UK JUNIOR MATHEMATICAL CHALLENGE

THURSDAY 27th APRIL 2017

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

Institute and Faculty of Actuaries

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 non-propelling 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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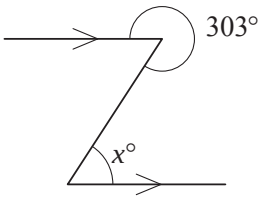
1. Which of the following calculations gives the largest answer?

A $2 - 1$ B $2 \div 1$ C 2×1 D 1×2 E $2 + 1$

2. Nadiya is baking a cake. The recipe says that her cake should be baked in the oven for 1 hour and 35 minutes. She puts the cake in the oven at 11:40 am. At what time should she take the cake out of the oven?

A 12:15 pm B 12:40 pm C 1:05 pm D 1:15 pm E 2:15 pm

3. What is the value of x ?



A 43 B 47 C 53 D 57 E 67

4. A download is 95% complete. What fraction is yet to be downloaded?

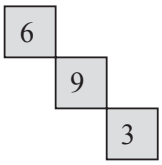
A $\frac{1}{2}$ B $\frac{1}{5}$ C $\frac{1}{9}$ D $\frac{1}{10}$ E $\frac{1}{20}$

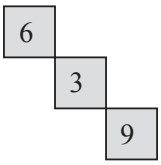
5. What is the value of $201 \times 7 - 7 \times 102$?

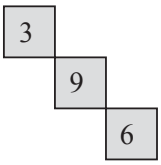
A 142 800 B 793 C 693 D 607 E 0

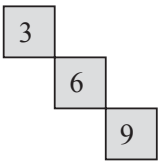
6. In a magic square, the numbers in each row, each column and the two main diagonals have the same total. This magic square uses the integers 2 to 10. Which of the following are the missing cells?

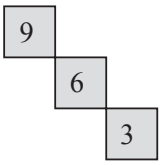
	10	5
8		4
7	2	

A 

B 

C 

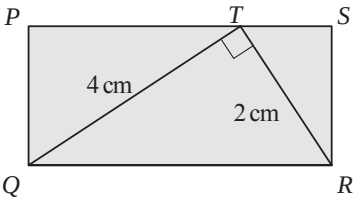
D 

E 

7. If you work out the values of the following expressions and then place them in increasing numerical order, which comes in the middle?

A $\frac{2}{3} + \frac{4}{5}$ B $\frac{2}{3} \times \frac{4}{5}$ C $\frac{3}{2} + \frac{5}{4}$ D $\frac{2}{3} \div \frac{4}{5}$ E $\frac{3}{2} \times \frac{5}{4}$

8. The diagram shows a rectangle $PQRS$ and T is a point on PS such that QT is perpendicular to RT. The length of QT is 4 cm. The length of RT is 2 cm.



What is the area of the rectangle $PQRS$?

A 6 cm^2 B 8 cm^2 C 10 cm^2 D 12 cm^2 E 16 cm^2

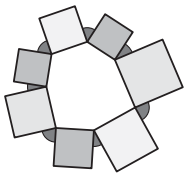
9. In William Shakespeare's play *As You Like It*, Rosalind speaks to Orlando about "He that will divide a minute into a thousand parts".
Which of the following is equal to the number of seconds in one thousandth of one minute?

A 0.24 B 0.6 C 0.024 D 0.06 E 0.006

10. Which of the following integers is not a multiple of 45?

A 765 B 675 C 585 D 495 E 305

11. Seven squares are drawn on the sides of a heptagon so that they are outside the heptagon, as shown in the diagram.



What is the sum of the seven marked angles?

A 315° B 360° C 420° D 450° E 630°

12. Last year, at the school where Gill teaches Mathematics, 315 out of the 600 pupils were girls. This year, the number of pupils in the school has increased to 640. The proportion of girls is the same as it was last year.

How many girls are there at the school this year?

A 339 B 338 C 337 D 336 E 335

13. Consider the following three statements.

(i) Doubling a positive number always makes it larger.

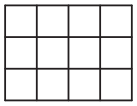
(ii) Squaring a positive number always makes it larger.

(iii) Taking the positive square root of a positive number always makes it smaller.

