UK JUNIOR MATHEMATICAL CHALLENGE

THURSDAY 1st MAY 2008

Organised by the **United Kingdom Mathematics Trust**
from the School of Mathematics, University of Leeds

The Actuarial Profession
making financial sense of the future

**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 8 or below.
   Candidates in Scotland must be in S2 or below.
   Candidates in Northern Ireland must be in School Year 9 or below.

5. **Use B or HB pencil only**. Mark *at most one* of the options A, B, C, D, E on the
   Answer Sheet for each question. Do not mark more than one option.

6. *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.

7. Five marks are awarded for each correct answer to Questions 1-15.
   Six marks are awarded for each correct answer to Questions 16-25.
   Each incorrect answer to Questions 16-20 loses 1 mark.
   Each incorrect answer to Questions 21-25 loses 2 marks.

8. Your Answer Sheet will be read only by a *dumb machine*. **Do not write or doodle on the
   sheet except to mark your chosen options**. The machine 'sees' all black pencil markings
   even if they are in the wrong places. If you mark the sheet in the wrong place, or leave bits of
   rubber stuck to the page, the machine will 'see' a mark and interpret this mark in its own way.

9. 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.
   The UK JMC is about solving interesting problems, not about lucky guessing.

1. Which of these calculations produces a multiple of 5?

   A $1 \times 2 + 3 + 4$ B $1 + 2 \times 3 + 4$ C $1 \times 2 + 3 \times 4$ D $1 + 2 \times 3 \times 4$ E $1 \times 2 \times 3 \times 4$

2. Which of these diagrams could be drawn without taking the pen off the page and without drawing along a line already drawn?
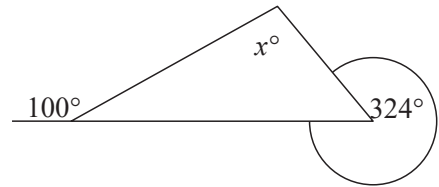
   A   B   C   D   E
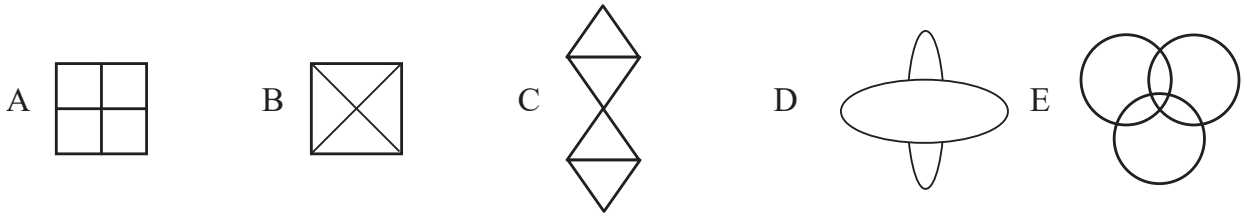
3. All of the Forty Thieves were light-fingered, but only two of them were caught red-handed. What percentage is that?

   A 2   B 5   C 10   D 20   E 50

4. In this diagram, what is the value of x?

   A 16   B 36   C 64   D 100   E 144

5. At Spuds-R-Us, a 2.5kg bag of potatoes costs £1.25. How much would one tonne of potatoes cost?

   A £5   B £20   C £50   D £200   E £500

6. The diagram shows a single floor tile in which the outer square has side 8cm and the inner square has side 6cm. If Adam Ant walks once around the perimeter of the inner square and Annabel Ant walks once around the perimeter of the outer square, how much further does Annabel walk than Adam?
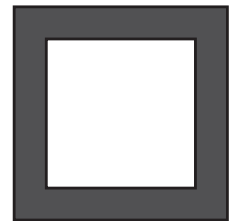
   A 2 cm   B 4 cm   C 6 cm   D 8 cm   E 16 cm

7. King Harry's arm is twice as long as his forearm, which is twice as long as his hand, which is twice as long as his middle finger, which is twice as long as his thumb. His new bed is as long as four arms. How many thumbs length is that?

   A 16   B 32   C 64   D 128   E 256

8. The shape on the right is made up of three rectangles, each measuring 3cm by 1cm. What is the perimeter of the shape?
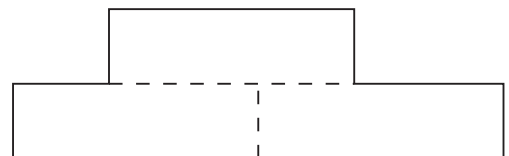
   A 16 cm   B 18 cm   C 20 cm   D 24 cm   E More information needed

9. Which of the following has the smallest value?

   A $\dfrac{1}{2} - \dfrac{1}{3}$ B $\dfrac{1}{3} - \dfrac{1}{4}$ C $\dfrac{1}{4} - \dfrac{1}{5}$ D $\dfrac{1}{5} - \dfrac{1}{6}$ E $\dfrac{1}{6} - \dfrac{1}{7}$

10. The faces of a cube are painted so that any two faces which have an edge in common are painted different colours. What is the smallest number of colours required?

A 2   B 3   C 4   D 5   E 6

11. In 1833 a ship arrived in Calcutta with 120 tons remaining of its cargo of ice. One third of the original cargo was lost because it had melted on the voyage. How many tons of ice was the ship carrying when it set sail?

