EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE
'PINK'
Thursday 15th March 2018

Organised by the United Kingdom Mathematics Trust and the Association Kangourou Sans Frontières

This competition is being taken by 6 million students in over 50 countries worldwide.

RULES AND GUIDELINES (to be read before starting):

1. Do not open the paper until the Invigilator tells you to do so.
2. Time allowed: **1 hour**.
   No answers, or personal details, may be entered after the allowed hour is over.
3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
4. Candidates in England and Wales must be in School Year 10 or 11.
   Candidates in Scotland must be in S3 or S4.
   Candidates in Northern Ireland must be in School Year 11 or 12.
5. **Use B or HB non-propelling pencil only**. For each question mark *at most one* of the options A, B, C, D, E on the Answer Sheet. Do not mark more than one option.
6. Five marks will be awarded for each correct answer to Questions 1 - 15.
   Six marks will be awarded for each correct answer to Questions 16 - 25.
7. *Do not expect to finish the whole paper in 1 hour*. Concentrate first on Questions 1-15. When you have checked your answers to these, have a go at some of the later questions.
8. The questions on this paper challenge you **to think**, not to guess. Though you will not lose marks for getting answers wrong, you will undoubtedly get more marks, and more satisfaction, by doing a few questions carefully than by guessing lots of answers.

Enquiries about the European Kangaroo should be sent to:
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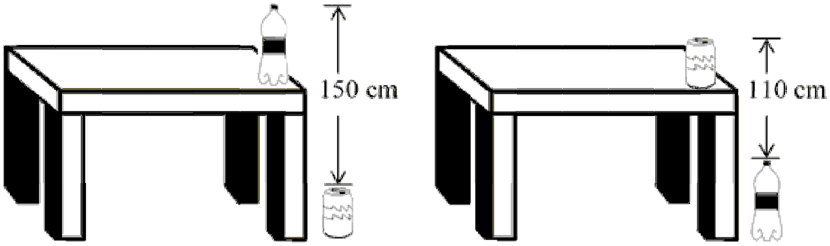
(Tel. 0113 343 2339)
http://www.ukmt.org.uk

1. The lengths of two sides of a triangle are 5 cm and 2 cm. The length of the third side in cm is an odd integer. What is the length of the third side?

A 1 cm B 3 cm C 5 cm D 7 cm E 9 cm

2. The distance from the top of the can on the floor to the top of the bottle on the table is 150 cm. The distance from the top of the bottle on the floor to the top of the can on the table is 110 cm. What is the height of the table?

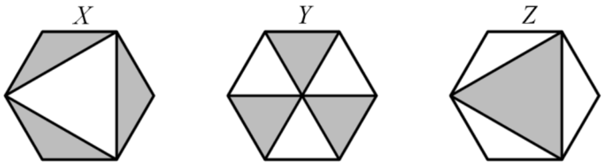


A 110 cm B 120 cm C 130 cm D 140 cm E 150 cm

3. The sum of five consecutive integers is 10^{2018}. What is the middle number?

A 10^{2013} B 5^{2017} C 10^{2017} D 2^{2018} E 2×10^{2017}

4. The diagram shows three congruent regular hexagons. Some diagonals have been drawn, and some regions then shaded. The total shaded areas of the hexagons are X, Y, Z as shown. Which of the following statements is true?



A X, Y and Z are all the same
B Y and Z are equal, but X is different
C X and Z are equal, but Y is different
D X and Y are equal, but Z is different
E X, Y, Z are all different

5. Marta has collected 42 apples, 60 apricots and 90 cherries. She wants to divide them into identical piles using all of the fruit and then give a pile to some of her friends. What is the largest number of piles she can make?

A 3 B 6 C 10 D 14 E 42

6. Some of the digits in the following correct addition have been replaced by the letters P, Q, R and S, as shown.
What is the value of $P + Q + R + S$?

$$\begin{array}{cccc} & P & 4 & 5 \\ + & Q & R & S \\ \hline & 6 & 5 & 4 \end{array}$$

A 14 B 15 C 16 D 17 E 24

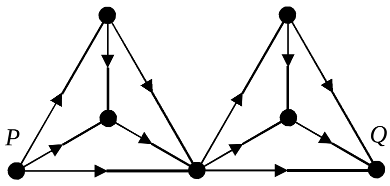
7. What is the sum of 25% of 2018 and 2018% of 25?

A 1009 B 2016 C 2018 D 3027 E 5045

8. Two buildings are located on one street at a distance of 250 metres from each other. There are 100 students living in the first building. There are 150 students living in the second building. Where should a bus stop be built so that the total distance that all residents of both buildings have to walk from their buildings to this bus stop would be the least possible?

A In front of the first building
B 100 metres from the first building
C 100 metres from the second building
D In front of the second building
E Anywhere between the buildings

9. Monika plans to travel across the network in the diagram from point P to point Q, travelling only in the direction of the arrows. How many different routes are possible?

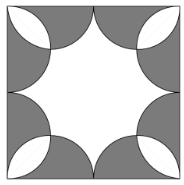


A 20 B 16 C 12 D 9 E 6

10. A sequence of positive integers starts with one 1, followed by two 2s, three 3s, and so on. (Each positive integer n occurs n times.) How many of the first 105 numbers in this sequence are divisible by 3?

