IMC Follow-up 1

Year 9 Grey Kangaroo

Instructions

1. Do not open the paper until the invigilator tells you to do so.
2. Time allowed: **60 minutes**.
   No answers, or personal details, may be entered after the allowed time is over.
3. The use of blank or lined paper for rough working is allowed; **squared paper**, **calculators and measuring instruments are forbidden**.
4. **Use a B or an HB non-propelling pencil.** Mark at most one of the options A, B, C, D, E on the Answer Sheet for each question. Do not mark more than one option.
5. **Do not expect to finish the whole paper in the time allowed.** The questions in this paper have been arranged in approximate order of difficulty with the harder questions towards the end. You are not expected to complete all the questions during the time. You should bear this in mind when deciding which questions to tackle.
6. **Scoring rules:**
   5 marks are awarded for each correct answer to Questions 1-15;
   6 marks are awarded for each correct answer to Questions 16-25;
   In this paper you will not lose marks for getting answers wrong.
7. Your Answer Sheet will be read by a machine. **Do not write or doodle on the sheet except to mark your chosen options.** The machine will read all black pencil markings even if they are in the wrong places. If you mark the sheet in the wrong place, or leave bits of eraser stuck to the page, the machine will interpret the mark in its own way.
8. **The questions on this paper are designed to challenge you to think, not to guess.** You will gain more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers. This paper is about solving interesting problems, not about lucky guessing.

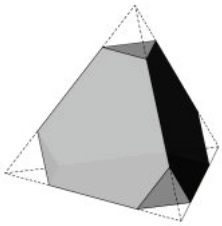
Comments and suggestions to DrYuFromShanghai@QQ.com

Answers:

	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	
1	B	E	B	D	C	B	E	D	A	A	D	D	E	C	C	E	D	A	D	1
2	C	E	E	D	E	B	B	E	B	B	C	C	E	D	B	E	B	E	A	2
3	D	E	D	C	E	C	E	D	C	C	E	E	B	B	E	B	C	E	A	3
4	D	C	C	D	D	A	C	B	E	D	E	B	D	C	D	D	D	D	B	4
5	E	D	E	B	C	E	A	E	C	D	B	E	D	C	B	D	A	B	B	5
6	B	A	C	D	B	C	B	B	A	E	C	B	D	B	A	C	D	C	D	6
7	E	C	B	E	E	B	C	D	B	C	E	E	B	C	A	E	A	B	E	7
8	D	B	C	A	C	C	C	C	D	C	E	B	C	E	E	D	C	A	C	8
9	A	D	B	C	B	C	B	B	C	B	B	C	B	A	C	B	B	C	B	9
10	C	A	D	D	A	E	B	D	C	A	B	E	D	D	A	C	E	C	D	10
11	C	E	E	B	E	D	C	C	A	C	A	E	E	D	E	C	B	C	C	11
12	E	D	D	B	B	D	A	D	E	D	A	C	C	B	D	A	C	D	B	12
13	D	A	C	B	D	D	D	C	B	C	E	B	C	A	B	D	C	A	C	13
14	D	C	C	D	A	C	E	A	D	E	C	E	B	D	B	D	D	C	E	14
15	A	D	A	E	C	D	D	E	C	B	B	D	A	B	C	A	B	E	C	15
16	C	E	C	B	B	D	C	B	B	A	D	A	B	D	D	B	C	A	C	16
17	C	B	D	A	D	C	B	C	E	D	D	E	E	D	B	E	C	A	B	17
18	B	C	B	E	A	A	A	B	D	B	C	A	C	E	C	C	C	D	D	18
19	C	B	A	C	B	A	D	B	B	E	B	D	D	D	A	E	B	B	D	19
20	B	A	E	E	A	B	C	C	D	D	C	C	A	E	D	B	B	C	A	20
21	C	E	D	C	C	A	B	D	D	E	A	A	D	C	E	D	A	C	C	21
22	B	B	A	A	C	B	E	C	B	B	B	B	D	A	D	C	C	E	A	22
23	E	C	A	B	D	D	D	B	B	C	D	C	A	D	E	B	E	D	B	23
24	B	D	B	E	D	B	D	A	A	C	B	B	C	C	A	C	E	D	A	24
25	B	B	A	C	B	E	C	A	C	A	C	B	D	A	D	A	D	C	C	25

Comments and suggestions to DrYuFromShanghai@QQ.com

1. Julio cuts off the four corners, or vertices, of a regular tetrahedron, as shown. How many vertices does the remaining shape have?



A 8 B 9 C 11 D 12 E 15

2. What is the value of $\dfrac{20 \times 24}{2 \times 0 + 2 \times 4}$?

A 12 B 30 C 48 D 60 E 120

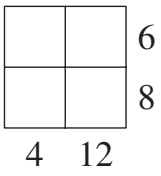
3. Ria has three counters marked 1, 5 and 11, as shown. She wants to place them side-by-side to make a four-digit number. How many different four-digit numbers can she make?

A 3 B 4 C 6 D 8 E 9

4. The maximum weight allowed in a service lift is satisfied exactly by 12 identical large packages or by 20 identical small packages. What is the greatest number of small packages that the lift can carry alongside nine large packages?

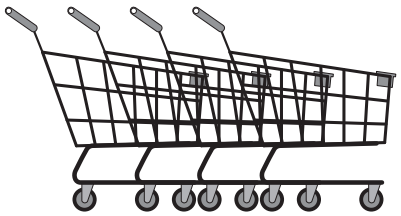
A 3 B 4 C 5 D 6 E 8

5. Four different positive integers are placed on a grid and then covered up. The product of the integers in each row and column is shown in the diagram. What is the sum of the four integers?



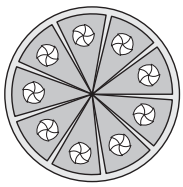
A 10 B 12 C 13 D 14 E 15

6. The length of a set of four well-parked and fitted trolleys is 108 cm. The length of a set of ten well-parked and fitted trolleys is 168 cm. What is the length of a single trolley?



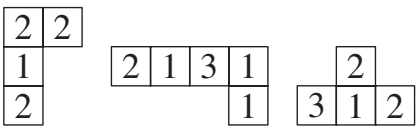
A 60 cm B 68 cm C 78 cm D 88 cm E 90 cm

7. Carina baked a cake and cut it into ten equal pieces. She ate one piece and then arranged the remaining pieces evenly, as shown. What is the size of the angle at the centre of the cake between any two adjacent pieces?



