{1}{6}$ (**B**) $\frac{1}{5}$ (**C**) $\frac{1}{4}$
(**D**) $\frac{1}{3}$ (**E**) $\frac{1}{2}$

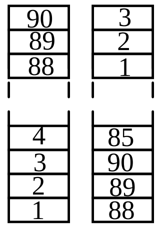


15. Pentagon $ABCDE$ is divided into four triangles with equal perimeter. Triangle ABC is equilateral and AEF, DFE and CDF are three identical isosceles triangles. What is the ratio of the perimeter of the pentagon $ABCDE$ to the perimeter of triangle ABC?



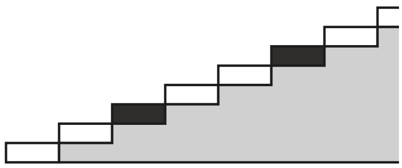
(**A**) 2 (**B**) 3/2 (**C**) 4/3 (**D**) 5/3 (**E**) 5/2

16. On the table there is a tower made of blocks numbered from 1 to 90. Bob takes blocks three at a time to build a new tower without turning them. Once he has finished placing all of the blocks, how many blocks will be between blocks 39 and 40?



(**A**) 0 (**B**) 1
(**C**) 2 (**D**) 3
(**E**) 4

17. Every third step of a staircase with 2023 steps is colored black. (The first seven steps are shown in the picture.) Anita walks up the steps one at a time, starting with either her right or left foot alternating each step.



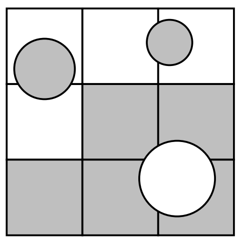
What is the smallest number of black steps she will step on with her right foot?

(**A**) 0 (**B**) 333 (**C**) 336 (**D**) 337 (**E**) 674

18. We will call a two-digit number **power-less** if none of its digits can be written as an integer to a power greater than 1. For example, 53 is power-less, but 54 is **NOT** power-less since $4 = 2^2$. Which of the following is a common divisor of the smallest and the largest power-less numbers?

(**A**) 3 (**B**) 5 (**C**) 7 (**D**) 11 (**E**) 13

19. A square of side 30 cm is divided into nine smaller identical squares. The large square contains three circles with radii 5 cm (bottom right) , 4 cm (top left) and 3 cm (top right), as shown. What is the area of the shaded part?



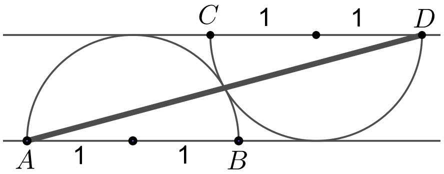
(**A**) 400 cm^2 (**B**) 500 cm^2 (**C**) $(400 + 50\pi)$ cm^2
(**D**) $(500 - 25\pi)$ cm^2 (**E**) $(500 + 25\pi)$ cm^2

20. Calculating the average of five different prime numbers results in an integer. What is the smallest possible result?

(**A**) 2 (**B**) 5 (**C**) 6 (**D**) 12 (**E**) 30

5 points

21. The figure shows two equal tangent semicircles of radius 1, with parallel diameters AB and CD. What is the square of the distance AD?



(**A**) 16 (**B**) $8+4\sqrt{3}$ (**C**) 12 (**D**) 9 (**E**) $5+2\sqrt{3}$

22. Given the following four numbers:

$$2,\ 0,\ 2,\ 3,$$

the Kangaroo Machine types subsequent numbers according to the rule that the next number is the smallest non-negative integer that is different from each of its four preceding terms. Which number is on 2023rd position?

(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

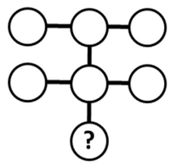
23. A rectangle with vertices $(0,0),(100,0),(100,50)$ and $(0,50)$ has a circle with centre $(75,30)$ and radius 10 cut out of it. What is the slope of the line through $(75,30)$ which divides evenly the remaining area of the rectangle?

(**A**) $\frac{1}{5}$ (**B**) $\frac{1}{3}$ (**C**) $\frac{1}{2}$ (**D**) $\frac{2}{5}$ (**E**) $\frac{2}{3}$

24. When Metin's phone is fully charged, it runs out in 32 hours if only talking is done, 20 hours if only internet is used, and 80 hours when no use is made. Metin gets on a train with his phone half-charged. While on the train, the time he is on the internet by phone, the time he speaks and the time he does not take any action are the same. If the battery dies as the train arrives at the station how many hours did the train journey take?

