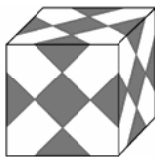


17. The numbers  $x$  and  $y$  are both greater than 1. Which of the following fractions has the greatest value?

A  $\frac{x}{y+1}$       B  $\frac{x}{y-1}$       C  $\frac{2x}{2y+1}$       D  $\frac{2x}{2y-1}$       E  $\frac{3x}{3y+1}$

18. Simone has a cube with sides of length 10 cm, and a pack of identical square stickers. She places one sticker in the centre of each face of the cube, and one across each edge so that the stickers meet at their corners, as shown in the diagram. What is the total area in  $\text{cm}^2$  of the stickers used by Simone?

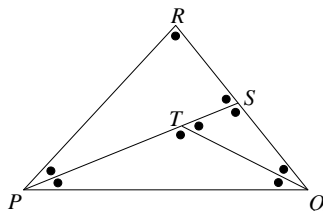


- A 150      B 180      C 200      D 225      E 300

19. Rafael writes down a 5-digit number whose digits are all distinct, and whose first digit is equal to the sum of the other four digits. How many 5-digit numbers with this property are there?

- A 72      B 144      C 168      D 216      E 288

20. In triangle  $PQR$ , a point  $S$  is chosen on the line segment  $QR$ , then a point  $T$  is chosen on the line segment  $PS$ . Considering the nine marked angles, what is the smallest number of different values that these nine angles could take?



- A 2      B 3      C 4      D 5      E 6

21. Xerxes chooses a positive integer  $x$ , and Yasmin chooses a positive integer  $y$ , such that  $\frac{1}{x} + \frac{1}{y} = \frac{1}{3}$ . In how many ways could they choose these numbers?

- A 1      B 2      C 3      D 4      E 5

22.  $C_1$  is a circle of radius  $r$ .  $PQ$  is a chord of this circle.  $C_2$  is a circle with diameter  $PQ$  and which passes through the centre of  $C_1$ . What is the area of the part of the circle  $C_2$  which is outside the circle  $C_1$ ?

- A  $\frac{1}{2}r^2$       B  $\frac{\sqrt{3}\pi}{12}r^2$       C  $\frac{\pi}{6}r^2$       D  $\frac{\sqrt{3}}{4}r^2$       E  $\frac{1}{\sqrt{2}}r^2$

23. Hassan selects four edges of a cube in such a way that none of the edges share a common vertex. How many different ways are there for Hassan to do this?

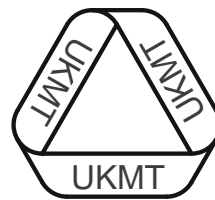
- A 6      B 8      C 9      D 12      E 18

24. Barbara has a new challenge. She places draughts on a  $5 \times 5$  board in such a way that each  $3 \times 3$  square contains exactly  $n$  draughts. No more than one draught is placed in any cell. Given that  $0 < n < 9$ , what are the possible values of  $n$ ?

- A 1      B 1 and 8      C 1, 2, 7 and 8      D 1, 2, 3, 6, 7 and 8  
E All whole numbers 1 to 8 inclusive

25. This morning, the two turtles Tor and Tur multiplied their ages together, correctly obtaining 1188. When they multiply their ages together on this day next year, which of the following will definitely not be a factor of the product?

- A 19      B 21      C 23      D 25      E 27



EUROPEAN 'KANGAROO' MATHEMATICAL CHALLENGE  
'PINK'

Thursday 17th March 2011

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):

- Do not open the paper until the Invigilator tells you to do so.
- Time allowed: **1 hour**.  
No answers, or personal details, may be entered after the allowed hour is over.
- The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
- 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.
- 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.
- 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.
- 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.
- 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.

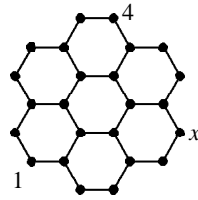
*Enquiries about the European Kangaroo should be sent to: Maths Challenges Office,  
School of Mathematics Satellite, University of Leeds, Leeds, LS2 9JT.  
(Tel. 0113 343 2339)  
<http://www.ukmt.org.uk>*

1. Given that  $P = 2 \times 3 + 3 \times 4 + 4 \times 5$ ,  $Q = 2^2 + 3^2 + 4^2$  and  $R = 1 \times 2 + 2 \times 3 + 3 \times 4$ , which of the following statements is true?

A  $Q < P < R$     B  $P < Q = R$     C  $P < Q < R$     D  $R < Q < P$     E  $Q = P < R$

2. The figure shows a hexagonal lattice. Numbers are to be placed at each of the dots  $\bullet$  in such a way that the sum of the two numbers at the ends of each segment is always the same. Two of the numbers are already given. What number is  $x$ ?

