UK Maths Trust

Senior Mathematical Challenge

Wednesday 7 October 2026

Organised by the United Kingdom Mathematics Trust

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Candidates must be full-time students at secondary school or FE college.
England & Wales: Year 13 or below | Scotland: S6 or below | Northern Ireland: Year 14 or below

Instructions

1. Do not open the paper until the invigilator tells you to do so.
2. Time allowed: **90 minutes**. No answers may be entered after the allowed time is over.
3. The use of blank paper for rough working is allowed; **squared paper, calculators and measuring instruments are forbidden**.
4. **Use a B or an HB non-propelling pencil**. For questions 1 to 22, mark at most one of the options, A, B, C, D, or E, on the Answer Sheet for each question. For questions 23 to 25, your answer will be a three-digit integer. Mark each of those three digits as shown in the example on the Answer Sheet.
5. **Do not expect to finish the whole paper in the time allowed**. The questions in this paper have been arranged in approximate order of difficulty with the harder questions towards the end. You are not expected to complete all the questions during the time. You should bear this in mind when deciding which questions to tackle.
6. **The questions on this paper are designed to challenge you to think, not to guess**. You will gain more satisfaction by doing one question carefully than by guessing lots of answers. This paper is about solving interesting problems, not about lucky guessing.
7. **Scoring rules**: All candidates start with 25 marks; 0 marks are awarded for each question left unanswered; 4 marks are awarded for each correct answer; 1 mark is deducted for each incorrect answer (to discourage guessing).
8. **Your Answer Sheet will be read by a machine**. Do not write or doodle on the sheet except to mark your chosen options. If you mark the sheet in the wrong place, doodle, or leave bits of eraser stuck to the page, the machine will interpret the mark in its own way, or reject the answer sheet.
9. To accommodate candidates sitting at other times, please do not discuss the paper on the internet until 08:00 BST on Friday 9th October, when the solutions video will be released at ukmt.org.uk/video-solutions-list. Candidates in time zones more than 2 hours ahead of GMT must sit the paper on Thursday 8th October (as defined locally).

Enquiries about the Senior Mathematical Challenge should be sent to:

challenges@ukmt.org.uk *www.ukmt.org.uk*

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1. What is the product of two numbers whose sum is 20 and whose difference is 26?

A 6 B 46 C 12 D -46 E -69

2. Alana buys 4 apples and 5 pears for £3.20. At the same prices, 5 apples and 4 pears cost £3.10.

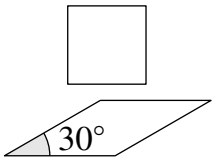
What is the total cost of one apple and one pear?

A 50p B 60p C 70p D 80p E 90p

3. The square and the rhombus with interior angle of 30° have the same area.

What is the ratio of the side-length of the square to the side-length of the rhombus?

A 1 : 1 B 1 : $\sqrt{2}$ C $\sqrt{3}$: 2 D 2 : 3 E 1 : 2



4. $2^x = \sqrt{4\sqrt{4\sqrt{4}}}$. What is the value of x?

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

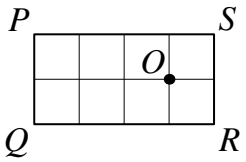
5. A sequence of numbers has the property that for every positive integer n, the mean of the first n terms of the sequence is $\frac{1}{n}$.

What is the 1000th term of this sequence?

A 0 B $\frac{1}{999}$ C $\frac{1}{1000}$ D $\frac{1}{1001}$ E $\frac{1}{1000000}$

6. Rectangle $PQRS$ is made from eight 1 by 1 squares as shown in the diagram. At point O, four of those squares meet. The rectangle is rotated through 180° about point O. Point P travels k times as far as point R during that rotation.

What is the value of k?



A $\sqrt{2}$ B $\sqrt{3}$ C 2 D $\sqrt{5}$ E $\sqrt{6}$

7. A bag contains 50 yellow and 25 purple beads which are to be arranged into five groups of 15.

What is the largest possible number of the groups having more purple than yellow beads?