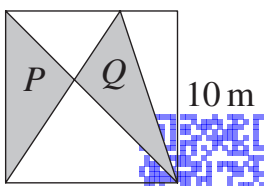
A 5° B 4° C 3° D 2° E 1°

8. Werner can make a 4×4 square, where the sums of the numbers in all four rows and in all four columns are the same, from the three pieces shown and one further piece. Which of the following pieces is needed to complete his square?



A 1 1 3 B 2 1 0 C 1 2 1 D 2 2 2 E 2 2 3

9. A square has side-length 10 m. It is divided into parts by three straight line segments, as shown. The areas of the two shaded triangles are P m^2 and Q m^2. What is the value of $P - Q$?

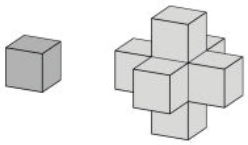


A 0 B 1 C 2 D 5 E 10

10. Paula the penguin goes fishing every day and always brings back twelve fish for her two chicks. Each day, she gives the first chick she sees seven fish and gives the second chick five fish, which they eat. In the last few days one chick has eaten 44 fish. How many has the other chick eaten?

A 34 B 40 C 46 D 52 E 64

11. Johan has a large number of identical cubes. He has made the structure on the right by taking a single cube and then sticking another cube to each face. He wants to make an extended structure in the same way so that each face of the structure on the right will have a cube stuck to it. How many extra cubes will he need to complete his extended structure?



A 10 B 12 C 14 D 16 E 18

12. Kenny the kangaroo jumps up a mountain and then jumps back down along the same route. He covers three times the distance with each downhill jump as he does with each uphill jump. Going uphill, he covers 1 metre per jump. In total, Kenny makes 2024 jumps. What is the total distance, in metres, that Kenny jumps?

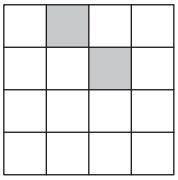
A 506 B 1012 C 2024 D 3036 E 4048

13. Gerard cuts a large rectangle into four smaller rectangles. The perimeters of three of these smaller rectangles are 16, 18 and 24, as shown in the diagram. What is the perimeter of the fourth small rectangle?

18	?
24	16

A 8 B 10 C 12 D 14 E 16

14. Tarek wants to shade two further squares on the diagram shown so that the resulting pattern has a single axis of symmetry. In how many different ways can he complete his pattern?



A 2 B 3 C 4 D 5 E 6

15. Nine cards numbered from 1 to 9 were placed facedown on the table. Aleksa, Bart, Clara and Deindra each picked up two of the cards. Aleksa said, "My numbers add up to 6." Bart said, "The difference between my numbers is 5." Clara said, "The product of my numbers is 18." Deindra said, "One of my numbers is twice the other one." All four made a true statement. Which number was left on the table?

A 1 B 3 C 6 D 8 E 9

16. The digits 0 to 9 can be drawn with horizontal and vertical segments, as shown. Greg chooses three different digits. In total, his digits have 5 horizontal segments and 10 vertical segments. What is the sum of his three digits?

A 9 B 10 C 14 D 18 E 19

17. Water makes up 80 per cent of fresh mushrooms. However, water makes up only 20 per cent of dried mushrooms. By what percentage does the mass of a fresh mushroom decrease during drying?

A 60 B 70 C 75 D 80 E 85

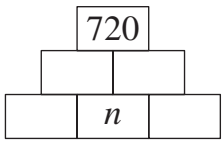
18. How many eight-digit numbers can be written using only the digits 1, 2 and 3 so that the difference between any two adjacent digits is 1?

A 16 B 20 C 24 D 28 E 32

19. A group of 50 girls sit in a circle. They throw a ball around the circle. Each girl who gets the ball throws it to the girl sitting six places anticlockwise from her, who catches it. Freda catches the ball 100 times. In that time, how many girls never get to catch the ball?

A 0 B 8 C 10 D 25 E 40

20. Donggyu wants to complete the diagram so that each box contains a positive integer and each box in the top two rows contains the product of the integers in the two boxes below it. He wants the integer in the top box to be 720. How many different values can the integer n take?

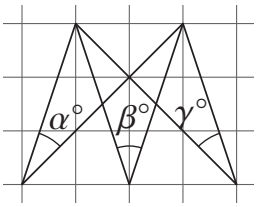


A 1 B 4 C 5 D 6 E 8

21. Farmer Fi is selling chicken and duck eggs. She has baskets holding 4, 6, 12, 13, 22 and 29 eggs. Her first customer buys all the eggs in one basket. Fi notices that the number of chicken eggs she has left is twice the number of duck eggs. How many eggs did the customer buy?

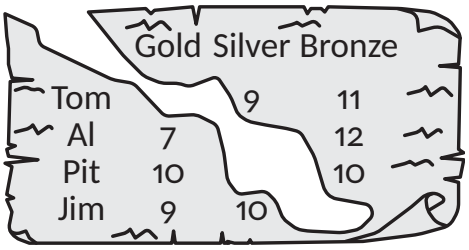
A 4 B 12 C 13 D 22 E 29

22. Three angles $\alpha°$, $\beta°$ and $\gamma°$ are marked on squared paper, as shown. What is the value of $\alpha + \beta + \gamma$?



A 60 B 70 C 75 D 90 E 120

23. Captain Flint asked four of his pirates to write on a piece of paper how many gold, silver and bronze coins were in the treasure chest. Their responses are shown in the diagram but unfortunately part of the paper was damaged. Only one of the four pirates told the truth. The other three lied in all their answers. The total number of coins was 30. Who told the truth?

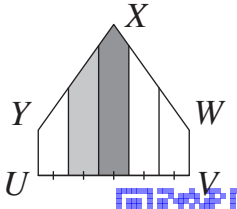


A Tom B Al C Pit D Jim
E We cannot be sure

24. Alex drives from point P to point Q, then immediately returns to P. Bob drives from point Q to point P, then immediately returns to Q. They travel on the same road, start at the same time and each travels at a constant speed. Alex's speed is three times Bob's speed. They meet each other for the first time 15 minutes after the start. How long after the start will they meet each other for the second time?