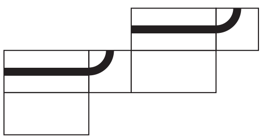
(**A**) 10 (**B**) 12 (**C**) 15 (**D**) 16 (**E**) 18

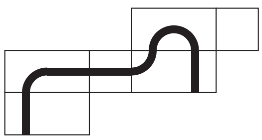
25. Seven distinct single digit numbers are placed, once each, in the circles of the diagram shown. The product of the three numbers in a straight line is the same for all three cases. Which number is in the circle with the question mark?

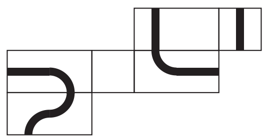


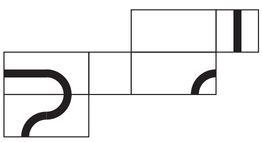
(**A**) 2 (**B**) 3 (**C**) 4 (**D**) 6 (**E**) 8

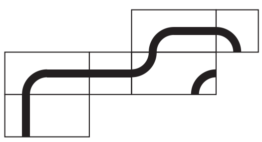
26. Leon has drawn a closed path on a rectangular prism and unfolded it into net. Which net could not be Leon's?

(**A**) 

(**B**) 

(**C**) 

(**D**) 

(**E**) 

27. How many three-digit positive integers x are there, such that subtracting the sum of digits of x

from x gives a three-digit number whose digits are all the same?

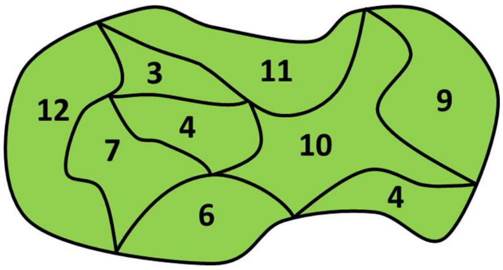
(**A**) 1 (**B**) 2 (**C**) 3 (**D**) 20 (**E**) 30

28. In how many different ways can we read the word **BANANA** from the following table if we always step to a cell that shares an edge with the previous cell? We may reuse cells multiple times.

B	A	N
A	N	A
N	A	N

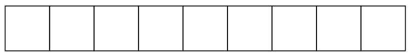
(**A**) 14 (**B**) 28 (**C**) 56 (**D**) 84 (**E**) other value

29. A map of a park is shown in the figure. The park is divided into regions where the numbers inside indicate their perimeters in km. What is the outer perimeter of the park?



(**A**) 22 km (**B**) 26 km (**C**) 28 km
(**D**) 32 km (**E**) none of the previous

30. Pia wants to write the integers 1 to 9 in the nine boxes shown so that the integers in any three adjacent boxes add to a multiple of 3. In how many ways can she do this?



(**A**) 6^4 (**B**) 6^3 (**C**) 2^9
(**D**) $6 \times 5 \times 4 \times 3 \times 2 \times 1$ (**E**) $9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

Student

3 points

1. What is the value of

$$\frac{7777^2}{5555 \times 2222}$$

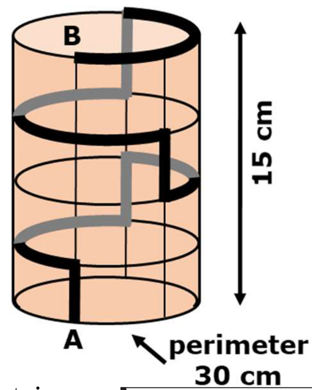
after simplifying?

(**A**) 1 (**B**) $\frac{7}{10}$ (**C**) $\frac{49}{10}$ (**D**) $\frac{77}{110}$ (**E**) 49

2. Giulia rolls 5 dice. She rolls 19 points in total. What is the maximum number of sixes she could have rolled?

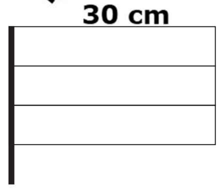
(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

3. A cylindrical can has height 15 cm and the perimeter of its circular base is 30 cm. An ant walks from point A on the base to point B on the roof. Its path is either vertically upwards or horizontally along circular arcs around the can. Its path is shown with a thicker line (black for the path on the front of the can and grey at the back). How long is the ant's path?



