United Kingdom
Mathematics Trust

Pink Kangaroo

Thursday 19 March 2020

a member of the Association Kangourou sans Frontières

supported by [XTX] MARKETS Overleaf

England & Wales: Year 11 or below
Scotland: S4 or below
Northern Ireland: Year 12 or below

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.

Enquiries about the Pink Kangaroo should be sent to:

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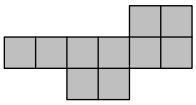
1. The diagram shows a shape made from ten squares of side-length 1 cm, joined edge to edge.



What is the length of its perimeter, in centimetres?

A 14 B 18 C 30 D 32 E 40

2. When the answers to the following calculations are put in order from smallest to largest, which will be in the middle?

A $1 + 23456$ B $12 + 3456$ C $123 + 456$ D $1234 + 56$ E $12345 + 6$

3. In the calculations shown, each letter stands for a digit. They are used to make some two-digit numbers. The two numbers on the left have a total of 79.

What is the total of the four numbers on the right?

A 79 B 158 C 869 D 1418 E 7979

$$\begin{array}{r} \text{J K} \\ +\,\text{L M} \\ \hline 7\ 9 \end{array} \qquad \begin{array}{r} \text{J M} \\ +\,\text{L M} \\ +\,\text{J K} \\ +\,\text{L K} \\ \hline ? \end{array}$$

4. The sum of four consecutive integers is 2. What is the least of these integers?

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

5. The years 2020 and 1717 both consist of a repeated two-digit number.

How many years after 2020 will it be until the next year which has this property?

A 20 B 101 C 120 D 121 E 202

6. Mary had ten pieces of paper. Some of them were squares, and the rest were triangles. She cut three squares diagonally from corner to corner. She then found that the total number of vertices of the 13 pieces of paper was 42.

How many triangles did she have before making the cuts?

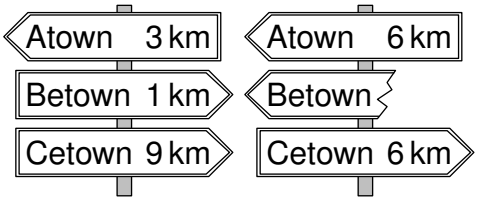
A 8 B 7 C 6 D 5 E 4

7. The positive integers a, b, c, d satisfy the equation $ab = 2cd$.

Which of the following numbers could not be the value of the product $abcd$?

A 50 B 100 C 200 D 450 E 800

8. The shortest path from Atown to Cetown runs through Betown. Two of the signposts that can be seen on this path are shown, but one of them is broken and a number missing.



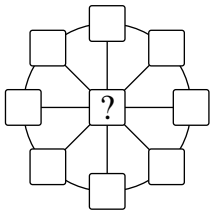
What distance was written on the broken sign?

A 2 km B 3 km C 4 km D 5 km E 6 km

9. An isosceles triangle has a side of length 20 cm. Of the remaining two side-lengths, one is equal to two-fifths of the other. What is the length of the perimeter of this triangle?

A 36 cm B 48 cm C 60 cm D 90 cm E 120 cm

10. Freda wants to write a number in each of the nine cells of this figure so that the sum of the three numbers on each diameter is 13 and the sum of the eight numbers on the circumference is 40.



What number must be written in the central cell?

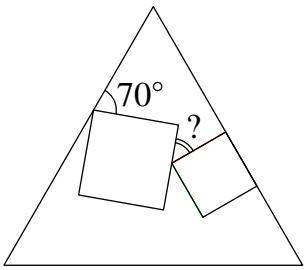
A 3 B 5 C 8 D 10 E 12

11. Masha put a multiplication sign between the second and third digits of the number 2020 and noted that the resulting product 20×20 was a square number.

How many integers between 2010 and 2099 (including 2020) have the same property?

A 1 B 2 C 3 D 4 E 5

12. Two squares of different sizes are drawn inside an equilateral triangle. One side of one of these squares lies on one of the sides of the triangle as shown. What is the size of the angle marked by the question mark?