A 20 min B 25 min C 30 min D 35 min E 45 min

25. In the pentagon $UVWXY$, $\angle U = \angle V = 90°$, $UY = VW$ and $YX = XW$. Four equally spaced points are marked between U and V, and perpendiculars are drawn through each point, as shown in the diagram. The dark shaded region has an area of 13 cm^2 and the light shaded region has an area of 10 cm^2. What is the area, in cm^2, of the entire pentagon?



A 45 B 47 C 49 D 58 E 60

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

A  triangle

B  rectangle

C  trapezium

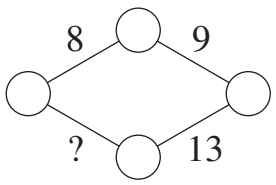
D  regular hexagon

E  square

2. What is the sum of the largest three-digit multiple of 4 and the smallest four-digit multiple of 3?

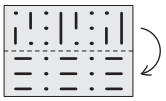
A 1996 B 1997 C 1998 D 1999 E 2000

3. 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 that edge. What number should he write on the edge marked with the question mark?



A 11 B 12 C 13 D 14 E 15

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



A  B  C  D  E 

5. 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 showing heads as showing tails?

A 10 B 15 C 20 D 25 E 30

6. 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

7. 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 should she write in the shaded box?

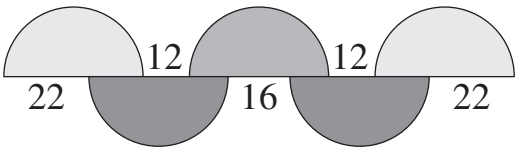
	4		
3		8	

A 1 B 2 C 5 D 6 E 7

8. Theodorika wrote down four consecutive positive integers in order. She used symbols instead of digits. She wrote the first three integers as □ ◇ ◇, ♡ △ △, ♡ △ □.
What would she write in place of the next integer in the sequence?

A ♡ ♡ ◇ B □ ♡ □ C ♡ △ ◇ D ♡ ◇ □ E ♡ △ ♡

9. 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 28

10. 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

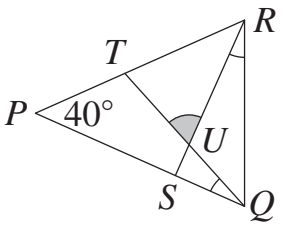
11. Matchsticks can be used to write digits, as shown in the diagram. How many different positive integers can be written using exactly six matchsticks in this way?

A 2 B 4 C 6 D 8 E 9

12. A square with side-length 10 cm long is drawn on a piece of paper. How many points on the paper are exactly 10 cm away from two of the vertices of this square?

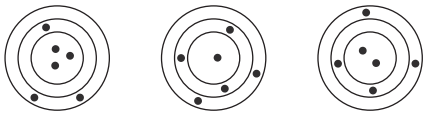
A 4 B 6 C 8 D 10 E 12

13. In the diagram shown, sides PQ and PR are equal. Also $\angle QPR = 40°$ and $\angle TQP = \angle SRQ$. What is the size of $\angle TUR$?



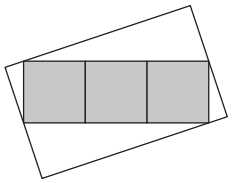
A 55° B 60° C 65° D 70° E 75°

14. Tom, John and Lily each shot six arrows at a target. Arrows hitting anywhere within the same ring scored 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

15. The diagram shows a smaller rectangle made from three squares, each of area 25 cm^2, inside a larger rectangle. Two of the vertices of the smaller rectangle lie on the mid-points of the shorter sides of the larger rectangle. The other two vertices of the smaller rectangle lie on the other two sides of the larger rectangle. What is the area, in cm^2, of the larger rectangle?



A 125 B 136 C 149 D 150 E 172

16. 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

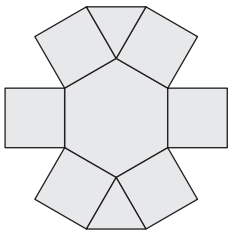
17. Some beavers and some kangaroos are standing in a circle. There are three beavers in total and no beaver is standing next to another beaver. Exactly three kangaroos stand next to another kangaroo. What is the number of kangaroos in the circle?

A 4 B 5 C 6 D 7 E 8

18. 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

19. Elizabetta wants to write the integers 1 to 9 in the regions of the shape shown, with one integer in each region. She wants the product of the integers in any two regions that have a common edge to be not more than 15. In how many ways can she do this?



A 8 B 12 C 16 D 24 E 32

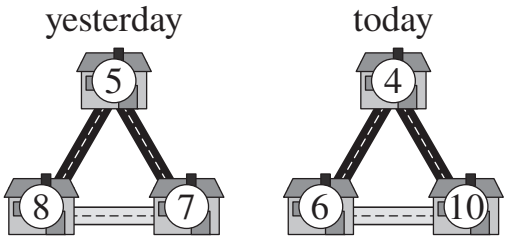
20. There were twice as many children as adults sitting round a table. The age of each person at the table was a positive integer greater than 1. The sum of the ages of the adults was 156. The mean age of the children was 80% less than the mean age of the whole group.
What the sum of the ages of the children?

A 10 B 12 C 18 D 24 E 27

21. 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

22. Some mice live in three neighbouring houses. Last night, every mouse left its house and moved to one 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 at the bottom of the diagram ?



A 9 B 11 C 12 D 16 E 19

23. Bart wrote the number 1015 as a sum of numbers using only the digit 7. He used a 7 a total of 10 times, including using the number 77 three 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 the number 77 occur in the sum?

$$\begin{array}{r} 777 \\ 77 \\ 77 \\ 77 \\ +\ \ 7 \\ \hline 1015 \end{array}$$

A 2 B 3 C 4 D 5 E 6

24. Jake wrote six consecutive numbers on 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 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

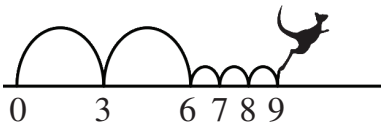
25. A rugby team scored 24 points, 17 points and 25 points in the seventh, eighth and ninth games of their season. Their mean points-per-game was higher after 9 games than it was after their first 6 games. What is the smallest number of points that they could score in their 10th game for their mean number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

A 22 B 23 C 24 D 25 E 26

1. Beate rearranges the five numbered pieces shown to display the smallest possible nine-digit number. Which piece does she place at the right-hand end?