(**A**) 45 cm (**B**) 55 cm (**C**) 60 cm
(**D**) 65 cm (**E**) 75 cm

4. Emma has 4 colours and she wants to colour the rectangular flag with 3 stripes (see the picture). In how many ways can she do that, if every stripe is coloured with only one colour, more than one stripe can be coloured with the same colour, but no adjacent stripes can be the same colour?



(**A**) 24 (**B**) 27 (**C**) 32 (**D**) 36 (**E**) 64

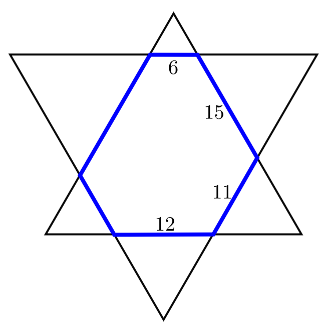
5. We call a positive integer n *two-prime*, if it has exactly three different divisors, namely 1, 2 and n itself. How many different two-prime numbers are there?

(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

6. How many pairs of positive integers x, y satisfy the equation $x + 2y = 2^{10}$?

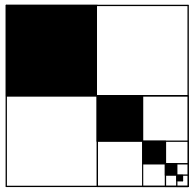
(**A**) $2^9 - 1$ (**B**) 2^9 (**C**) $2^9 + 1$ (**D**) $2^9 + 2$ (**E**) 0

7. Two equilateral triangles are put together to form a hexagon with opposite sides parallel. We know the length of four sides of this hexagon, as shown in the picture. What is the perimeter of the hexagon?



(**A**) 64 (**B**) 66 (**C**) 68 (**D**) 70 (**E**) 72

8. A square with area 84 is divided into four squares. The upper left square is coloured black. The lower right square is again divided into four squares, and so on. The process is repeated an infinite number of times. What area of the original square is coloured black?



(**A**) 24 (**B**) 28 (**C**) 31 (**D**) 35 (**E**) 42

9. The integers from 1 to 9 are to be distributed in the 9 boxes in the picture so that any three numbers in consecutive boxes add to a multiple of 3. The numbers 7 and 9 have already been placed. In how many different ways can the remaining boxes be filled?

	7		9					

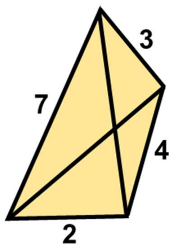
(**A**) 9 (**B**) 12 (**C**) 15 (**D**) 18 (**E**) 24

10. What is the units digit of the product $(5^5+1)(5^{10}+1)(5^{15}+1)$?

(**A**) 0 (**B**) 1 (**C**) 3 (**D**) 5 (**E**) 6

$\boxed{\text{4 points}}$

11. A triangular pyramid has edges of integer length. Four of these lengths are as shown. What is the sum of the lengths of the other two edges?



(**A**) 9 (**B**) 10
(**C**) 11 (**D**) 12
(**E**) 13

12. For a positive integer n, $n!$ is defined as the product of all integers from 1 to n. For example $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$. What is the sum of the digits of N if $N! = 6! \cdot 7!$?

(**A**) 1 (**B**) 2 (**C**) 4 (**D**) 8 (**E**) 9

13. The graphs of the functions $y = x^3 + 3x^2 + ax + 2a + 4$ all pass through the same point no matter what value of a is chosen. What is the sum of the coordinates of that point?

(**A**) 2 (**B**) 4 (**C**) 7 (**D**) 8
(**E**) none of the previous

14. We are given five numbers a_1, a_2, a_3, a_4, a_5 whose sum is S. They are related by the formula $a_k = k + S$ for $1 \le k \le 5$. What is the value of S?

(**A**) $\frac{15}{4}$ (**B**) $-\frac{15}{4}$ (**C**) -15 (**D**) 15
(**E**) none of the previous

15. How many pairs of integers m, n satisfy the inequality $|2m - 2023| + |2n - m| \le 1$?

(**A**) 0 (**B**) 1 (**C**) 2 (**D**) 3 (**E**) 4

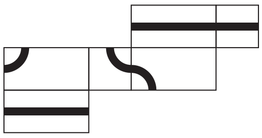
16. 23 animals are sitting in a row at the cinema. Each animal is either a beaver or a kangaroo. Everyone has at least one neighbour who is a kangaroo. At most how many beavers are sitting in the row?

