

United Kingdom  
Mathematics Trust

# JUNIOR MATHEMATICAL CHALLENGE

Thursday 29 April 2021

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supported by  

*England & Wales: Year 8 or below*  
*Scotland: S2 or below*  
*Northern Ireland: Year 9 or below*

## INSTRUCTIONS

1. Do not open the paper until the invigilator tells you to do so.
2. Time allowed: **60 minutes**.  
No answers, or personal details, may be entered after the allowed time is over.
3. The use of blank or lined paper for rough working is allowed; **squared paper, calculators and measuring instruments are forbidden**.
4. **Use a B or an HB non-propelling pencil**. 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.
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. **Scoring rules:**  
5 marks are awarded for each correct answer to Questions 1-15;  
6 marks are awarded for each correct answer to Questions 16-25.  
In this paper you will not lose marks for getting questions wrong.
7. Your Answer Sheet will be read by a machine. **Do not write or doodle on the sheet except to mark your chosen options**. The machine will read 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 eraser stuck to the page, the machine will interpret the mark in its own way.
8. **The questions on this paper are designed to challenge you to think, not to guess**. You will gain more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers. This paper is about solving interesting problems, not about lucky guessing.

Enquiries about the Junior Mathematical Challenge should be sent to:

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1. What is the value of  $123 - 456 + 789$ ?

- A 456                      B 556                      C 567                      D 678                      E 789

2. Brianna has £20, all in 5p coins, and £50, all in 2p coins. How many coins does she have in total?

- A 200                      B 290                      C 1000                      D 2540                      E 2900

3. What is the value of  $1 - 2 \times 3 + 4 \div 5$ ?

- A -4.2                      B -2.8                      C 0                      D 0.2                      E 4

4. How many of the following numbers are multiples of 11?

187	156	253	495	132
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- A 1                      B 2                      C 3                      D 4                      E 5

5. When I have walked 20% of the way to school, I have 1200 metres more to walk than when I have 20% of the walk remaining.

How far, in metres, is it from my home to my school?

- A 1240                      B 1440                      C 1680                      D 1800                      E 2000

6. What is the value of  $(2 - \frac{1}{2})(3 - \frac{1}{3})(4 - \frac{1}{4})$ ?

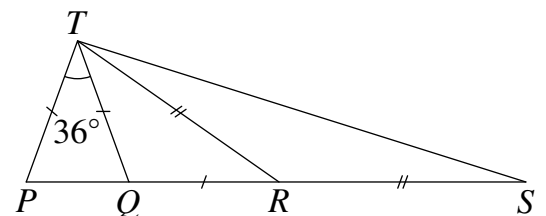
- A 16                      B 15                      C 14                      D 13                      E 12

7. In the diagram shown,  $PT = QT = QR$ .

Also,  $RT = RS$  and  $\angle PTQ = 36^\circ$ .

What is  $\angle PTS$ ?

- A  $72^\circ$                       B  $80^\circ$                       C  $90^\circ$                       D  $100^\circ$   
E  $108^\circ$



8. What is the value of  $1 - (2 - (3 - (4 - 5)))$ ?

- A -5                      B -3                      C -1                      D 1                      E 3

9. Each cell in the crossnumber below contains a single non-zero digit. The answer to each clue is a two-digit number.

Clues

ACROSS

1. A square  
3. An odd square

DOWN

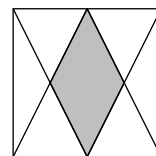
1. A square  
2. A square

1	2
3	x

What is the value of  $x$ ?

- A 1                      B 3                      C 5                      D 7                      E 9

10. The diagram shows a rhombus formed by joining each vertex of a square to the midpoint of a side of the square.



What fraction of the area of the square has been shaded?

- A  $\frac{1}{2}$                       B  $\frac{1}{3}$                       C  $\frac{1}{4}$                       D  $\frac{1}{6}$                       E  $\frac{1}{8}$

11. A particular prism has ten faces. How many edges does it have?

- A 20                      B 21                      C 24                      D 27                      E 30

12. The pupils in my class work very quickly. Jasleen answers four questions every 30 seconds and Ella answers five questions every 40 seconds.

Last week, Jasleen took exactly 1 hour to answer a large set of questions.

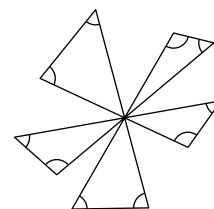
How many minutes more than Jasleen did Ella take to answer the same set of questions?