A 4 B 8 C 31 D 59 E 107

2. Kanga likes jumping on the number line. She always makes two large jumps of length 3, followed by three small jumps of length 1, as shown, and then repeats this over and over again. She starts jumping at 0.



Which of these numbers will Kanga land on?

A 82 B 83 C 84 D 85 E 86

3. The front number plate of Max's car fell off. He put it back upside down but luckily this didn't make any difference. Which of the following could be Max's number plate?

A 04 NSN 40 B 80 BNB 08 C 03 HNH 30 D 08 XBX 80 E 60 HOH 09

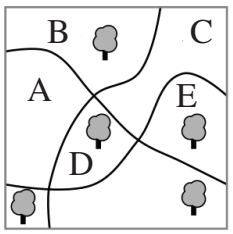
4. In the equation on the right there are five empty squares. Sanja wants to fill four of them with plus signs and one with a minus sign so that the equation is correct.

$6 \square 9 \square 12 \square 15 \square 18 \square 21 = 45$

Where should she place the minus sign?

A Between 6 and 9 B Between 9 and 12 C Between 12 and 15
D Between 15 and 18 E Between 18 and 21

5. There are five big trees and three paths in a park. It has been decided to plant a sixth tree so that there are the same number of trees on either side of each path. In which region of the park should the sixth tree be planted?

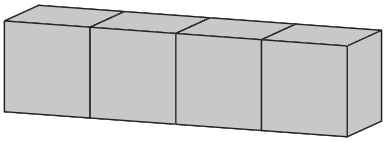


A B C D E

6. How many positive integers between 100 and 300 have only odd digits?

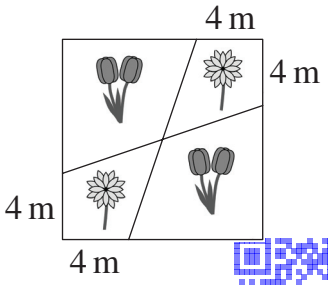
A 25 B 50 C 75 D 100 E 150

7. On a standard dice, the sum of the numbers of pips on opposite faces is always 7. Four standard dice are glued together as shown. What is the minimum number of pips that could lie on the whole surface?



A 52 B 54 C 56 D 58 E 60

8. Tony the gardener planted tulips and daisies in a square flowerbed of side-length 12 m, arranged as shown.



What is the total area, in m^2, of the regions in which he planted daisies?

A 48 B 46 C 44 D 40 E 36

9. Three sisters, whose average age is 10, all have different ages. The average age of one pair of the sisters is 11, while the average age of a different pair is 12. What is the age of the eldest sister?

A 10 B 11 C 12 D 14 E 16

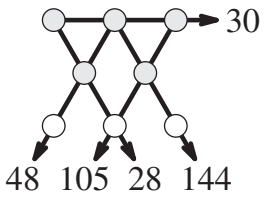
10. In my office there are two digital 24-hour clocks. One clock gains one minute every hour and the other loses two minutes every hour. Yesterday I set both of them to the same time but when I looked at them today, I saw that the time shown on one was 11:00 and the time on the other was 12:00. What time was it when I set the two clocks?

A 23:00 B 19:40 C 15:40 D 14:00 E 11:20

11. Werner wrote a list of numbers with sum 22 on a piece of paper. Ria then subtracted each of Werner's numbers from 7 and wrote down her answers. The sum of Ria's numbers was 34. How many numbers did Werner write down?

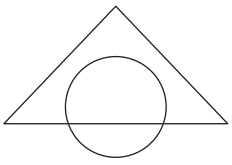
A 7 B 8 C 9 D 10 E 11

12. The numbers 1 to 8 are to be placed, one per circle, in the circles shown. The number next to each arrow shows what the product of the numbers in the circles on that straight line should be. What will be the sum of the numbers in the three circles at the bottom of the diagram?



A 11 B 12 C 15 D 16 E 17

13. The area of the intersection of a triangle and a circle is 45% of the total area of the diagram. The area of the triangle outside the circle is 40% of the total area of the diagram. What percentage of the circle lies outside the triangle?



A 20% B 25% C 30% D $33\frac{1}{3}$% E 35%

14. Jenny decided to enter numbers into the cells of a 3×3 table so that the sum of the numbers in all four possible 2×2 cells will be the same. The numbers in three of the corner cells have already been written, as shown. Which number should she write in the fourth corner cell?

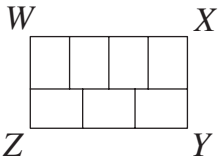
2		4
?		3

A 0 B 1 C 4 D 5 E 6

15. The villages P, Q, R and S are situated, not necessarily in that order, on a long straight road. The distance from P to R is 75 km, the distance from Q to S is 45 km and the distance from Q to R is 20 km. Which of the following could **not** be the distance, in km, from P to S?

A 10 B 50 C 80 D 100 E 140

16. The large rectangle $WXYZ$ is divided into seven identical rectangles, as shown. What is the ratio $WX : XY$?



A 3 : 2 B 4 : 3 C 8 : 5 D 12 : 7 E 7 : 3

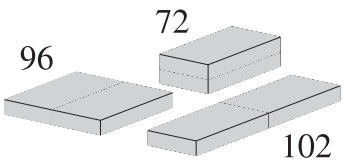
17. You can choose four positive integers X, Y, Z and W. What is the maximum number of odd numbers you can obtain from the six sums $X+Y, X+Z, X+W, Y+Z, Y+W$ and $Z+W$?

A 2 B 3 C 4 D 5 E 6

18. Marc always cycles at the same speed and he always walks at the same speed. He can cover the round trip from his home to school and back again in 20 minutes when he cycles and in 60 minutes when he walks. Yesterday Marc started cycling to school but stopped and left his bike at Eva's house on the way before finishing his journey on foot. On the way back, he walked to Eva's house, collected his bike and then cycled the rest of the way home. His total travel time was 52 minutes.
What fraction of his journey did Marc make by bike?

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

19. A builder has two identical bricks. She places them side by side in three different ways, as shown. The surface areas of the three shapes obtained are 72, 96 and 102.
What is the surface area of the original brick?

