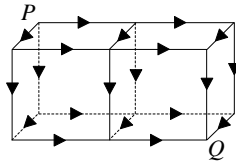


17. How many different paths are there between points  $P$  and  $Q$ , only travelling along the edges in the direction of the arrows shown?

A 6      B 8      C 9      D 12      E 15



18. How many decimal places are needed after the decimal point to write the fraction  $\frac{1}{1024000}$  as a decimal, using the smallest possible number of digits?

A 10      B 11      C 12      D 13      E 14

19. How many positive integers are multiples of 2013 and have exactly 2013 factors (including 1 and the number itself)?

A none      B 1      C 2      D 3      E 6

20. Using the whole numbers from 1 to 22 inclusive, Sylvie wants to form eleven fractions by choosing one number as the numerator, and one number as the denominator. Every number will be used exactly once. What is the maximum number of Sylvie's fractions that could have an integer value?

A 11      B 10      C 9      D 8      E 7

21. Julio creates a procedure for turning a set of three numbers into a new set of three numbers: each number is replaced by the sum of the other two. For example,  $\{3, 4, 6\}$  becomes  $\{10, 9, 7\}$ . How many times must Julio apply this procedure to the set  $\{1, 2, 3\}$  before he first obtains a set containing the number 2013?

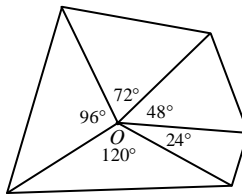
A 8      B 9      C 10      D more than 10 times      E 2013 will never appear

22. The numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 are to be written around a circle in some order. Then each number will be added to its immediate neighbours to obtain ten new numbers. What is the largest possible value of the smallest of these new numbers?

A 14      B 15      C 16      D 17      E 18

23. Several non-overlapping isosceles triangles have vertex  $O$  in common. Every triangle shares an edge with each immediate neighbour. The smallest of the angles at  $O$  has size  $m^\circ$ , where  $m$  is a positive integer and the other triangles have angles at  $O$  of size  $2m^\circ$ ,  $3m^\circ$ ,  $4m^\circ$ , and so on. The diagram shows an arrangement of five such triangles. What is the smallest value of  $m$  for which such a set of triangles exists?

A 2      B 3      C 4      D 5      E 6

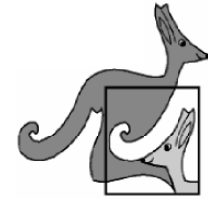
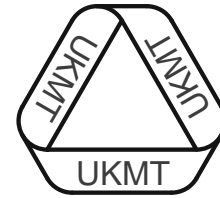


24. A regular 13-sided polygon is inscribed in a circle with centre  $O$ . Triangles can be formed by choosing three vertices of this polygon to be the vertices of a triangle. For how many of the triangles formed in this way is the point  $O$  inside the triangle?

A 39      B 72      C 78      D 91      E 260

25. Yurko saw a tractor slowly pulling a long pipe down the road. Yurko walked along beside the pipe in the same direction as the tractor, and counted 140 paces to get from one end to the other. He then turned around and walked back to the other end, taking only 20 paces. The tractor and Yurko kept to a uniform speed, and Yurko's paces were all 1 m long. How long was the pipe?

A 35 m      B 40 m      C  $46\frac{2}{3}$  m      D 80 m      E 120 m



EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE  
'PINK'

Thursday 21st March 2013

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 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.*

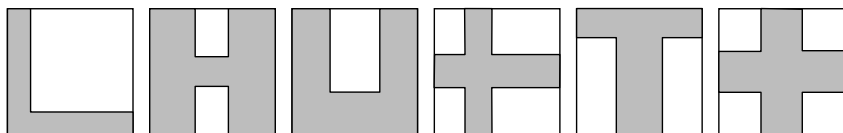
*(Tel. 0113 343 2339)*

*<http://www.ukmt.org.uk>*

1. Which of the following is *not* a factor of 200013 – 2013 ?

- A 2                      B 3                      C 5                      D 7                      E 11

2. The diagram shows six identical squares, each containing a shaded region.



How many of the regions have perimeter equal in length to the perimeter of one of the squares?

- A 2                      B 3                      C 4                      D 5                      E 6

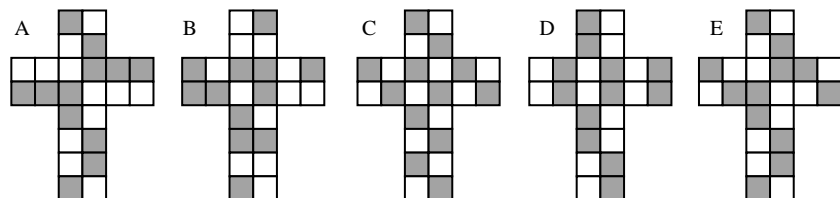
3. Three of the numbers 2, 4, 16, 25, 50, 125 have product 1000. What is the sum of those three numbers?

