EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE
'PINK'
Thursday 15th March 2012

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

Kangaroo papers are being taken by over 5.5 million students in 46 countries in Europe and beyond.

RULES AND GUIDELINES (to be read before starting):

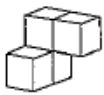
1. Do not open the paper until the Invigilator tells you to do so.
2. Time allowed: **1 hour**.
   No answers, or personal details, may be entered after the allowed hour is over.
3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
4. Candidates in England 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 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. You get more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers.

Enquiries about the European Kangaroo should be sent to: Maths Challenges Office, School of Mathematics Satellite, University of Leeds, Leeds, LS2 9JT.
(Tel. 0113 343 2339)
http://www.ukmt.org.uk

1. What is the value of $11.11 - 1.111$?

A 9.009 B 9.0909 C 9.99 D 9.999 E 10

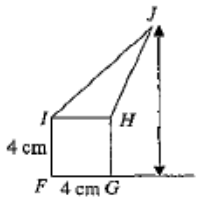
2. A cuboid is made of four pieces as shown. Each piece consists of four cubes and is a single colour. What is the shape of the white piece?

A  B  C  D  E 

3. The sum of the digits of a 7-digit number is six. What is the product of the digits?

A 0 B 1 C 5 D 6 E 7

4. The triangle HIJ has the same area as the square $FGHI$, whose sides are of length 4 cm. What is the perpendicular distance, in cm, of the point J from the line extended through F and G?



A 8 B $4+2\sqrt{3}$ C 12 D $10\sqrt{2}$
E depends on the location of J

5. In four of the following expressions, the value of the expression is unchanged when each number 8 is replaced by any other positive number (always using the same number for every replacement). Which expression does *not* have this property?

A $(8 + 8 - 8) \div 8$ B $8 \div (8 \div 8) - 8$ C $8 \div (8 + 8 + 8)$
D $8 \times (8 \div 8) \div 8$ E $8 - (8 \div 8) + 8$

6. The right-angled triangle FGH has shortest sides of length 6 cm and 8 cm. The points I, J, K are the midpoints of the sides FG, GH, HF respectively. What is the length, in cm, of the perimeter of the triangle IJK ?

A 10 B 12 C 15 D 20 E 24

7. When 144 is divided by the positive integer n, the remainder is 11. When 220 is divided by the positive integer n, the remainder is also 11. What is the value of n?

A 11 B 15 C 17 D 19 E 38

8. A quadrilateral has a side of length 1 cm and a side of length 4 cm. It has a diagonal of length 2 cm that dissects the quadrilateral into two isosceles triangles. What is the length, in cm, of the perimeter of the quadrilateral?

A 8 B 9 C 10 D 11 E 12

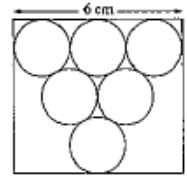
9. When Clement stands on a table and Dimitri stands on the floor, Clement appears to be 80 cm taller than Dimitri. When Dimitri stands on the same table and Clement stands on the floor, Dimitri appears to be one metre taller than Clement. How high is the table, in metres?

A 0.2 B 0.8 C 0.9 D 1 E 1.2

10. Maria and Meinke spun a coin thirty times. Whenever the coin showed heads, Maria gave two sweets to Meinke. When the coin showed tails, Meinke gave three sweets to Maria. After 30 spins, both Maria and Meinke had the same number of sweets as they started with. How many times were tails spun?

A 6 B 12 C 18 D 24 E 30

11. Six identical circles fit together tightly in a rectangle of width 6 cm as shown. What is the height, in cm, of the rectangle?

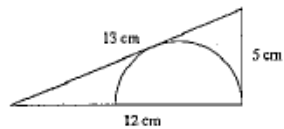


A 5 B $2\sqrt{3}+2$ C $3\sqrt{2}$ D $3\sqrt{3}$ E 6

12. In Clara's kitchen there is a clock on each of the four walls. Each clock is either slow or fast. The first clock is wrong by two minutes, the second clock by three minutes, the third by four minutes and the fourth by five minutes. What is the actual time when the four clocks show, in no particular order, six minutes to three, three minutes to three, two minutes past three and three minutes past three?

A 2:57 B 2:58 C 2:59 D 3:00 E 3:01

13. The right-angled triangle shown has sides of length 5 cm, 12 cm and 13 cm. What, in cm, is the radius of the inscribed semicircle whose diameter lies on the side of length 12 cm?