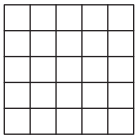


A 36 B 48 C 52 D 54 E 60

20. Carl wrote a list of 10 distinct positive integers on a board. Each integer in the list, apart from the first, is a multiple of the previous integer. The last of the 10 integers is between 600 and 1000. What is this last integer?

A 640 B 729 C 768 D 840 E 990

21. What is the smallest number of cells that need to be coloured in a 5×5 square grid so that every 1×4 or 4×1 rectangle in the grid has at least one coloured cell?



A 5 B 6 C 7 D 8 E 9

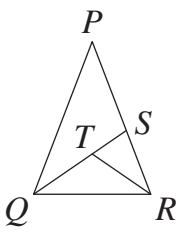
22. Mowgli asked a snake and a tiger what day it was. The snake always lies on Monday, Tuesday and Wednesday but tells the truth otherwise. The tiger always lies on Thursday, Friday and Saturday but tells the truth otherwise. The snake said "Yesterday was one of my lying days". The tiger also said "Yesterday was one of my lying days". What day of the week was it?

A Thursday B Friday C Saturday D Sunday E Monday

23. Several points were marked on a line. Renard then marked another point between each pair of adjacent points on the line. He performed this process a total of four times. There were then 225 points marked on the line. How many points were marked on the line initially?

A 15 B 16 C 20 D 25 E 30

24. An isosceles triangle PQR, in which $PQ = PR$, is split into three separate isosceles triangles, as shown, so that $PS = SQ$, $RT = RS$ and $QT = RT$.
What is the size, in degrees, of angle QPR?



A 24 B 28 C 30 D 35 E 36

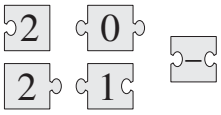
25. There are 2022 kangaroos and some koalas living across seven parks. In each park, the number of kangaroos is equal to the total number of koalas in all the other parks.
How many koalas live in the seven parks in total?

A 288 B 337 C 576 D 674 E 2022

1. What is the value of $\dfrac{20 \times 21}{2+0+2+1}$?

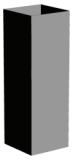
A 42 B 64 C 80 D 84 E 105

2. When the five pieces shown are fitted together correctly, the result is a rectangle with a calculation written on it. What is the answer to this calculation?

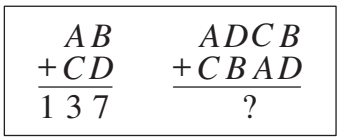


A -100 B -8 C -1 D 199 E 208

3. Each of the five vases shown has the same height and each has a volume of 1 litre. Half a litre of water is poured into each vase. In which vase would the level of the water be the highest?

A  B  C  D  E 

4. A student correctly added the two two-digit numbers on the left of the board and got the answer 137. What answer will she obtain if she adds the two four-digit numbers on the right of the board?



A 13737 B 13837 C 14747 D 23723 E 137137

5. A bike lock has four wheels numbered with the digits 0 to 9 in order. Each of the four wheels is rotated by 180° from the code shown in the first diagram to get the correct code. What is the correct code for the bike lock?

A  B  C  D  E 

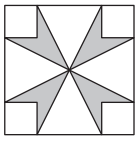
6. A rectangular chocolate bar is made of equal squares. Irena breaks off two complete strips of squares and eats the 12 squares she obtains. Later, Jack breaks off one complete strip of squares from the same bar and eats the 9 squares he obtains. How many squares of chocolate are left in the bar?

A 72 B 63 C 54 D 45 E 36

7. When a jar is one-fifth filled with water, it weighs 560 g. When the same jar is four-fifths filled with water, it weighs 740 g. What is the weight of the empty jar?

A 60 g B 112 g C 180 g D 300 g E 500 g

8. In the diagram, the area of the large square is 16 cm^2 and the area of each small corner square is 1 cm^2. What is the shaded area?



A 3 cm^2 B $\frac{7}{2}$ cm^2 C 4 cm^2 D $\frac{11}{2}$ cm^2 E 6 cm^2

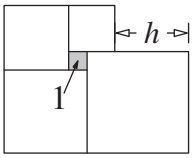
9. Costa is building a new fence in his garden. He uses 25 planks of wood, each of which is 30 cm long. He arranges these planks so that there is the same slight overlap between any two adjacent planks, as shown in the diagram. The total length of Costa's new fence is 6.9 metres. What is the length in centimetres of the overlap between any pair of adjacent planks?

A 2.4 B 2.5 C 3 D 4.8 E 5

10. Five identical right-angled triangles can be arranged so that their larger acute angles touch to form the star shown in the diagram. It is also possible to form a different star by arranging more of these triangles so that their smaller acute angles touch.
How many triangles are needed to form the second star?

A 10 B 12 C 18 D 20 E 24

11. Five squares are positioned as shown. The small square indicated has area 1.
What is the value of h?



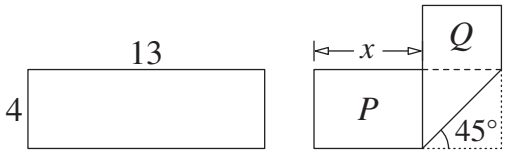
A 3 B 3.5 C 4 D 4.2 E 4.5

12. There are 20 questions in a quiz. Seven points are awarded for each correct answer, four points are deducted for each incorrect answer and no points are awarded or deducted for each question left blank.

Erica took the quiz and scored 100 points. How many questions did she leave blank?

A 0 B 1 C 2 D 3 E 4

13. A rectangular strip of paper of dimensions 4×13 is folded as shown in the diagram. Two rectangles are formed with areas P and Q where $P = 2Q$. What is the value of x?

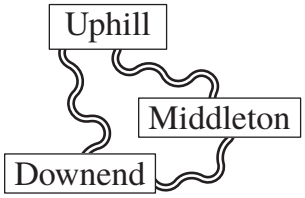


A 5 B 5.5 C 6 D 6.5 E $4\sqrt{2}$

14. A box of fruit contained twice as many apples as pears. Chris and Lily divided them up so that Chris had twice as many pieces of fruit as Lily. Which one of the following statements is always true?

A Chris took at least one pear.
B Chris took twice as many apples as pears
C Chris took twice as many apples as Lily.
D Chris took as many apples as Lily took pears.
E Chris took as many pears as Lily took apples.