A 0 B 1 C 2 D 3 E 4

8. The number N is the largest 10-digit integer, all of whose digits are different, which is divisible by 7.

What is the remainder when N is divided by 10?

A 0 B 1 C 2 D 3 E 4

9. A string of letters is created by applying the following rule in each iteration: Any 'a' is replaced by 'ab', and any 'b' is replaced by letter 'a'. Alison writes down letter 'a' in line 1, then she applies the rule and writes down 'ab' in line 2, and 'aba' in line 3.

How many 'a's will appear in line 10 if Alison keeps applying the same rule correctly?

A 34 B 55 C 64 D 89 E 128

10. How many seven-digit numbers are there such that each digit is either 4, 5 or 6 and each pair of adjacent digits differ by 1?

A 12 B 18 C 24 D 30 E 32

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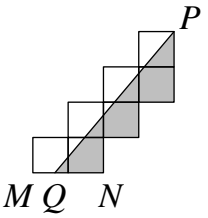
11. Seven squares of unit length are aligned edge-to-edge as shown. A straight line is drawn from P to Q, where Q is the point on the line MN such that the shaded area formed is half the total area of the seven squares.



What is the ratio $MQ : QN$?

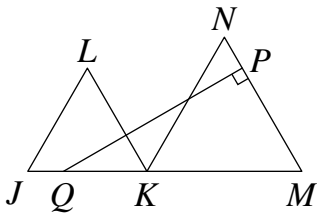
A 1 : 2 B 2 : 3 C 3 : 5 D 5 : 8 E 8 : 13

12. A cube has a dot at each vertex, at the midpoint of each edge and at the midpoint of each face.

How many straight lines can pass through exactly 3 dots?

A 24 B 36 C 48 D 60 E 72

13. JKL and KMN are equilateral triangles with side-lengths 20 and 26 respectively. Points J, K and M lie on a straight line. Points P on NM, and Q on JK, are such that JQ and NP have the same length and QPM is a right angle. The length of PQ is $t\sqrt{3}$.



What is the value of t?

A 24 B 23 C 22 D 21 E 20

14. Consider the possible expressions formed when each □ is filled with a + or a − sign in $\square\frac{1}{1}\square\frac{1}{2}\square\frac{1}{3}\square\frac{1}{4}\square\frac{1}{5}\square\frac{1}{6}$.

For example, $-\frac{1}{1}+\frac{1}{2}-\frac{1}{3}-\frac{1}{4}+\frac{1}{5}+\frac{1}{6}$ which has value $-\frac{43}{60}$ is one of the 2^6 possible expressions.

Among these expressions, what is the smallest possible positive value?

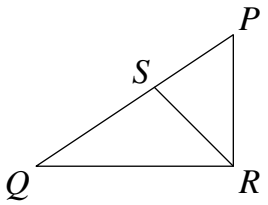
A $\frac{1}{60}$ B $\frac{1}{30}$ C $\frac{1}{20}$ D $\frac{1}{10}$ E $\frac{1}{5}$

15. The mean of n numbers is n, $n > 2$. One of the numbers is $4n$ and another is $n - 6$. The other numbers are all equal to k.

Which of these expressions gives k in terms of n?

A $n - 3$ B $n - \frac{5}{2}$ C $n - 2$ D $n - \frac{3}{2}$ E $n - 1$

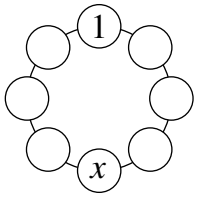
16. Triangle PQR has a right angle at R. The lengths of QR and RP are $3\sqrt{5}$ and $2\sqrt{5}$ respectively and $\angle QRS = 45°$.



What is the area of triangle PSR?

A 5 B 6 C $3\sqrt{5}$ D 7.5 E $7\sqrt{2}$

17. The numbers 2, 3, 4, 5, 6, 7 and 8 are to be placed in the empty circles so that (i) there is one number in each circle, and (ii) the sum of the numbers in each pair of adjacent circles is prime.



How many possible values are there for x?

