UK JUNIOR MATHEMATICAL CHALLENGE

TUESDAY 30th APRIL 2002

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

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.

The UKMT is a registered charity

1. What is 2002×5?

    A 10 010   B 100 010   C 100 100   D 10 100   E 100 001

2. Which of the following statements is false?

    A $3 + 5 \times 4 = 23$ B $20 - 5 \times 4 = 0$ C $12 - 5 \times 2 = 2$ D $3 + 6 \times 4 = 36$ E $5 \times 3 - 2 = 13$

3. Which of the following has the biggest value?

    A 1/2 of 24   B 1/3 of 36   C 1/4 of 60   D 1/5 of 50   E 1/6 of 84

4. The diagram shows a square drawn inside an equilateral triangle.
    What is the size of angle JMC?

    A 90°   B 60°   C 45°   D 30°   E 15°
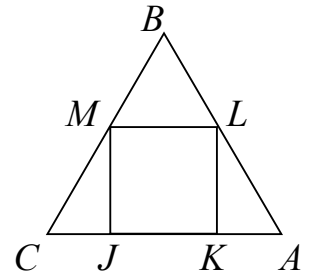
5. How many of the following numbers are multiples of 5?

    A 1   B 2   C 3   D 4   E 5

6. What is the value of $101 + 2002 + 30003 + 400004 + 5000005$?

    A 5432115   B 15012345   C 5432345   D 5234325   E 54321012345

7. The sum of seven, single-digit positive whole numbers is 17. Six of these numbers are equal, so what is the other number?

    A 1   B 3   C 5   D 7   E 9

8. The diagram shows two circles enclosed in a rectangle measuring 9 cm × 5 cm.
   What is the distance between the centres of the circles?

   A 2 cm   B 2.5 cm   C 3 cm   D 3.5 cm   E 4 cm
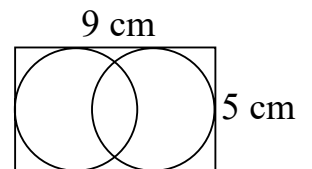
9. Lisa's bucket does not have a hole in it and weighs 21 kg when full of water. After she pours out half the water from the bucket, it weighs 12 kg. What is the weight of the empty bucket?

    A 1 kg   B 2 kg   C 3 kg   D 4 kg   E 5 kg

10. On the island of Erewhon, all numbers are written with the digits in reverse order. For example, twelve is written 21. Su Erasmus, an inhabitant of Erewhon, was shown the subtraction $729 - 45$. If no mistake was made, what answer did Su write down?

    A 684   B 486   C 279   D 873   E 378

11. The Pythagoras School of Music has 100 students. Of these, 60 are in the band and 20 are in the orchestra. Given that 12 students are in both the band and the orchestra, how many are in neither the band nor the orchestra?

    A 8   B 20   C 24   D 28   E 32

12. My rabbit Nibbles lives in a movable pen and helps to keep the grass short. The pen is rectangular and measures 3 m by 2 m, as shown in the diagram, where the arrow indicates North. On successive days, the pen is moved 1 m East, 2 m South, 1 m West and 2 m North. What is the total area, in square metres, of the region of grass which Nibbles can nibble?

2 m

N

3 m
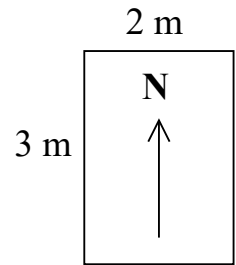
A 6 B 12 C 15 D 18 E 24

13. The number 2002 is a *palindrome*, since it reads the same forwards and backwards. For how many other years this century will the number of the year be a palindrome?

A none B 1 C 9 D 81 E 90

14. The diagram shows four empty glasses with their bases at the bottom. One move consists of turning exactly three of the four glasses upside-down. What is the smallest number of moves needed before all of the glasses have their bases at the top?