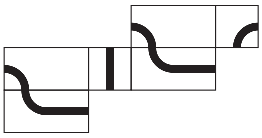
(**A**) 7 (**B**) 8 (**C**) 10 (**D**) 11 (**E**) 12

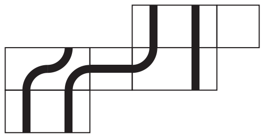
17. If 5^{5^6} is written in the form n^n for some natural number n, what is the value of n?

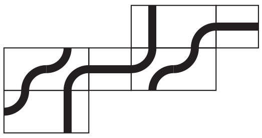
(**A**) 5^{30} (**B**) 5^6 (**C**) 5^5 (**D**) 30 (**E**) 11

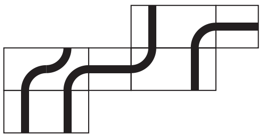
18. Leon has drawn a closed path on a rectangular prism. Which net could show his path?

(**A**) 

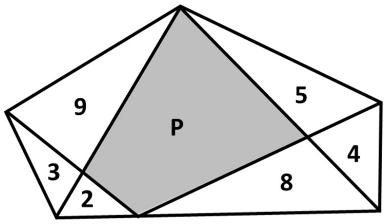
(**B**) 

(**C**) 

(**D**) 

(**E**) 

19. A pentagon is dissected into smaller parts, as shown. The numbers inside the triangles indicate their areas. What is the area P of the shaded quadrilateral?



(**A**) 15 (**B**) $\dfrac{31}{2}$ (**C**) 16 (**D**) 17

(**E**) none of the previous

20. How many numbers divide $2^{20}3^{23}$ but do not divide $2^{10}3^{20}$?

(**A**) 13 (**B**) 30 (**C**) 273 (**D**) 460

(**E**) none of the previous

$\boxed{\text{5 points}}$

21. Two functions f and g on $\mathbb{R}$ satisfy the system of equations $f(x)+2g(1-x)=x^2$ and $f(1-x)-g(x)=x^2$. What is f?

(**A**) $x^2-\frac{4}{3}x+\frac{2}{3}$ (**B**) $x^2+\frac{4}{3}x+\frac{2}{3}$ (**C**) $-x^2-\frac{4}{3}x+\frac{2}{3}$

(**D**) x^2-4x+5 (**E**) there are no such functions

22. In a bouldering competition, 13 climbers compete in three categories. The score of each competitor is the product of their rankings in the three categories. For example, if one is 4th, 3rd and 6th, their final score is $4\cdot 3\cdot 6=72$. The higher your score, the lower your overall ranking. What is Hannah's lowest possible overall ranking in this competition if she ranks 1st in two of the categories?

(**A**) 2nd (**B**) 3rd (**C**) 4th (**D**) 5th (**E**) 6th

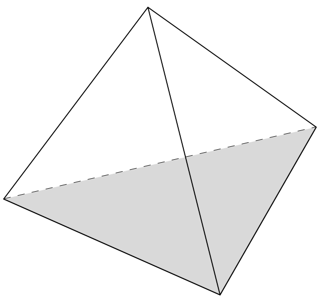
23. A spiral of consecutive numbers is created, as shown, starting with 1. If the pattern of the spiral continues, in what shape will the numbers 625, 626 and 627 appear?

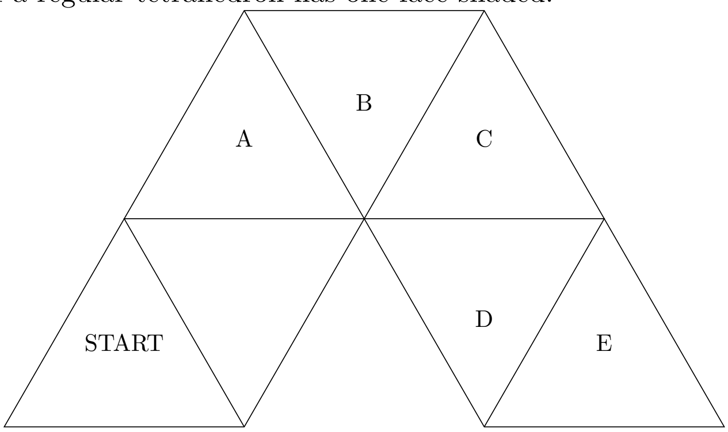
$$\begin{array}{ccccccccc}
\vdots & & 10 & \rightarrow & 11 & \rightarrow & 12 & \rightarrow & 13 \\
\uparrow & & \uparrow & & & & & & \downarrow \\
24 & & 9 & & 2 & \rightarrow & 3 & & 14 \\
\uparrow & & \uparrow & & \uparrow & & \downarrow & & \downarrow \\
23 & & 8 & & 1 & & 4 & & 15 \\
\uparrow & & \uparrow & & & & \downarrow & & \downarrow \\
22 & & 7 & \leftarrow & 6 & \leftarrow & 5 & & 16 \\
\uparrow & & & & & & & & \downarrow \\
21 & \leftarrow & 20 & \leftarrow & 19 & \leftarrow & 18 & \leftarrow & 17
\end{array}$$