- A 70                      B 77                      C 131                      D 143                      E 145

4. Which of the following is equal to  $4^{15} + 8^{10}$  ?

- A  $2^{10}$                       B  $2^{15}$                       C  $2^{20}$                       D  $2^{30}$                       E  $2^{31}$

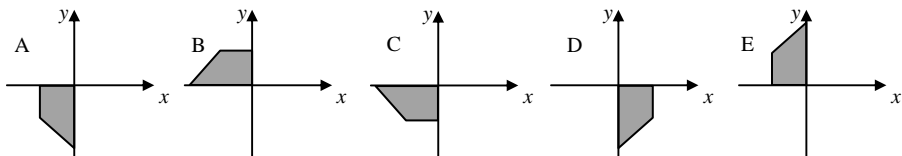
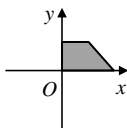
5. The outside of a  $2 \times 2 \times 2$  cube is painted with black and white squares in such a way that it appears as if it was built using alternate black cubes and white cubes, as shown.



6. The number  $n$  is the largest positive integer for which  $4n$  is a 3-digit number, and  $m$  is the smallest positive integer for which  $4m$  is a 3-digit number. What is the value of  $4n - 4m$ ?

- A 900                      B 899                      C 896                      D 225                      E 224

7. The trapezium shown in the diagram is rotated anti-clockwise by  $90^\circ$  around the origin  $O$ , and then reflected in the  $x$ -axis. Which of the following shows the end result of these transformations?

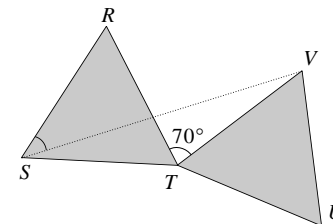


8. Which of the following has the largest value?

- A  $20\sqrt{13}$                       B  $\sqrt{20} \times \sqrt{13}$                       C  $\sqrt{20} \times 13$                       D  $\sqrt{201} \times 3$                       E  $\sqrt{2013}$

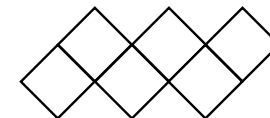
9. The diagram shows an equilateral triangle  $RST$  and also the triangle  $TUV$  obtained by rotating triangle  $RST$  about the point  $T$ . Angle  $RTV = 70^\circ$ . What is angle  $RSV$ ?

- A  $20^\circ$                       B  $25^\circ$                       C  $30^\circ$                       D  $35^\circ$                       E  $40^\circ$



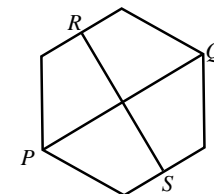
10. The diagram shows a shape made from six squares, each measuring 1 cm by 1 cm. The shape has perimeter of length 14 cm. The zigzag shape is then continued until it has 2013 squares. What is the length, in cm, of the perimeter of the new shape?

- A 2022                      B 4028                      C 4032                      D 6038                      E 8050



11. The points  $P$  and  $Q$  are opposite vertices of a regular hexagon and the points  $R$  and  $S$  are midpoints of opposite edges, as shown. The area of the hexagon is  $60 \text{ cm}^2$ . What is the product of the lengths, in cms, of  $PQ$  and  $RS$ ?

- A 30                      B 60                      C 80                      D 90                      E 120

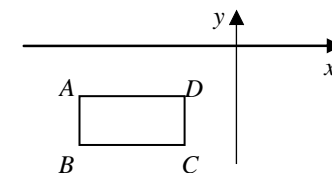


12. A class of students sat a test. If each boy had scored three points more for the test, then the mean score of the class would have been 1.2 points higher. What percentage of the class are girls?

- A 20                      B 30                      C 40                      D 50                      E 60

13. The rectangle  $ABCD$  lies below the  $x$ -axis, and to the left of the  $y$ -axis. The edges of the rectangle are parallel to the coordinate axes. For each point  $A, B, C, D$ , the  $y$ -coordinate is divided by the  $x$ -coordinate. Which of the points yields the smallest value from this calculation?

- A                      B                      C                      D  
E it depends on the size of the rectangle

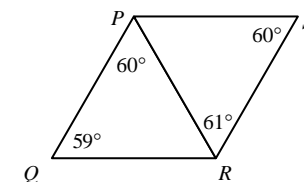


14. On John's birthday this year, he multiplied his age by his son's age and correctly obtained the answer 2013. In which year was John born?

- A 1952                      B 1953                      C 1980                      D 1981                      E 2002

15. In quadrilateral  $PQRS$ ,  $\angle PQR = 59^\circ$ ,  $\angle RPQ = 60^\circ$ ,  $\angle PRS = 61^\circ$  and  $\angle RSP = 60^\circ$ , as shown. Which of the following line segments is the longest?

- A  $PQ$                       B  $PR$                       C  $PS$                       D  $QR$                       E  $RS$



16. Ivana wants to write down all possible lists of five consecutive positive integers with the property that three of the numbers have the same sum as the other two. How many different sets of five numbers could she write down?

- A 1                      B 2                      C 3                      D 4                      E 5