

UK JUNIOR MATHEMATICAL CHALLENGE

FRIDAY 6th MAY 2011

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)

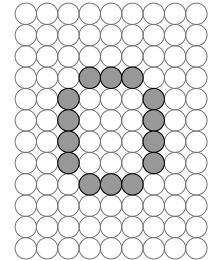
1. Do not open the paper until the Invigilator tells you to do so.
2. Time allowed: **1 hour**.
No answers, or personal details, may be entered after the allowed hour is over.
3. The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
4. Candidates in England and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

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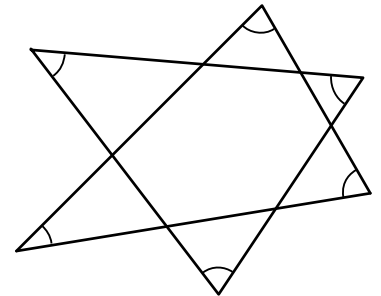
- What is the value of $2 \times 0 \times 1 + 1$?
 A 0 B 1 C 2 D 3 E 4
- How many of the integers 123, 234, 345, 456, 567 are multiples of 3?
 A 1 B 2 C 3 D 4 E 5

- A train display shows letters by lighting cells in a grid, such as the letter 'o' shown. A letter is made **bold** by also lighting any unlit cell immediately to the right of one in the normal letter. How many cells are lit in a **bold** 'o'?
 A 22 B 24 C 26 D 28 E 30



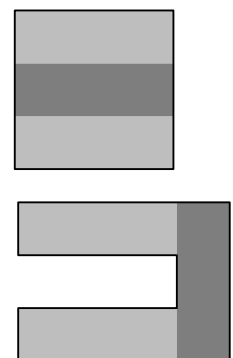
- The world's largest coin, made by the Royal Mint of Canada, was auctioned in June 2010. The coin has mass 100 kg, whereas a standard British £1 coin has mass 10 g. What sum of money in £1 coins has the same mass as the record-breaking coin?
 A £100 B £1000 C £10 000 D £100 000 E £1 000 000
- All old Mother Hubbard had in her cupboard was a Giant Bear chocolate bar. She gave each of her children one-twelfth of the chocolate bar. One third of the bar was left. How many children did she have?
 A 6 B 8 C 12 D 15 E 18

- What is the sum of the marked angles in the diagram?
 A 90° B 180° C 240° D 300° E 360°



- Peter Piper picked a peck of pickled peppers. $1 \text{ peck} = \frac{1}{4} \text{ bushel}$ and $1 \text{ bushel} = \frac{1}{9} \text{ barrel}$. How many **more** pecks must Peter Piper pick to fill a barrel?
 A 12 B 13 C 34 D 35 E 36

- A square is divided into three congruent rectangles. The middle rectangle is removed and replaced on the side of the original square to form an octagon as shown. What is the ratio of the length of the perimeter of the square to the length of the perimeter of the octagon?



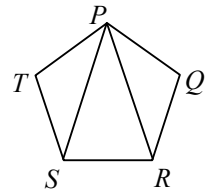
- A 3:5 B 2:3 C 5:8 D 1:2 E 1:1

9. What is the smallest possible difference between two different nine-digit integers, each of which includes all of the digits 1 to 9?

- A 9 B 18 C 27 D 36 E 45

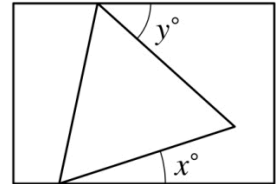
10. You want to draw the shape on the right without taking your pen off the paper and without going over any line more than once. Where should you start?

- A only at T or Q B only at P C only at S or R
 D at any point E the task is impossible



11. The diagram shows an equilateral triangle inside a rectangle. What is the value of $x + y$?

- A 30 B 45 C 60 D 75 E 90



12. If $\blacktriangle + \blacktriangle = \blacksquare$ and $\blacksquare + \blacktriangle = \bullet$ and $\blacklozenge = \bullet + \blacksquare + \blacktriangle$, how many \blacktriangle s are equal to \blacklozenge ?