A 40   B 80   C 120   D 150   E 180

12. The sculpture 'Cubo Vazado' [Emptied Cube] by the Brazilian artist Franz Weissmann is formed by removing cubical blocks from a solid cube to leave the symmetrical shape shown.
If all the edges have length 1, 2 or 3, what is the volume of the sculpture?

A 9   B 11   C 12   D 14   E 18
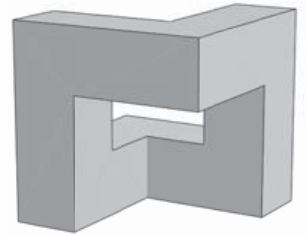
13. A rectangle $PQRS$ is cut into two pieces along PX, where $PX = XR$ and $PS = SX$ as shown. The two pieces are reassembled without turning either piece over, by matching two edges of equal length. Not counting the original rectangle, how many different shapes are possible?

A 1   B 2   C 3   D 4   E 5
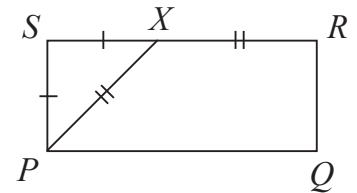
14. A solid wooden cube is painted blue on the outside. The cube is then cut into eight smaller cubes of equal size. What fraction of the total surface area of these new cubes is blue?

A $\dfrac{1}{8}$ B $\dfrac{1}{3}$ C $\dfrac{3}{8}$ D $\dfrac{1}{2}$ E $\dfrac{3}{4}$

15. An active sphagnum bog deposits a depth of about 1 metre of peat per 1000 years. Roughly how many millimetres is that per day?

A 0.0003   B 0.003   C 0.03   D 0.3   E 3

16. The figures below are all drawn to scale. Which figure would result from repeatedly following the instructions in the box on the right?

A   B   C   D   E
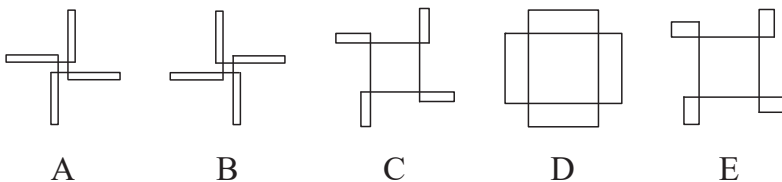
> Move forward 2 units.
> Turn right.
> Move forward 15 units.
> Turn right.
> Move forward 20 units.
> Turn right.

17. In this *Multiplication Magic Square*, the **product** of the three numbers in each row, each column and each of the diagonals is 1. What is the value of $r + s$?

p	q	r
s	1	t
u	4	$\frac{1}{8}$

A $\dfrac{1}{2}$ B $\dfrac{9}{16}$ C $\dfrac{5}{4}$ D $\dfrac{33}{16}$ E 24
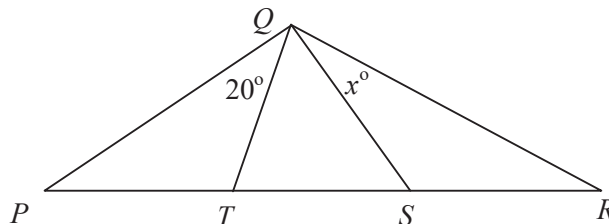
18. Granny swears that she is getting younger. She has calculated that she is four times as old as I am now, but remembers that 5 years ago she was five times as old as I was at that time. What is the sum of our ages now?

A 95   B 100   C 105   D 110   E 115

19. In the diagram on the right, $PT = QT = TS$, $QS = SR$, $\angle PQT = 20°$. What is the value of x?

A 20   B 25   C 30   D 35   E 40

20. If all the whole numbers from 1 to 1000 inclusive are written down, which digit appears the smallest number of times?
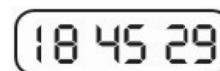
A 0   B 2   C 5   D 9   E none: no single digit appears fewer times than all the others

21. What is the value of ♥ if each row and each column has the total given?

			Total
♥	☼	♫	12
♫	♥	♥	11
☼	☼	♫	13
Total 12	11	13	

A 3   B 4   C 5   D 6   E more information needed

22. On a digital clock displaying hours, minutes and seconds, how many times in each 24-hour period do all six digits change simultaneously?

A 0   B 1   C 2   D 3   E 24

23. In a 7-digit numerical code each group of four adjacent digits adds to 16 and each group of five adjacent digits adds to 19. What is the sum of all seven digits?

A 21   B 25   C 28   D 32   E 35

24. The list 2, 1; 3, 2; 2, 3; 1, 4; describes itself, since there are two 1s, three 2s, two 3s and one 4. There is exactly one other list of eight numbers containing only the numbers 1, 2, 3, and 4 that, in the same way, describes the numbers of 1s, 2s, 3s and 4s in that order. What is the total number of 1s and 3s in this other list?

A 2   B 3   C 4   D 5   E 6

25. A large square is divided into adjacent pairs of smaller squares with integer sides, as shown in the diagram (which is not drawn to scale). Each size of smaller square occurs only twice. The shaded square has sides of length 10. What is the area of the large square?

A 1024   B 1089   C 1156   D 1296   E 1444