EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE
'GREY'
Thursday 17th March 2016

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

This competition is being taken by 6 million students in over 60 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 9 or below.
   Candidates in Scotland must be in S2 or below.
   Candidates in Northern Ireland must be in School Year 10 or below.

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 triangle in the diagram contains a right angle.
   What is the sum of the other two marked angles on the diagram?

   A 150°   B 180°   C 270°   D 320°   E 360°
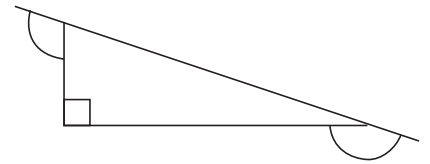
2. Jenny had to add 26 to a certain number. Instead she subtracted 26 and obtained
   −14. What number should she have obtained?

   A 28   B 32   C 36   D 38   E 42

3. Joanna turns over the card shown about its lower edge and then about
   its right-hand edge, as indicated in the diagram.
   What does she see?

   A   B   C   D   E
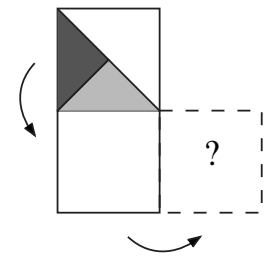
4. In my school, 60% of the teachers come to school by bicycle. There are 45 teachers who
   come to school by bicycle. Only 12% come to school by car. How many teachers come to
   school by car?

   A 4   B 6   C 9   D 10   E 12

5. What is the total area in cm² of the shaded region?
   A 50   B 80   C 100   D 120   E 150
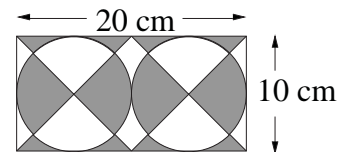
6. Two pieces of rope have lengths 1 m and 2 m. Alex cuts the pieces into several parts. All the
   parts have the same length. Which of the following could not be the total number of parts he
   obtains?

   A 6   B 8   C 9   D 12   E 15

7. Four towns *P*, *Q*, *R* and *S* are connected by roads, as shown.
   A race uses each road exactly once. The race starts at *S* and
   finishes at *Q*. How many possible routes are there for the race?

   A 10   B 8   C 6   D 4   E 2
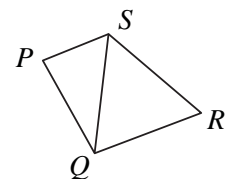
8. Petra has 49 blue beads and one red bead. How many beads must Petra remove so that 90% of
   her beads are blue?

   A 4   B 10   C 29   D 39   E 40

9. Three equilateral triangles are cut from the corners of a large equilateral
   triangle to form an irregular hexagon, as shown in the diagram.
   The perimeter of the large equilateral triangle is 60 cm. The perimeter of the
   irregular hexagon is 40 cm. What is the sum of the perimeters of the
   triangles that were cut from the large triangle?

   A 60 cm   B 66 cm   C 72 cm   D 75 cm   E 81 cm
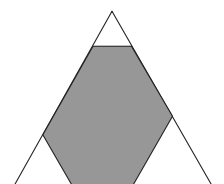
10. Tim, Tom and Tam are triplets (three brothers born on the same day). Their twin brothers Jon and Jim are exactly three years younger. Which of the following numbers could be the sum of the ages of the five brothers?

   A 36   B 53   C 76   D 89   E 92

11. A 3 cm wide strip is grey on one side and white on the other. Maria folds the strip, so that it fits inside a rectangle of length 27 cm, as shown. The grey trapeziums are identical. What is the length of the original strip?
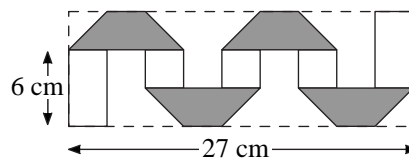
   A 36 cm   B 48 cm   C 54 cm   D 57 cm   E 81 cm

12. Two kangaroos Bo and Ing start to jump at the same time, from the same point, in the same direction. After that, they each make one jump per second. Each of Bo's jumps is 6 m in length. Ing's first jump is 1 m in length, his second is 2 m, his third is 3 m, and so on. After how many jumps does Ing catch Bo?

   A 10   B 11   C 12   D 13   E 14

13. Ivor writes down the results of the quarter-finals, the semi-finals and the final of a knock-out tournament. The results are (not necessarily in this order): Bart beat Antony, Carl beat Damian, Glen beat Harry, Glen beat Carl, Carl beat Bart, Ed beat Fred and Glen beat Ed. Which pair played in the final?