(A) $\begin{array}{c}627\\ \uparrow\\ 626\\ \uparrow\\ 625\end{array}$ **(B)** $\begin{array}{ccc}626 & \rightarrow & 627\\ \uparrow & & \\ 625 & & \end{array}$ **(C)** $625 \rightarrow 626 \rightarrow 627$

(D) $\begin{array}{ccc}625 & \rightarrow & 626\\ & & \downarrow\\ & & 627\end{array}$ **(E)** $\begin{array}{c}625\\ \downarrow\\ 626\\ \downarrow\\ 627\end{array}$

24. A block in the shape of a regular tetrahedron has one face shaded.

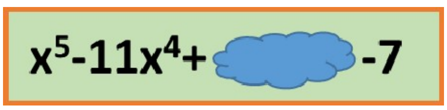




The shaded face of the block is placed on the board on the triangle with the caption START. Then the block is rolled from one triangle to the next one by rotating around an edge. On which triangle will the block stand for the first time again on its shaded face?

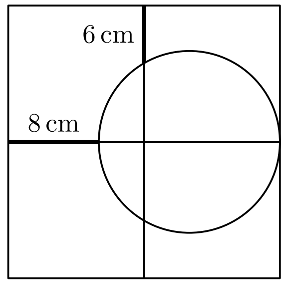
(A) A **(B)** B **(C)** C **(D)** D **(E)** E

25. Part of the fifth degree polynomial shown cannot be seen because of an inkblot. It is known that all five roots of the polynomial are integers. What is the highest power of $x-1$ that divides the polynomial?



(A) $(x-1)^1$ **(B)** $(x-1)^2$ **(C)** $(x-1)^3$ **(D)** $(x-1)^4$ **(E)** $(x-1)^5$

26. The large square in the diagram is dissected into four smaller squares. The circle touches the right hand side of the square at its midpoint. What is the side length of the large square? Note that the diagram is not drawn to scale.



(**A**) 18 cm

(**B**) 20 cm

(**C**) 24 cm

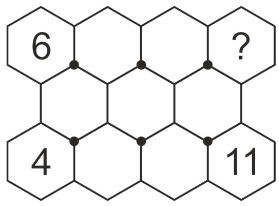
(**D**) 28 cm

(**E**) 30 cm

27. What is the greatest common divisor of all numbers of the form $n^3(n+1)^3(n+2)^3(n+3)^3(n+4)^3$ where n is a nonzero natural number?

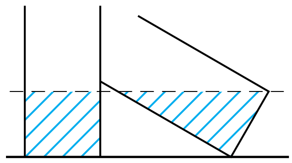
(**A**) $2^9 3^3$ (**B**) $2^6 3^3 5^3$ (**C**) $2^6 3^3 5^3$ (**D**) $2^8 3^2 5^3$ (**E**) $2^9 3^3 5^3$

28. The numbers from 1 to 11 are placed in the empty hexagons so that the sum of the three numbers around each of the six black dots is the same. What number will be inserted in the hexagon with a question mark?



(**A**) 5 (**B**) 4 (**C**) 7 (**D**) 3 (**E**) 9

29. Two identical cylinders contain the same amount of water. One cylinder is standing straight, and the other is leaning against it, and the water level in each of them is the same (see the picture). The bottom of each of the cylinders is a circle with area $3\pi\, m^2$. How much water does each cylinder contain?



(**A**) $3\sqrt{3}\pi\, m^3$ (**B**) $6\pi\, m^3$ (**C**) $9\pi\, m^3$ (**D**) $\frac{3\pi}{4}\, m^3$

(**E**) it's impossible to determine from the information given

30. The product of six consecutive numbers is a 12-digit number of the form

$$abb\,cdd\,cdd\,abb,$$

where the digits a, b, c and d are themselves four consecutive numbers in some order. The value of digit d is

(**A**) 1 (**B**) 2 (**C**) 3 (**D**) 4 (**E**) 5