15. Three villages are connected by paths as shown. From Downend to Uphill, the detour via Middleton is 1 km longer than the direct path. From Downend to Middleton, the detour via Uphill is 5 km longer than the direct path. From Uphill to Middleton, the detour via Downend is 7 km longer than the direct path. What is the length of the shortest of the three direct paths between the villages?



A 1 km B 2 km C 3 km D 4 km E 5 km

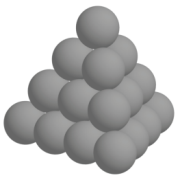
16. In a particular fraction the numerator and denominator are both positive. The numerator of this fraction is increased by 40%. By what percentage should its denominator be decreased so that the new fraction is double the original fraction?

A 10% B 20% C 30% D 40% E 50%

17. The six-digit number $2PQRST$ is multiplied by 3 and the result is the six-digit number $PQRST2$.
What is the sum of the digits of the original number?

A 24 B 27 C 30 D 33 E 36

18. A triangular pyramid is built with 20 cannonballs, as shown. Each cannonball is labelled with one of A, B, C, D or E. There are four cannonballs with each type of label. The diagrams show the labels on the cannonballs on three of the faces of the pyramid. What is the label on the hidden cannonball in the middle of the fourth face?



A B C D E

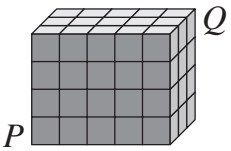
19. A ball is made of white hexagons and black pentagons, as seen in the picture. There are 12 pentagons in total. How many hexagons are there?

A 12 B 15 C 18 D 20 E 24

20. The positive integer N is the smallest one whose digits add to 41. What is the sum of the digits of $N + 2021$?

A 10 B 12 C 16 D 2021 E 4042

21. The diagram shows a $3 \times 4 \times 5$ cuboid consisting of 60 identical small cubes. A termite eats its way along the diagonal from P to Q. This diagonal does not intersect the edges of any small cube inside the cuboid. How many of the small cubes does it pass through on its journey?



A 8 B 9 C 10 D 11 E 12

22. Lewis and Geraint left Acaster to travel to Beetown at the same time. Lewis stopped for an hour in Beetown and then drove back towards Acaster. He drove at a constant 70 km/h. He met Geraint, who was cycling at a constant 30 km/h, 105 km from Beetown. How far is it from Acaster to Beetown?

A 315 km B 300 km C 250 km D 210 km E 180 km

23. A total of 2021 coloured koalas are arranged in a row and are numbered from 1 to 2021. Each koala is coloured red, white or blue. Amongst any three consecutive koalas, there are always koalas of all three colours. Sheila guesses the colours of five koalas. These are her guesses: Koala 2 is white; Koala 20 is blue; Koala 202 is red; Koala 1002 is blue; Koala 2021 is white. Only one of her guesses is wrong. What is the number of the koala whose colour she guessed incorrectly?

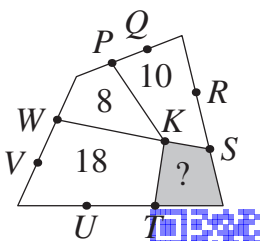
A 2 B 20 C 202 D 1002 E 2021

24. In a tournament each of the six teams plays one match against every other team. In each round of matches, three take place simultaneously. A TV station has already decided which match it will broadcast for each round, as shown in the diagram. In which round will team S play against team U?

1	2	3	4	5
P–Q	R–S	P–T	T–U	P–R

A 1 B 2 C 3 D 4 E 5

25. The diagram shows a quadrilateral divided into four smaller quadrilaterals with a common vertex K. The other labelled points divide the sides of the large quadrilateral into three equal parts. The numbers indicate the areas of the corresponding small quadrilaterals. What is the area of the shaded quadrilateral?

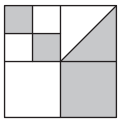


A 4 B 5 C 6 D 6.5 E 7

1. Which of these fractions has the largest value?

A $\frac{8+5}{3}$ B $\frac{8}{3+5}$ C $\frac{3+5}{8}$ D $\frac{8+3}{5}$ E $\frac{3}{8+5}$

2. A large square is divided into smaller squares. In one of the smaller squares a diagonal is also drawn, as shown. What fraction of the large square is shaded?

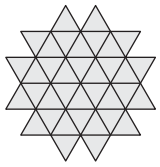


A $\frac{4}{5}$ B $\frac{3}{8}$ C $\frac{4}{9}$ D $\frac{1}{3}$ E $\frac{1}{2}$

3. There are 4 teams in a football tournament. Each team plays every other team exactly once. In each match, the winner gets 3 points and the loser gets 0 points. In the case of a draw, both teams get 1 point. After all matches have been played, which of the following total number of points is it impossible for any team to have obtained?

A 4 B 5 C 6 D 7 E 8

4. The diagram shows a shape made up of 36 identical small equilateral triangles. What is the smallest number of small triangles identical to these that could be added to the shape to turn it into a hexagon?



A 10 B 12 C 15 D 18 E 24

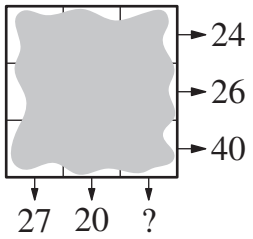
5. Kanga wants to multiply three different numbers from the following list: $-5, -3, -1, 2, 4, 6$. What is the smallest result she could obtain?

A -200 B -120 C -90 D -48 E -15

6. John always walks to and from school at the same speed. When he walks to school along the road and walks back using a short cut across the fields, he walks for 50 minutes. When he uses the short cut both ways, he walks for 30 minutes. How long does it take him when he walks along the road both ways?

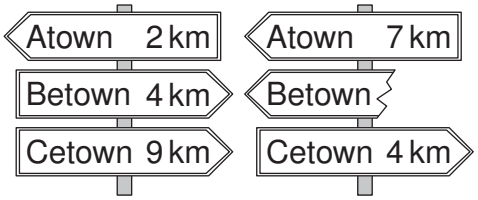
A 60 minutes B 65 minutes C 70 minutes D 75 minutes E 80 minutes

7. Each cell of a 3×3 square has a number written in it. Unfortunately the numbers are not visible because they are covered in ink. However, the sum of the numbers in each row and the sum of the numbers in two of the columns are all known, as shown by the arrows on the diagram. What is the sum of the numbers in the third column?