A 1    B 2    C 3    D 4    E 5



3. A rectangular mosaic with area  $360 \text{ cm}^2$  is made from square tiles, all of which are the same size. The mosaic is  $24 \text{ cm}$  high and  $5$  tiles wide. What is the area of each tile in  $\text{cm}^2$ ?

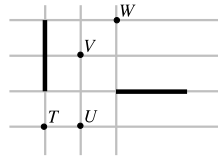
A 1    B 4    C 9    D 16    E 25

4. Tomas writes down all 4-digit numbers whose digits add up to four. If he writes these numbers in descending order, which position will the number 2011 occupy?

A 6th    B 7th    C 8th    D 9th    E 10th

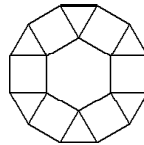
5. One of the line segments shown on the grid is the image produced by a rotation of the other line segment. Which of the points  $T$ ,  $U$ ,  $V$ ,  $W$  could be the centre of such a rotation?

A only  $T$     B only  $U$     C either of  $U$  and  $W$   
D any of  $U$ ,  $V$  and  $W$     E any of  $T$ ,  $U$ ,  $V$  and  $W$



6. The diagram shows a shape made from a regular hexagon of side one unit, six triangles and six squares. What is the perimeter of the shape?

A  $6(1 + \sqrt{2})$     B  $6(1 + \frac{1}{2}\sqrt{3})$     C 12  
D  $6 + 3\sqrt{2}$     E 9



7. Three normal dice are placed one on top of another, with the bottom die standing on a table. Where the two lower dice meet, the spots on the two touching faces add to five; similarly where the two higher dice meet, the spots on the two touching faces add to five. One of the visible faces on the bottom die shows just one spot. How many spots are on the top face of the top die?

A 2    B 3    C 4    D 5    E 6

8. In a certain month last year, there were five Mondays, five Tuesdays and five Wednesdays. In the month before there had been exactly four Sundays. Which of the following were included in the month after?

A exactly four Fridays    B exactly four Saturdays    C exactly five Wednesdays  
D exactly five Saturdays    E exactly five Sundays

9. Michael, Fernando and Sebastian had a race. Immediately after the start Michael was in the lead with Fernando second and Sebastian last. During the race Michael overtook, or was overtaken by Fernando a total of 9 times; similarly Fernando and Sebastian interchanged places 10 times, and Michael and Sebastian interchanged places 11 times. In what order, first to last, did they finish?

A Michael, Fernando, Sebastian    B Fernando, Sebastian, Michael  
C Sebastian, Michael, Fernando    D Sebastian, Fernando, Michael  
E Fernando, Michael, Sebastian

10. Given that  $9^n + 9^n + 9^n = 3^{2011}$ , what is the value of  $n$ ?

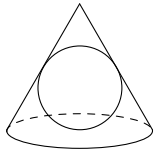
A 1005    B 1006    C 2010    D 2011    E 6033

11. Ulf has two cubes, with sides of length  $a \text{ cm}$  and  $a + 1 \text{ cm}$ . The larger cube is full of water and the smaller cube is empty. Ulf now fills the smaller cube with water from the larger cube, leaving  $217 \text{ ml}$  in the larger cube. How much water is then in the smaller cube, in  $\text{ml}$ ?

A 125    B 243    C 512    D 729    E 1331

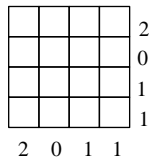
12. A marble with radius  $15 \text{ cm}$  fits exactly under a cone as shown in the diagram. The slant height of the cone is equal to the diameter of its base. What is the height of the cone in  $\text{cm}$ ?

A 45    B  $25\sqrt{3}$     C  $30\sqrt{2}$     D 60    E  $60(\sqrt{3} - 1)$



13. Barbara wants to place draughts on a  $4 \times 4$  board in such a way that the number of draughts in each row is equal to the number shown at the end of the row, and the number of draughts in each column is equal to the number shown at the bottom of the column. No more than one draught is to be placed in any cell. In how many ways can this be done?

A 1    B 2    C 3    D 4    E 5



14. How many numbers appear in the longest run of consecutive 3-digit numbers each of which has at least one odd digit?

A 1    B 10    C 100    D 110    E 111

15. Nik wants to write integers in the cells of a  $3 \times 3$  table so that the sum of the numbers in any  $2 \times 2$  square is 10. He has already written five numbers in the table as shown. What is the sum of the four missing numbers?

A 9    B 10    C 11    D 12    E 13

1		0
	2	
4		3

16. During a rough sailing trip, Jacques tried to sketch a map of his village. He managed to draw the four streets where they cross and the houses of his friends. The houses are marked on the correct streets, and the intersections are correct, however, in reality, Arrow Street, Nail Street and Ruler Street are all absolutely straight. The fourth street is Curvy Street. Who lives on Curvy Street?

A Adeline    B Benjamin    C Carole  
D David    E It is impossible to tell without a better map