A 3 B 4 C 7 D 11 E 13

15. In which of the following lists are the terms *not* increasing?

A $\frac{1}{5}, 0.25, \frac{3}{10}, 0.5$ B $\frac{3}{5}, 0.7, \frac{4}{5}, 1.5$ C $\frac{2}{5}, 0.5, \frac{7}{10}, 0.9$

D $\frac{3}{5}, 0.5, \frac{4}{5}, 0.9$ E $\frac{2}{5}, 1.5, \frac{10}{5}, 2.3$
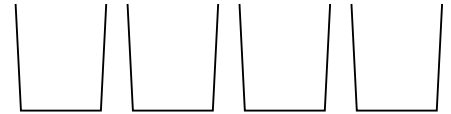
16. The diagram shows a poster which Beatrix has (this way up!) on her wall. When Beatrix was standing on her head, looking in a mirror on the opposite wall at the poster on the wall behind her, how many letters could still be read in the normal way?

FUN BEATRIX

A 2 B 3 C 4 D 5 E 7

17. 5p, 2p and 1p coins (or a mixture of any or all of these) are used to make a total of 11p. In how many different ways can this be done?

A 13 B 11 C 9 D 6 E 3

18. A square piece of paper measuring 16 × 16 is folded in half twice. Then pieces are removed by cutting through all the resulting layers, leaving the shape shown. When the paper is unfolded, how many square holes are in it?

fold   fold

fold

fold
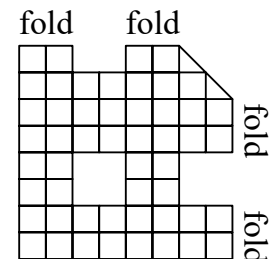
A 1 B 2 C 6 D 7 E 9

19. The number of diagonals of a regular polygon equals twice the number of sides. How many sides has the polygon?

A 4 B 5 C 6 D 7 E 8

20. Sally has 72 small wooden cubes, each measuring 1 cm × 1 cm × 1 cm. She arranges them all so that they form a cuboid. Given that the perimeter of the base of the cuboid is 16 cm, what is its height?

A 4 cm   B 6 cm   C 8 cm   D 9 cm   E 12 cm

21.
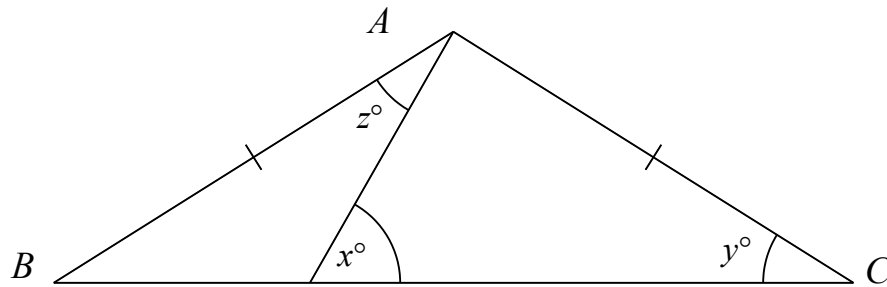
Given that $AB = AC$ and $z < 90$, which of the following expressions must equal z?

A $x - y$ B $x + y$ C $x + y - 180$ D $180 + x - y$ E $180 - x + y$

22. When 26 is divided by a positive integer N, the remainder is 2. What is the sum of all the possible values of N?

A 21   B 33   C 45   D 57   E 70

23. The diagram shows a circle with circumference 1 being rolled around an equilateral triangle with sides of length 1. How many complete turns does the circle make as it rolls once around the triangle without slipping?
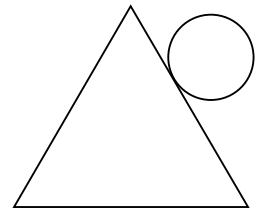
A 3   B $3\frac{1}{2}$ C 4   D 5   E $5\frac{1}{2}$

24. In the multiplication

$$\begin{array}{r} AB \\ \times\ C \\ \hline DE \end{array}$$

each letter represents a different digit and only the digits 1, 2, 3, 4, 5 are used. Which of the letters represents 2 ?

A   B   C   D   E

25. Gill sat the JMC last year, when the scoring system used was the same as this year's system. She answered all the questions she did correctly. The first question took her 1 second, question 2 took her 2 seconds, question 3 took her 4 seconds and so on, the time doubling for each question. What was Gill's score?

A 30   B 55   C 60   D 125   E 135