A 8/3 B 10/3 C 11/3 D 4 E 13/3

14. Numbers are to be placed into the table shown, one number in each cell, in such a way that each row has the same total, and each column has the same total. Some of the numbers are already given. What number is x?

2	4		2
	3	3	
6		1	x

A 4 B 5 C 6 D 7 E 8

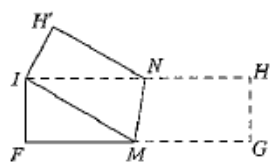
15. Three runners, Friedrich, Gottlieb and Hans had a race. Before the race, a commentator said, "Either Friedrich or Gottlieb will win." Another commentator said, "If Gottlieb comes second, then Hans will win." Another said, "If Gottlieb comes third, Friedrich will not win." And another said, "Either Gottlieb or Hans will be second." In the event, it turned out that all the commentators were correct. In what order did the runners finish?

A Friedrich, Gottlieb, Hans
B Friedrich, Hans, Gottlieb
C Hans, Gottlieb, Friedrich
D Gottlieb, Friedrich, Hans
E Gottlieb, Hans, Friedrich

16. What is the last non-zero digit when $2^{57} \times 3^4 \times 5^{53}$ is evaluated?

A 1 B 2 C 4 D 6 E 8

17. A rectangular piece of paper $FGHI$ with sides of length 4 cm and 16 cm is folded along the line MN so that the vertex G coincides with the vertex I as shown. The outline of the paper now makes a pentagon $FMNH'I$. What is the area, in cm^2, of the pentagon $FMNH'I$?



A 51 B 50 C 49 D 48 E 47

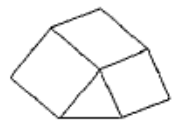
18. Erica saw an eastbound train to Brussels passing. It took 8 seconds to pass her. A westbound train to Lille took 12 seconds to pass her. They took 9 seconds to pass each other. Assuming both trains maintained a constant speed, which of the following statements is true?

A the Brussels train is twice as long as the Lille train B the trains are of the same length
C the Lille train is 50% longer than the Brussels train D the Lille train is twice as long as the Brussels train E it is impossible to say if the statements A to D are true

19. Brigitte wrote down a list of all 3-digit numbers. For each of the numbers on her list she found the product of the digits. She then added up all of these products. Which of the following is equal to this total?

A 45 B 45^2 C 45^3 D 2^{45} E 3^{45}

20. The diagram shows a square with sides of length 4 mm, a square with sides of length 5 mm, a triangle with area 8 mm^2, and a parallelogram. What is the area, in mm^2, of the parallelogram?



A 15 B 16 C 17 D 18 E 19

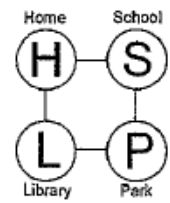
21. Anya has found positive integers k and m such that $m^m \times (m^k - k) = 2012$. What is the value of k?

A 2 B 3 C 8 D 9 E 11

22. Pedro writes down a list of six different positive integers, the largest of which is N. There is exactly one pair of these numbers for which the smaller number does not divide the larger. What is the smallest possible value of N?

A 18 B 20 C 24 D 36 E 45

23. Carlos creates a game. The diagram shows the board for the game. At the start, the kangaroo is at the school (S). According to the rules of the game, from any position except home (H), the kangaroo can jump to either of the two neighbouring positions. When the kangaroo lands on H the game is over. In how many ways can the kangaroo move from S to H in exactly 13 jumps?



A 12 B 32 C 64 D 144 E 1024

24. Lali and Gregor play a game with five coins, each with Heads on one side and Tails on the other. The coins are placed on a table, with Heads showing. In each round of the game, Lali turns over a coin, and then Gregor turns over a different coin. They play a total of ten rounds. Which of the following statements is then true?

A It is impossible for all the coins to show Heads
B It is impossible for all the coins to show Tails
C It is definite that all the coins show Heads
D It is definite that all the coins show Tails
E None of the statements A to D is true

25. A regular octagon has vertices A, B, C, D, E, F, G, H. One of the vertices C, D, E, F, G, H is chosen at random, and the line segment connecting it to A is drawn. Then one of the vertices C, D, E, F, G, H is chosen at random and the line segment connecting it to B is drawn. What is the probability that the octagon is cut into exactly three regions by these two line segments?

A $\frac{1}{6}$ B $\frac{5}{18}$ C $\frac{1}{4}$ D $\frac{1}{3}$ E $\frac{4}{9}$