A 41 B 43 C 44 D 45 E 47

8. The shortest path from Atown to Cetown runs through Betown. The two signposts shown are set up at different places along this path. What distance is written on the broken sign?



A 1 km B 3 km C 4 km D 5 km E 9 km

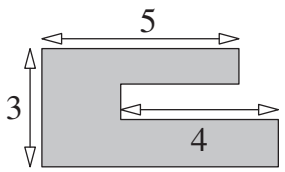
9. Anna wants to walk 5 km on average each day in March. At bedtime on 16th March, she realises that she has walked 95 km so far. What distance does she need to walk on average for the remaining days of the month to achieve her target?

A 5.4 km B 5 km C 4 km D 3.6 km E 3.1 km

10. Every pupil in a class either swims or dances. Three fifths of the class swim and three fifths dance. Five pupils both swim and dance. How many pupils are in the class?

A 15 B 20 C 25 D 30 E 35

11. Sacha's garden has the shape shown. All the sides are either parallel or perpendicular to each other. Some of the dimensions are shown in the diagram. What is the length of the perimeter of Sacha's garden?

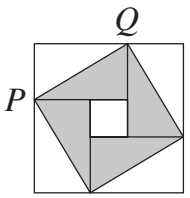


A 22 B 23 C 24 D 25 E 26

12. Werner's salary is 20% of his boss's salary. By what percentage is his boss's salary larger than Werner's salary?

A 80% B 120% C 180% D 400% E 520%

13. The pattern on a large square tile consists of eight congruent right-angled triangles and a small square. The area of the tile is 49 cm^2 and the length of the hypotenuse PQ of one of the triangles is 5 cm. What is the area of the small square?



A 1 cm^2 B 4 cm^2 C 9 cm^2 D 16 cm^2 E 25 cm^2

14. Andrew buys 27 identical small cubes, each with two adjacent faces painted red. He then uses all of these cubes to build a large cube. What is the largest number of completely red faces that the large cube can have?

A 2 B 3 C 4 D 5 E 6

15. Aisha has a strip of paper with the numbers 1, 2, 3, 4 and 5 written in five cells as shown. She folds the strip so that the cells overlap, forming 5 layers. Which of the following configurations, from top layer to bottom layer, is it not possible to obtain?

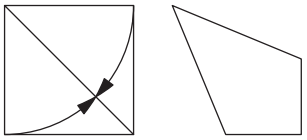
1	2	3	4	5

A 3, 5, 4, 2, 1 B 3, 4, 5, 1, 2 C 3, 2, 1, 4, 5 D 3, 1, 2, 4, 5 E 3, 4, 2, 1, 5

16. Twelve coloured cubes are arranged in a row. There are 3 blue cubes, 2 yellow cubes, 3 red cubes and 4 green cubes but not in that order. There is a yellow cube at one end and a red cube at the other end. The red cubes are all together within the row. The green cubes are also all together within the row. The tenth cube from the left is blue. What colour is the cube sixth from the left?

A green B yellow C blue D red E red or blue

17. Bella took a square piece of paper and folded two of its sides to lie along the diagonal, as shown, to obtain a quadrilateral. What is the largest size of an angle in that quadrilateral?



A 112.5° B 120° C 125° D 135° E 150°

18. How many four-digit numbers N are there, such that half of the number N is divisible by 2, a third of N is divisible by 3 and a fifth of N is divisible by 5?

A 1 B 7 C 9 D 10 E 11

19. In the final of a dancing competition, each of the three members of the jury gives each of the five competitors 0 points, 1 point, 2 points, 3 points or 4 points. No two competitors get the same mark from any individual judge. Adam knows all the sums of the marks and a few single marks, as shown. How many points does Adam get from judge III?

	Adam	Berta	Clara	David	Emil
I	2	0			
II		2	0		
III					
Sum	7	5	3	4	11

A 0 B 1 C 2 D 3 E 4

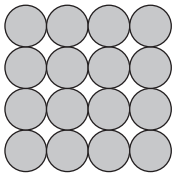
20. Harriet writes a positive integer on each edge of a square. She also writes at each vertex the product of the integers on the two edges that meet at that vertex. The sum of the integers at the vertices is 15. What is the sum of the integers on the edges of the square?

A 6 B 7 C 8 D 10 E 15

21. Sophia has 52 identical isosceles right-angled triangles. She wants to make a square using some of them. How many different-sized squares could she make?

A 6 B 7 C 8 D 9 E 10

22. Cleo builds a pyramid with identical metal spheres. Its square base is a 4×4 array of spheres, as shown in the diagram. The upper layers are a 3×3 array of spheres, a 2×2 array of spheres and a single sphere at the top. At each point of contact between two spheres, a blob of glue is placed. How many blobs of glue will Cleo place?



A 72 B 85 C 88 D 92 E 96

23. Four children are in the four corners of a 10 m × 25 m pool. Their coach is standing somewhere on one side of the pool. When he calls them, three children get out and walk as short a distance as possible round the pool to meet him. They walk 50 m in total. What is the shortest distance the coach needs to walk to get to the fourth child's corner?

A 10 m B 12 m C 15 m D 20 m E 25 m

24. Anne, Bronwyn and Carl ran a race. They started at the same time, and their speeds were constant. When Anne finished, Bronwyn had 15 m to run and Carl had 35 m to run. When Bronwyn finished, Carl had 22 m to run. What was the length of the race?

A 135 m B 140 m C 150 m D 165 m E 175 m

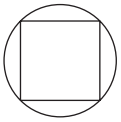
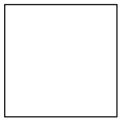
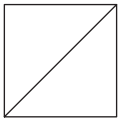
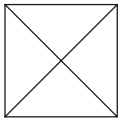
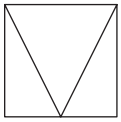
25. The statements on the right give clues to the identity of a four-digit number.

What is the last digit of the four-digit number?

A 0 B 1 C 3
D 5 E 9

4 1 3 2	Two digits are correct but in the wrong places.
9 8 2 6	One digit is correct and in the right place.
5 0 7 9	Two digits are correct with one of them being in the right place and the other one in the wrong place.
2 7 4 1	One digit is correct but in the wrong place.
7 6 4 2	None of the digits is correct.