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

13. Five line segments coincide at a point as shown.

What is the sum of the marked angles?

- A  $900^\circ$                       B  $720^\circ$                       C  $540^\circ$                       D  $360^\circ$                       E  $180^\circ$



14. I begin with a three-digit positive integer. I divide it by 9 and then subtract 9 from the answer. My final answer is also a three-digit integer.

How many different positive integers could I have begun with?

- A 3                      B 5                      C 7                      D 11                      E 13

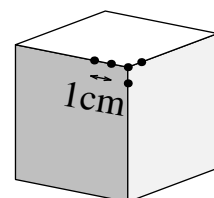
15. Alex has a pile of two pence coins. She swapped exactly half of them for the same number of 10p coins. Now she has £4.20. How much money did Alex have initially?"

- A 42p                      B 84p                      C £1.12                      D £1.40                      E £1.68

16. A cube has edge length 10 cm. Starting at the vertices, dots are placed along every edge at 1 cm intervals. Part of this pattern is shown.

How many dots will there be in total, once the pattern has been completed?

- A 128                      B 116                      C 112                      D 108                      E 104

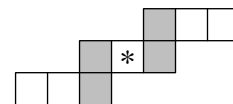


17. In 1770, Joseph-Louis Lagrange proved that every positive integer can be written as the sum of four squares. For example,  $13 = 0^2 + 0^2 + 2^2 + 3^2$ .

How many of the first 15 positive integers can be written as the sum of *three* squares?

- A 11                      B 12                      C 13                      D 14                      E 15

18. Each of the numbers 1 to 9 is to be placed in a different cell of the grid shown so that the sum of the three numbers in each row is 15. Also, the sum of the two numbers in each shaded column is to be 15.

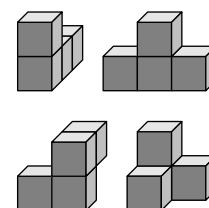


How many choices are there for the number to be placed in the central cell indicated by \*?

- A 0                      B 1                      C 2                      D 3                      E 4
19. In my class, everyone studies French or German, but not both languages. One third of the girls and the same number of boys study German. Twice as many boys as girls study French. Which of these could be the total number of boys and girls in my class?

- A 26                      B 28                      C 30                      D 32                      E 34

20. Each of the shapes shown has been made from four unit cubes. For each shape, Max takes eight copies of the shape and tries to fit them together to make a  $2 \times 4 \times 4$  cuboid.



How many of the shapes can be used to make a cuboid of this size in this way?

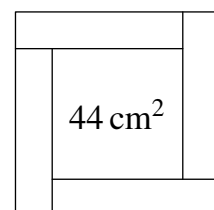
- A 0                      B 1                      C 2                      D 3                      E 4

21. Some fish, some dogs and some children are swimming in a bay. There are 40 legs in total, twice as many heads as tails and more dogs than fish.

How many fish are in the bay?

- A 1                      B 2                      C 3                      D 4                      E 5

22. The diagram shows four congruent rectangles, each of perimeter 20 cm, surrounding a square of area  $44 \text{ cm}^2$ .



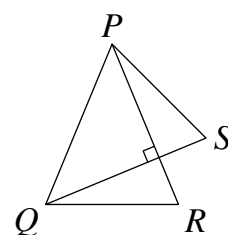
What is the area of each rectangle?

- A  $14 \text{ cm}^2$                       B  $16 \text{ cm}^2$                       C  $18 \text{ cm}^2$                       D  $20 \text{ cm}^2$                       E  $22 \text{ cm}^2$

23. Four different positive integers  $p, q, r, s$  satisfy the equation  $(9 - p)(9 - q)(9 - r)(9 - s) = 9$ . What is the value of  $p + q + r + s$ ?

- A 20                      B 24                      C 28                      D 32                      E 36

24. In the diagram shown,  $PQ = PR = QS$ . Line segments  $PR$  and  $QS$  are perpendicular to each other.



What is the sum of  $\angle PRQ$  and  $\angle PSQ$ ?

- A  $90^\circ$                       B  $105^\circ$                       C  $120^\circ$                       D  $135^\circ$                       E  $150^\circ$

25. I choose four different integers. When I add all the pairs of these numbers in turn, the totals that I obtain are 23, 26, 29, 32 and 35, with one of these totals being repeated.

What is the largest of the four integers?

- A 18                      B 19                      C 20                      D 21                      E 22