   A Glen and Carl   B Glen and Harry   C Carl and Bart
            D Glen and Ed   E Carl and Damian

14. Seven standard dice are glued together to make the solid shown.

   The pairs of faces of the dice that are glued together have the same number of dots on them. How many dots are on the surface of the solid?
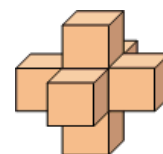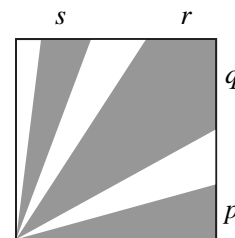
   A 24   B 90   C 95   D 105   E 126

15. There are twenty students in a class. Some of them sit in pairs so that exactly one third of the boys sit with a girl, and exactly one half of the girls sit with a boy. How many boys are there in the class?

   A 9   B 12   C 15   D 16   E 18

16. Inside a square of area 36 cm^2, there are shaded regions as shown. The total shaded area is 27 cm^2. What is the value of $p + q + r + s$?

   A 4 cm   B 6 cm   C 8 cm   D 9 cm   E 10 cm

17. Theo's watch is 10 minutes slow, but he believes it is 5 minutes fast. Leo's watch is 5 minutes fast, but he believes it is 10 minutes slow. At the same moment, each of them looks at his own watch. Theo thinks it is 12:00. What time does Leo think it is?

   A 11:30   B 11:45   C 12:00   D 12:30   E 12:45

18. Twelve girls met in a cafe. On average, they ate $1\frac{1}{2}$ cupcakes each, although no cupcakes were actually divided. None of them ate more than two cupcakes and two of them ate no cupcakes at all. How many girls ate two cupcakes?

   A 2   B 5   C 6   D 7   E 8

19. Little Red Riding Hood is delivering waffles to three grannies. She starts with a basket full of waffles. Just before she enters the house of each granny, the Big Bad Wolf eats half of the waffles in her basket. She delivers the same number of waffles to each granny. When she leaves the third granny's house, she has no waffles left. Which of the following numbers definitely divides the number of waffles she started with?

    A 4   B 5   C 6   D 7   E 9

20. The cube shown is divided into 64 small cubes. Exactly one of the cubes is grey, as shown in the diagram. Two cubes are said to be 'neighbours' if they have a common face.
    On the first day, the white neighbours of the grey cube are changed to grey. On the second day, the white neighbours of all the grey cubes are changed to grey.
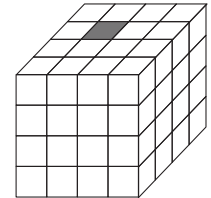
    How many grey cubes are there at the end of the second day?

    A 11   B 13   C 15   D 16   E 17

21. Several different positive integers are written on a blackboard. The product of the smallest two of them is 16. The product of the largest two of them is 225. What is the sum of all the integers written on the blackboard?

   A 38   B 42   C 44   D 58   E 243

22. The diagram shows a pentagon. The lengths of the sides of the pentagon are given in the diagram.
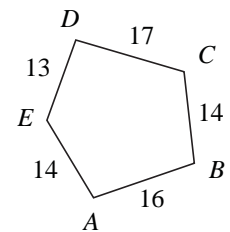
    Sepideh draws five circles with centres *A*, *B*, *C*, *D* and *E* such that the two circles with centres at the ends of a side of the pentagon touch on that side. Which point is the centre of the largest circle that she draws?

    A *A*   B *B*   C *C*   D *D*   E *E*

23. Katie writes a different positive integer on the top face of each of the fourteen cubes in the pyramid shown.
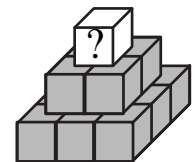
    The sum of the nine integers written on the cubes in the bottom layer is 50. The integer written on each of the cubes in the middle and top layers of the pyramid is equal to the sum of the integers on the four cubes underneath it. What is the greatest possible integer that she can write on the top cube?

    A 80   B 98   C 104   D 118   E 128

24. A train has five carriages, each containing at least one passenger. Two passengers are said to be 'neighbours' if either they are in the same carriage or they are in adjacent carriages. Each passenger has exactly five or exactly ten neighbours. How many passengers are there on the train?

    A 13   B 15   C 17   D 20   E There is more than one answer.

25. A 3 × 3 × 3 cube is built from 15 black cubes and 12 white cubes. Five faces of the larger cube are shown.
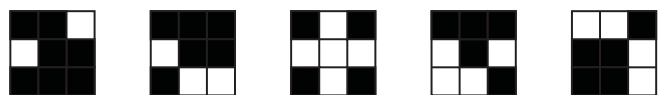
    Which of the following is the sixth face of the larger cube?

    A   B   C   D   E