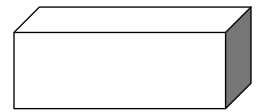
- A 2 B 3 C 4 D 5 E 6

13. What is the mean of $\frac{2}{3}$ and $\frac{4}{9}$?

- A $\frac{1}{2}$ B $\frac{2}{9}$ C $\frac{7}{9}$ D $\frac{3}{4}$ E $\frac{5}{9}$

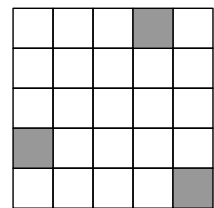
14. The diagram shows a cuboid in which the area of the shaded face is one-quarter of the area of each of the two visible unshaded faces. The total surface area of the cuboid is 72 cm^2 . What, in cm^2 , is the area of one of the visible unshaded faces of the cuboid?

- A 16 B 28.8 C 32 D 36 E 48



15. What is the smallest number of *additional* squares which must be shaded so that this figure has at least one line of symmetry *and* rotational symmetry of order 2?

- A 3 B 5 C 7 D 9 E more than 9



16. The pupils in Year 8 are holding a mock election. A candidate receiving more votes than any other wins. The four candidates receive 83 votes between them. What is the smallest number of votes the winner could receive?

- A 21 B 22 C 23 D 41 E 42

17. Last year's match at Wimbledon between John Isner and Nicolas Mahut, which lasted 11 hours and 5 minutes, set a record for the longest match in tennis history. The fifth set of the match lasted 8 hours and 11 minutes.

Approximately what fraction of the whole match was taken up by the fifth set?

- A $\frac{1}{5}$ B $\frac{2}{5}$ C $\frac{3}{5}$ D $\frac{3}{4}$ E $\frac{9}{10}$

18. Peri the winkle leaves on Monday to go and visit Granny, 90m away. Except for rest days, Peri travels 1m each day (24-hour period) at a constant rate and without pause. However, Peri stops for a 24-hour rest every tenth day, that is, after every nine days' travelling. On which day of the week does Peri arrive at Granny's?

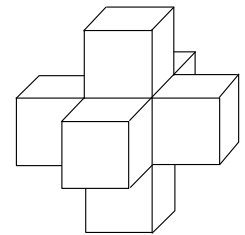
A Sunday B Monday C Tuesday D Wednesday E Thursday

19. A list is made of every digit that is the units digit of at least one prime number. How many of the following numbers appear in the list?

A 1 B 2 C 3 D 4 E 5

20. One cube has each of its faces covered by one face of an identical cube, making a solid as shown. The volume of the solid is 875 cm^3 . What, in cm^2 , is the surface area of the solid?

A 750 B 800 C 875 D 900 E 1050



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21. Gill leaves Lille by train at 09:00. The train travels the first 27 km at 96 km/h. It then stops at Lens for 3 minutes before travelling the final 29 km to Lillers at 96 km/h. At what time does Gill arrive at Lillers?

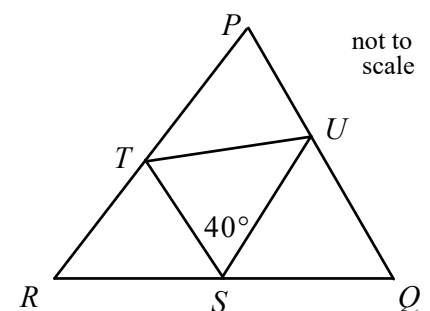
A 09:35 B 09:38 C 09:40 D 09:41 E 09:43

22. Last week Evariste and Sophie both bought some stamps for their collections. Each stamp Evariste bought cost him £1.10, whilst Sophie paid 70p for each of her stamps. Between them they spent exactly £10. How many stamps did they buy in total?

A 9 B 10 C 11 D 12 E 13

23. The points S , T , U lie on the sides of the triangle PQR , as shown, so that $QS = QU$ and $RS = RT$. $\angle TSU = 40^\circ$. What is the size of $\angle TPU$?

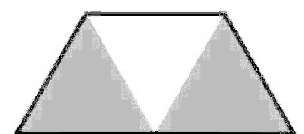
A 60° B 70° C 80° D 90° E 100°



24. Two adults and two children wish to cross a river. They make a raft but it will carry only the weight of one adult or two children. What is the minimum number of times the raft must cross the river to get all four people to the other side? (N.B. The raft may not cross the river without at least one person on board.)

A 3 B 5 C 7 D 9 E 11

25. The diagram shows a trapezium made from three equilateral triangles. Three copies of the trapezium are placed together, without gaps or overlaps and so that only complete edges coincide, to form a polygon with N sides.



How many different values of N are possible?

A 4 B 5 C 6 D 7 E 8