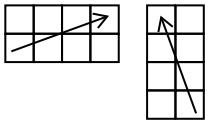
19. A swimming club has three categories of members: junior, senior, veteran. The ratio of junior to senior members is 3 : 2 and the ratio of senior members to veterans is 5 : 2.
Which of the following could be the total number of members in the swimming club?

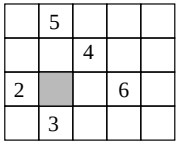
A 30 B 35 C 48 D 58 E 60

20. A 'long knight' moves on a square grid. A single move, as shown, consists of moving three squares in one direction (horizontally or vertically) and then one square at right angles to the first direction. What is the smallest number of moves a long knight requires to go from one corner of an 8 × 8 square board to the diagonally opposite corner?



A 4 B 5 C 6 D 7 E 8

21. The 5 × 4 grid is divided into blocks. Each block is a square or a rectangle and contains the number of cells indicated by the integer within it.
Which integer will be in the same block as the shaded cell?



A 2 B 3 C 4 D 5 E 6

22. Two numbers in the 4 × 4 grid can be swapped to create a Magic Square (in which all rows, all columns and both main diagonals add to the same total).
What is the sum of these two numbers?

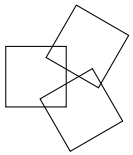
9	6	3	16
4	13	10	5
14	1	8	11
7	12	15	2

A 12 B 15 C 22 D 26 E 28

23. In our school netball league a team gains a certain whole number of points if it wins a game, a lower whole number of points if it draws a game and no points if it loses a game. After 10 games my team has won 7 games, drawn 3 and gained 44 points. My sister's team has won 5 games, drawn 2 and lost 3. How many points has her team gained?

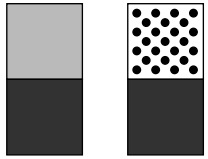
A 28 B 29 C 30 D 31 E 32

24. Three congruent squares overlap as shown. The areas of the three overlapping sections are 2 cm^2, 5 cm^2 and 8 cm^2 respectively. The total area of the non-overlapping parts of the squares is 117 cm^2.
What is the side-length of each square?



A 6 cm B 7 cm C 8 cm D 9 cm E 10 cm

25. For Beatrix's latest art installation, she has fixed a 2 × 2 square sheet of steel to a wall. She has two 1 × 2 magnetic tiles, both of which she attaches to the steel sheet, in any orientation, so that none of the sheet is visible and the line separating the two tiles cannot be seen. As shown alongside, one tile has one black cell and one grey cell; the other tile has one black cell and one spotted cell.
How many different looking 2 × 2 installations can Beatrix obtain?



A 4 B 8 C 12 D 14 E 24

UK JUNIOR MATHEMATICAL CHALLENGE

THURSDAY 25th APRIL 2013

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 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 has the largest value?

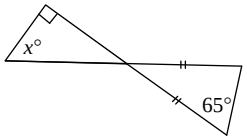
A $1 - 0.1$ B $1 - 0.01$ C $1 - 0.001$ D $1 - 0.0001$ E $1 - 0.00001$

2. Heidi is 2.1 m tall, while Lola is only 1.4 m tall. What is their average height?

A 1.525 m B 1.6 m C 1.7 m D 1.725 m E 1.75 m

3. What is the value of x?

A 25 B 35 C 40 D 65 E 155



4. Gill went for a five-hour walk. Her average speed was between 3 km/h and 4 km/h. Which of the following could be the distance she walked?

A 12 km B 14 km C 19 km D 24 km E 35 km

5. The diagram shows a weaver's design for a *rihlèlò*, a winnowing tray from Mozambique.
How many lines of symmetry does the design have?

A 0 B 1 C 2 D 4 E 8



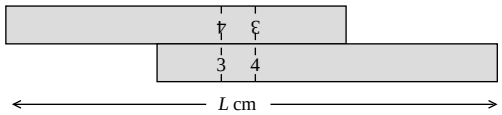
6. What is the value of $((1 - 1) - 1) - (1 - (1 - 1))$?

A -2 B -1 C 0 D 1 E 2

7. After tennis training, Andy collects twice as many balls as Roger and five more than Maria. They collect 35 balls in total. How many balls does Andy collect?

A 20 B 19 C 18 D 16 E 8

8. Two identical rulers are placed together, as shown (not to scale).
Each ruler is exactly 10 cm long and is marked in centimetres from 0 to 10. The 3 cm mark on each ruler is aligned with the 4 cm mark on the other.



The overall length is L cm. What is the value of L?

A 13 B 14 C 15 D 16 E 17

9. Peter has three times as many sisters as brothers. His sister Louise has twice as many sisters as brothers. How many children are there in the family?

A 15 B 13 C 11 D 9 E 5

10. On standard dice the total number of pips on each pair of opposite faces is 7.
Two standard dice are placed in a stack, as shown, so that the total number of pips on the two touching faces is 5.
What is the total number of pips on the top and bottom faces of the stack?

A 5 B 6 C 7 D 8 E 9

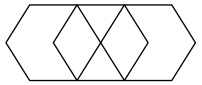


11. Usain runs twice as fast as his mum. His mum runs five times as fast as his pet tortoise, Turbo. They all set off together for a run down the same straight path. When Usain has run 100 m, how far apart are his mum and Turbo the tortoise?

A 5 m B 10 m C 40 m D 50 m E 55 m

12. How many hexagons are there in the diagram?

A 4 B 6 C 8 D 10 E 12



13. When painting the lounge, I used half of a 3 litre can to complete the first coat of paint. I then used two thirds of what was left to complete the second coat. How much paint was left after both coats were complete?

A 150 ml B 200 ml C 250 ml D 500 ml E 600 ml

14. Each side of an isosceles triangle is a whole number of centimetres. Its perimeter has length 20 cm. How many possibilities are there for the lengths of its sides?

A 3 B 4 C 5 D 6 E 7

15. The Grand Old Duke of York had 10 000 men. He lost 10% of them on the way to the top of the hill, and he lost 15% of the rest as he marched them back down the hill. What percentage of the 10 000 men were still there when they reached the bottom of the hill?

A $76\frac{1}{2}\%$ B 75% C $73\frac{1}{2}\%$ D $66\frac{2}{3}\%$ E 25%

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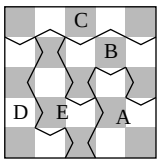
16. Ulysses, Kim, Mei and Tanika have their 12th, 14th, 15th and 15th birthdays today. In what year will their ages first total 100?

A 2023 B 2024 C 2025 D 2057 E 2113

17. A 5 cm × 5 cm square is cut into five pieces, as shown.
Each cut is a sequence of identical copies of the same shape but pointing up, down, left or right.
Which piece has the longest perimeter?

A B C D E



18. Weighing the baby at the clinic was a problem. The baby would not keep still and caused the scales to wobble. So I held the baby and stood on the scales while the nurse read off 78 kg. Then the nurse held the baby while I read off 69 kg. Finally I held the nurse while the baby read off 137 kg. What was the combined weight of all three ?

A 142 kg B 147 kg C 206 kg D 215 kg E 284 kg

(*This problem appeared in the first Schools' Mathematical Challenge in 1988 − 25 years ago.*)