A 0 B 1 C 2 D 3 E 4

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18. Let $g(x) = x^{\frac{1}{n}}$. Each of x, a and b are positive real numbers and n is a positive integer.

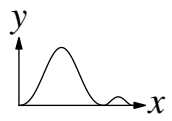
Which of the following is a simplification of $g(a) \times g(b^2) \times g(a^3) \times g(b^4) \times \ldots \times g(a^{2n-1}) \times g(b^{2n})$?

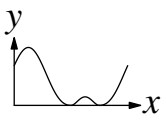
A $a^n b^{n+1}$ B $a^n b^{n+2}$ C $a^{n+1} b^{n+2}$ D $a^{2n} b^{2n+2}$ E $a^{2n+1} b^{2n+2}$

19. The largest integer less than or equal to x is represented by $\lfloor x \rfloor$. For example $\lfloor 5.8 \rfloor = 5$ and $\lfloor 3 \rfloor = 3$. For how many positive integers x does $\lfloor x^{\frac{1}{2}} \rfloor + \lfloor x^{\frac{1}{3}} \rfloor = 8$?

A 9 B 10 C 11 D 12 E 13

20. Which of the following is a sketch of the graph of $y = 1 + \sin x \cos x - \sin x - \cos x$ for $0° \leq x° \leq 360°$?

A 

B 

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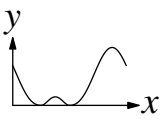
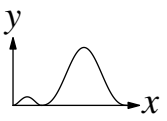
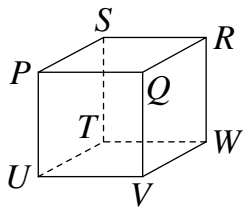
D 

E 

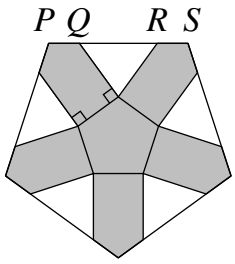
21. The diagram shows a clear plastic cube, $PQRSTUVW$. An ant starts at vertex S and walks on the surface of the solid cube. It travels along straight line segments (first to Q, U or W), alternately across the diagonal of a face and then along an edge. An example of a possible five-segment journey is $SQRTSW$.



At the end of a journey of 81 segments, which of the following vertices is it impossible for the ant to reach?

A S B Q C U D W E V

22. As shown in the diagram, a playground is built in the shape of a regular pentagon. In the centre is a smaller regular pentagon, with lines perpendicular to each side at each vertex of the smaller pentagon. The order of the rotational symmetry of the diagram is 5. The side-length of the larger pentagon is 10 m, and $PQ = RS = 2$ m.



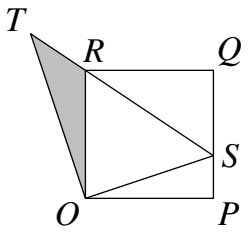
What fraction of the area of the playground is the area of the shaded region?

A $\frac{3}{5}$ B $\frac{5}{8}$ C $\frac{9}{25}$ D $\frac{16}{25}$ E $\frac{81}{125}$

23. Let $PQRS$ be a trapezium with QP parallel to RS and with $QP = 20$, $RS = 26$ and $PS = QR = n$, for some positive integer n. The length of the diagonal QS is also a positive integer.

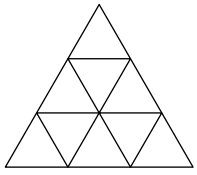
What is the maximum possible value of n?

24. $OPQR$ is a square. The point S lies on PQ such that $PS : SQ = 1 : 2$. Points S, R and T lie on a straight line and angle TOS is a right angle. The area of the triangle ORT is 30.



What is the area of $OPQR$?

25. This diagram, built from equilateral triangles of side-length 1, has a total of 18 edges of length 1. Each edge is to be coloured red, white or blue. Note that different colourings of the edges of the diagram which can be made the same by rotation or reflection of the diagram are to be considered as different colourings.



How many different coloured diagrams can be made, given that each equilateral triangle of side-length 1 must have edges of all three colours?

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