Which statements are true?

A All three B None C Only (i) D (i) and (ii) E (ii) and (iii)

14. Mathias is given a grid of twelve small squares. He is asked to shade grey exactly four of the small squares so that his grid has two lines of reflection symmetry.



How many different grids could he produce?

A 2 B 3 C 4 D 5 E 6

15. What is the remainder when the square of 49 is divided by the square root of 49?

A 0 B 2 C 3 D 4 E 7

16. In New Threeland there are three types of coins: the 2p; the 5p; and one other. The smallest number of coins needed to make 13p is three. The smallest number of coins needed to make 19p is three. What is the value of the third type of coin?

A 4p B 6p C 7p D 9p E 12p

17. I add up all even numbers between 1 and 101. Then from my total I subtract all odd numbers between 0 and 100.

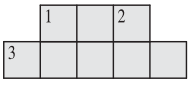
What is the result?

A 0 B 50 C 100 D 255 E 2525

18. What is the sum of the digits in the completed crossnumber?

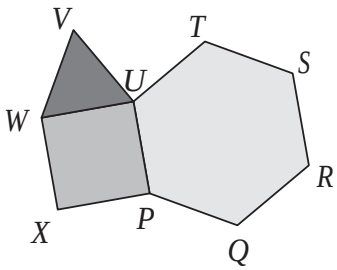
ACROSS
1. A cube
3. A power of 11

DOWN
2. A square



A 25 B 29 C 32 D 34 E 35

19. The diagram shows a regular hexagon $PQRSTU$, a square $PUWX$ and an equilateral triangle UVW.



What is the angle TVU ?

A 45° B 42° C 39° D 36° E 33°

20. The range of a list of integers is 20, and the median is 17.
What is the smallest possible number of integers in the list?

A 1 B 2 C 3 D 4 E 5

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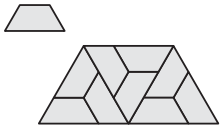
21. The small trapezium on the right has three equal sides and angles of 60° and 120°. Nine copies of this trapezium can be placed together to make a larger version of it, as shown.



The larger trapezium has perimeter 18 cm.
What is the perimeter of the smaller trapezium?

A 2 cm B 4 cm C 6 cm D 8 cm E 9 cm

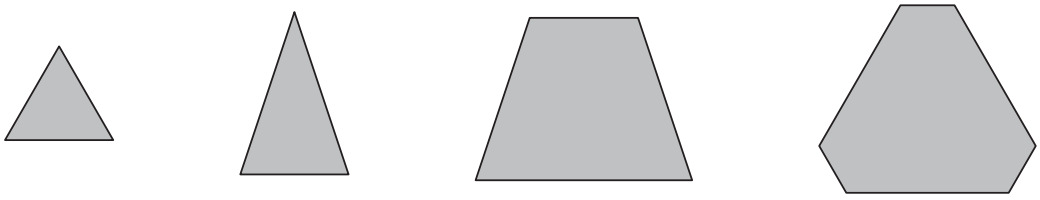
22. In the window of Bradley's Bicycle Bazaar there are some unicycles, some bicycles and some tricycles. Laura sees that there are seven saddles in total, thirteen wheels in total and more bicycles than tricycles.
How many unicycles are in the window?

A 1 B 2 C 3 D 4 E 5

23. The positive integers from 1 to 150 inclusive are placed in a 10 by 15 grid so that each cell contains exactly one integer. Then the multiples of 3 are given a red mark, the multiples of 5 are given a blue mark, and the multiples of 7 are given a green mark.
How many cells have more than 1 mark?

A 10 B 12 C 15 D 18 E 19

24. A large solid cube is cut into two pieces by a single plane cut. How many of the following four shapes could be the shape of the cross-section formed by the cut?



A 0 B 1 C 2 D 3 E 4

25. The distance between Exeter and London is 175 miles. Sam left Exeter at 10:00 on Tuesday for London. Morgan left London for Exeter at 13:00 the same day. They travelled on the same road. Up to the time when they met, Sam's average speed was 25 miles per hour, and Morgan's average speed was 35 miles an hour.
At what time did Sam and Morgan meet?

A 17:00 B 15:55 C 15:30 D 15:00 E 14:40