1. Which of the diagrams below cannot be drawn without lifting your pencil off the page and without drawing along the same line twice?

A  B  C  D  E 

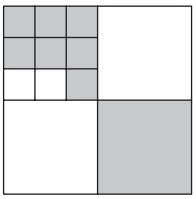
2. The expression $2 - 0 - 1 - 9$ contains four digits and three minus signs. What is the largest value that can be obtained by inserting exactly one pair of brackets into the expression?

A 13 B 12 C 10 D 9 E 8

3. Kerry writes a list of all the integers from 1 to n on a whiteboard. She uses the digit 0 five times and the digit 9 six times. What is the value of n?

A 39 B 49 C 59 D 69 E 99

4. A large square is divided into smaller squares, as shown. What fraction of the large square is shaded grey?



A $\frac{2}{3}$ B $\frac{2}{5}$ C $\frac{4}{7}$ D $\frac{4}{9}$ E $\frac{5}{12}$

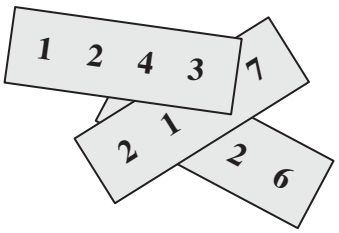
5. In a race, Lotar finished before Manfred, Victor finished after Jan, Manfred finished before Jan and Eddy finished before Victor. Who finished last of these five runners?

A Victor B Manfred C Lotar D Jan E Eddy

6. Five friends all brought some cakes with them when they met. Each of them gave a cake to each of the others. They then ate all the cakes they had just been given. As a result, the total number of cakes they had between them decreased by half. How many cakes did the five friends have at the start?

A 20 B 24 C 30 D 40 E 60

7. A four-digit integer is written on each of three pieces of paper and the pieces of paper are arranged so that three of the digits are covered, as shown. The sum of the three four-digit integers is 10 126. What are the covered digits?

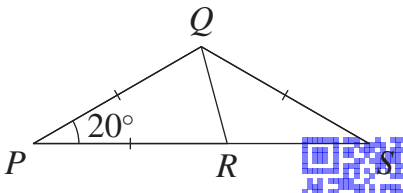


A 5, 6 and 7 B 4, 5 and 7 C 4, 6 and 7 D 4, 5 and 6
E 3, 5 and 6

8. Andrew divided some apples into six equal piles. Boris divided the same number of apples into five equal piles. Boris noticed that each of his piles contained two more apples than each of Andrew's piles. How many apples did Andrew have?

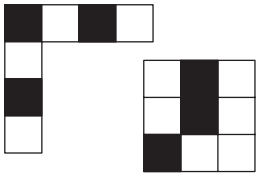
A 30 B 55 C 60 D 75 E 90

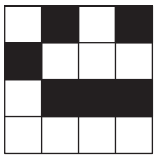
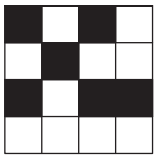
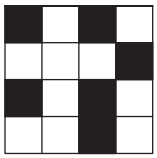
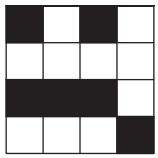
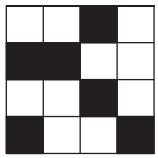
9. In the diagram, $PQ = PR = QS$ and $\angle QPR = 20°$. What is $\angle RQS$?



A 50° B 60° C 65° D 70° E 75°

10. Which of the following 4×4 tiles cannot be formed by combining the two given pieces?



A 
B 
C 
D 
E 

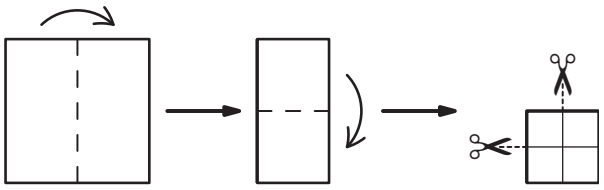
11. Alan, Bella, Claire, Dora, and Erik met together and shook hands exactly once with everyone they already knew. Alan shook hands once, Bella shook hands twice, Claire shook hands three times and Dora shook hands four times. How many times did Erik shake hands?

A 1 B 2 C 3 D 4 E 5

12. Jane was playing basketball. After a series of 20 shots, Jane had a success rate of 55%. Five shots later, her success rate had increased to 56%. On how many of the last five shots did Jane score?

A 1 B 2 C 3 D 4 E 5

13. Cathie folded a square sheet of paper in half twice and then cut it through the middle twice, as shown in the diagram, before unfolding it all. How many of the pieces that she obtained were squares?

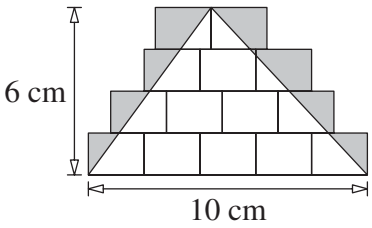


A 3 B 4 C 5 D 6 E 8

14. Michael keeps dogs, cows, cats and kangaroos as pets. He has 24 pets in total and $\frac{1}{8}$ of them are dogs, $\frac{3}{4}$ are not cows and $\frac{2}{3}$ are not cats. How many kangaroos does Michael keep?

A 4 B 5 C 6 D 7 E 8

15. Some identical rectangles are drawn on the floor. A triangle of base 10 cm and height 6 cm is drawn over them, as shown, and the region inside the rectangles and outside the triangle is shaded. What is the area of the shaded region?



A 10 cm^2 B 12 cm^2 C 14 cm^2 D 15 cm^2 E 21 cm^2

16. Chloe chose a three-digit integer with all its digits different and wrote it on lots of pieces of paper. Peter picked some of the pieces of paper and added the three-digit integers on them. His answer was 2331. How many pieces of paper did Peter pick?

A 2331 B 21 C 9 D 7 E 3

17. Julio has two cylindrical candles with different heights and diameters. The two candles burn wax at the same uniform rate. The first candle lasts 6 hours, while the second candle lasts 8 hours. He lights both candles at the same time and three hours later both candles are the same height. What is the ratio of their original heights?

A 4 : 3 B 8 : 5 C 5 : 4 D 3 : 5 E 7 : 3