A 25° B 30° C 35° D 45° E 50°

13. Luca began a 520 km trip by car with 14 litres of fuel in the car tank. His car consumes 1 litre of fuel per 10 km. After driving 55 km, he saw a road sign showing the distances from that point to five petrol stations ahead on the road. These distances are 35 km, 45 km, 55 km, 75 km and 95 km. The capacity of the car's fuel tank is 40 litres and Luca wants to stop just once to fill the tank.

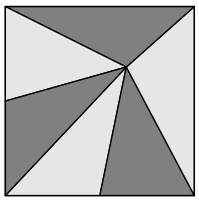
How far is the petrol station that he should stop at?

A 35 km B 45 km C 55 km D 75 km E 95 km

14. The numbers x and y satisfy the equation $17x + 51y = 102$. What is the value of $9x + 27y$?

A 54 B 36 C 34 D 18
E The value is undetermined.

15. A vertical stained glass square window of area 81 cm^2 is made out of six triangles of equal area (see figure). A fly is sitting on the exact spot where the six triangles meet. How far from the bottom of the window is the fly sitting?



A 3 cm B 5 cm C 5.5 cm D 6 cm E 7.5 cm

16. The digits from 1 to 9 are randomly arranged to make a 9-digit number.

What is the probability that the resulting number is divisible by 18?

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

17. A hare and a tortoise competed in a 5 km race along a straight line, going due North. The hare is five times as fast as the tortoise. The hare mistakenly started running due East. After a while he realised his mistake, then turned and ran straight to the finish point. He arrived at the same time as the tortoise. What was the distance between the hare's turning point and the finish point?

A 11 km B 12 km C 13 km D 14 km E 15 km

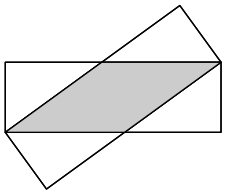
18. There are some squares and triangles on the table. Some of them are blue and the rest are red. Some of these shapes are large and the rest are small. We know that

1. If the shape is large, it's a square;
2. If the shape is blue, it's a triangle.

Which of the statements A–E must be true?

A All red figures are squares. B All squares are large. C All small figures are blue.
D All triangles are blue. E All blue figures are small.

19. Two identical rectangles with sides of length 3 cm and 9 cm are overlapping as in the diagram. What is the area of the overlap of the two rectangles?



A 12 cm^2 B 13.5 cm^2 C 14 cm^2 D 15 cm^2 E 16 cm^2

20. Kanga labelled the vertices of a square-based pyramid using 1, 2, 3, 4 and 5 once each. For each face Kanga calculated the sum of the numbers on its vertices. Four of these sums equalled 7, 8, 9 and 10. What is the sum for the fifth face?

A 11 B 12 C 13 D 14 E 15

21. A large cube is built using 64 smaller identical cubes. Three of the faces of the large cube are painted. What is the maximum possible number of small cubes that can have exactly one face painted?

A 27 B 28 C 32 D 34 E 40

22. In each of the cells, a number is to be written so that the sum of the 4 numbers in each row and in each column are the same.

What number must be written in the shaded cell?

1		6	3
	2	2	8
	7		4
		7	

A 5 B 6 C 7 D 8 E 9

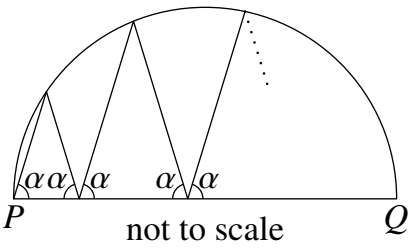
23. Alice, Belle and Cathy had an arm-wrestling contest. In each game two girls wrestled, while the third rested. After each game, the winner played the next game against the girl who had rested. In total, Alice played 10 times, Belle played 15 times and Cathy played 17 times. Who lost the second game?

A Alice
B Belle
C Cathy
D Either Alice or Belle could have lost the second game.
E Either Belle or Cathy could have lost the second game.

24. Eight consecutive three-digit positive integers have the following property: each of them is divisible by its last digit. What is the sum of the digits of the smallest of these eight integers?

A 9 B 10 C 11 D 12 E 13

25. A zig-zag line starts at the point P, at one end of the diameter PQ of a circle. Each of the angles between the zig-zag line and the diameter PQ is equal to α as shown. After four peaks, the zig-zag line ends at the point Q. What is the size of angle α?



A 60° B 72° C 75° D 80° E 86°