A 4 B 12 C 21 D 30 E 45

11. Eight congruent semicircles are drawn inside a square of side-length 4. Each semicircle begins at a vertex of the square and ends at a midpoint of an edge of the square. What is the area of the non-shaded part of the square?



A 2π B $3\pi + 2$ C 8 D $6 + \pi$ E 3π

12. In a certain region are five towns, Freiburg, Göttingen, Hamburg, Ingolstadt and Jena.

On a certain day 40 trains each made a journey, leaving one of these towns and arriving at one of the other towns.

Ten trains travelled either from or to Freiburg. Ten trains travelled either from or to Göttingen.

Ten trains travelled either from or to Hamburg. Ten trains travelled either from or to Ingolstadt.

How many trains travelled from or to Jena?

A 0 B 10 C 20 D 30 E 40

13. At the University of Bugelstein you can study Languages, History and Philosophy.

35% of students that study a language study English.

13% of all the university students study a language other than English.

No student studies more than one language.

What percentage of the university students study Languages?

A 13 % B 20 % C 22 % D 48 % E 65 %

14. Peter wanted to buy a book, but he didn't have any money. He bought it with the help of his father and his two brothers. His father gave him half of the amount given by his brothers. His elder brother gave him one third of what the others gave. The younger brother gave him 10 euros. What was the price of the book?

A 24 euros B 26 euros C 28 euros D 30 euros E 32 euros

15. How many 3-digit numbers are there with the property that the 2-digit number obtained by deleting the middle digit is equal to one ninth of the original 3-digit number?

A 1 B 2 C 3 D 4 E 5

16. In the calculation shown, how many times does the term 2018^2 appear inside the square root to make the calculation correct?

$$\sqrt{2018^2 + 2018^2 + \dots + 2018^2} = 2018^{10}$$

A 5 B 8 C 18 D 2018^8 E 2018^{18}

17. A list of integers has a sum of 2018, a product of 2018, and includes the number 2018 in the list. Which of the following could be the number of integers in the list?

A 2016 B 2017 C 2018 D 2019 E 2020

18. Lonneke drew a regular polygon with 2018 vertices, which she labelled from 1 to 2018, in a clockwise direction. She then drew a diagonal from the vertex labelled 18 to the vertex labelled 1018. She also drew the diagonal from the vertex labelled 1018 to the vertex labelled 2000. This divided the original polygon into three new polygons. How many vertices did each of the resulting three polygons have?

A 38, 983, 1001 B 37, 983, 1001 C 38, 982, 1001 D 37, 982, 1000 E 37, 983, 1002

19. Abdul wrote down four positive numbers. He chose one of them and added it to the mean of the other three. He repeated this for each of the four numbers in turn.

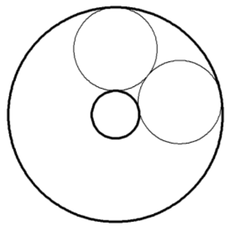
The results were 17, 21, 23 and 29. What was the largest of Abdul's numbers?

A 12 B 15 C 21 D 24 E 29

20. Omar marks a sequence of 12 points on a straight line beginning with a point O, followed by a point P with $OP = 1$. He chooses the points so that each point is the midpoint of the two immediately following points. For example O is the midpoint of PQ, where Q is the third point he marks. What is the distance between the first point O and the 12th point Z?

A 171 B 341 C 512 D 587 E 683

21. An annulus is a shape made from two concentric circles. The diagram shows an annulus consisting of two concentric circles of radii 2 and 9. Inside this annulus two circles are drawn without overlapping, each being tangent to both of the concentric circles that make the annulus. In a different annulus made by concentric circles of radii 1 and 9, what would be the largest possible number of non-overlapping circles that could be drawn in this way?



A 2 B 3 C 4 D 5 E 6

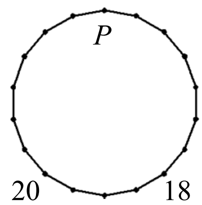
22. Diana drew a rectangular grid of 12 squares on squared paper. Some of the squares were then painted black. In each white square she wrote the number of black squares that shared an edge with it (a whole edge, not just a vertex). The figure shows the result. Then she did the same with a rectangular grid of 2 by 1009 squares. What is the maximum value that she could obtain as the result of the sum of all the numbers in this grid?

1	■	2	1
0	3	■	■
1	■	2	1

A 1262 B 2016 C 2018 D 3025 E 3027

23. At each vertex of the 18-gon in the picture a number should be written which is equal to the sum of the numbers at the two adjacent vertices.

Two of the numbers are given. What number should be written at the vertex P?



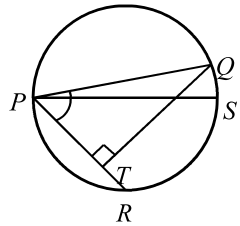
A 2018 B 38 C 18 D −20 E −38

24. Each of the numbers 1, 2, 3, 4, 5, 6 is to be placed in the cells of a 2×3 table, with one number in each cell. In how many ways can this be done so that in each row and in each column the sum of the numbers is divisible by 3?

A 36 B 42 C 45 D 48 E another number

25. Two chords PQ and PR are drawn in a circle with diameter PS.

The point T lies on PR and QT is perpendicular to PR. The angle $QPR = 60°$, $PQ = 24$ cm, $RT = 3$ cm. What is the length of the chord QS in cm?



A $\sqrt{3}$ B 2 C 3 D $2\sqrt{3}$ E $3\sqrt{2}$