UK Maths Trust

Junior Mathematical Challenge

Solutions 2025

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For reasons of space, these solutions are necessarily brief.

There are more in-depth, extended solutions available on the UKMT website, which include some exercises for further investigation:
www.ukmt.org.uk

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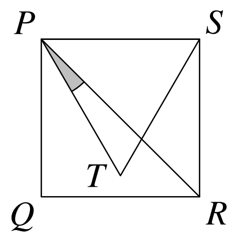
1. A 10% of 20 is 2. Half of 2 is 1.

2. A $\frac{4444+5555}{1111+2222} = \frac{9999}{3333} = \frac{3\times 3333}{3333} = 3.$

3. E Wriiten as the product of prime factors, $15 = 3 \times 5$; $25 = 5^2$; $45 = 3^2 \times 5$; $75 = 3 \times 5^2$; $225 = 3^2 \times 5^2$. Also, $2025 = 3^4 \times 5^2$. Therefore all five integers are factors of 2025.

4. A Jasmin beat the cut-off time of 60 hours by 1 minute 39 seconds, that is 99 seconds.

5. C Triangle PRS is an isosceles triangle in which $PS = SR$.
Therefore $\angle SPR = \angle PRS = ((180 - 90) \div 2)^\circ = 45^\circ$.
Also, triangle PTS is equilateral, so $\angle SPT = 60^\circ$.
Therefore $\angle RPT = (60 - 45)^\circ = 15^\circ$.



6. D While Carol swims 36 lengths, the number of lengths which Sandra swims is $36 \times \frac{4}{3}$, that is 48. So the required distance is 48×25 m, that is 1200 m.

7. D An integer is a multiple of 3 precisely when the sum of its digits is a multiple of 3. So the smallest four-digit multiple of 3 is 1002. Also, an integer is a multiple of 4 precisely when the last two digits form a multiple of 4. So the largest three-digit multiple of 4 is 996. Hence the required difference is $1002 - 996 = 6$.

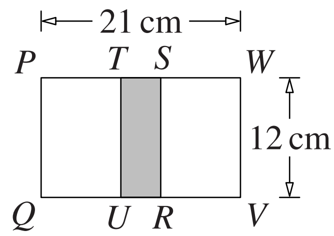
8. B 8.8 kg is equivalent to 8800 g. Therefore the required number of bars is $8800 \div 100$, that is 88.

9. B Let the two integers which give the smallest sum be 'pq' and 'rs'. For the sum to be as small as possible, p and r are 1 and 2 in some order, as neither can be 0. However, q or s could be 0, so for the sum to be as small as possible these two variables are 0 and 3 in some order. Hence the smallest possible sum of the two numbers is 33, which can be achieved in two different ways: $10 + 23$ or $13 + 20$.

10. D From the information given, we can deduce that two-thirds of the length of the turtle is 60 cm. Hence one-third of its length is 30 cm. Therefore the required length is 3×30 cm, that is 90 cm.

11. E The one-digit cubes are 1 and 8. However, 1 cannot be the cube as neither 2 nor 3 is a square. So the required integers are 6, 7, 8 or 7, 8, 9. However, neither 6 nor 7 is a square. That leaves 7, 8, 9 in which 7 is prime, 8 is a cube and 9 is a square. Their product is $7 \times 8 \times 9$, that is 504.

12. B Let the length of TS be x cm. Then $PT = SW = (12 - x)$ cm.
Therefore, as $PW = 21$ cm, $12 - x + x + 12 - x = 21$.
So $24 - x = 21$, that is $x = 3$.
Hence the shaded area, in cm^2, is $3 \times 12 = 36$.



13. B The dimensions, in cm, of the next four rectangles in the sequence are 12 by 14, 14 by 15, 16 by 16, 18 by 17. As the height of each successive rectangle in the sequence increases by more than the width of the rectangle increases, the only square in the sequence is that of side 16 cm.

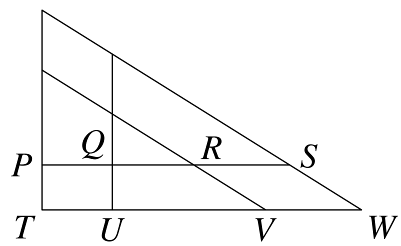
14. A $3^3 + 4^3 + 5^3 = 27 + 64 + 125 = 216 = 6^3$.

15. B Baby's weight in ounces was $8 \times 16 + 13 = 128 + 13 = 141$.
So her weight in grams was approximately $141 \times 28.35 \approx 140 \times 30 = 4200$.
Therefore baby's weight was approximately 4 kg.

16. C The sum of 20% of 40% of 60 and 40% of 60% of 80 $= \dfrac{20}{100} \times \dfrac{40}{100} \times 60 + \dfrac{40}{100} \times \dfrac{60}{100} \times 80$

$$= \frac{40 \times 60 \times (20 + 80)}{100 \times 100} = \frac{40 \times 60}{100} = \frac{2400}{100} = 24.$$

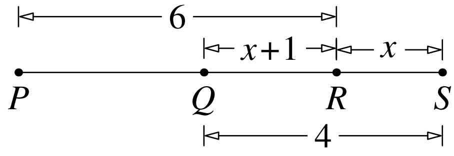
17. C Each of the triangles in the diagram has a base parallel to that of the large triangle, namely TW. There are four triangles whose bases lie along TW. They have bases TV, TW, UV, UW. The only other line segments along TW are TU and VW, but neither is the base of a triangle. Similarly, there are four triangles whose bases lie along PS. They have bases PR, PS, QR, QS. The only other line segments along PS are PQ and RS, but neither is the base of a triangle. So, in total, there are eight triangles in the diagram.



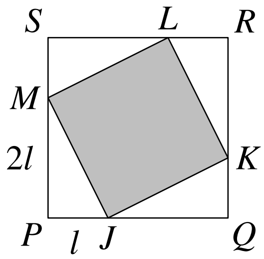
18. B The number n that we seek is divisible by 9 and 12, that is by 3^2 and $2^2 \times 3$. So it must be divisible by their least common multiple $2^2 \times 3^2$, that is, by 36.
Now 36 has the nine factors 1, 2, 3, 4, 6, 9, 12, 18 and 36. Any larger multiple of 36 has these nine and also itself as factors. So it has more than nine factors. Hence 36 is the number required.

19. E As four cards display the letter P, these cards must be paired with counters displaying 1, 2, 3 and 4. There are now no counters displaying 3, so the three cards displaying Q are paired with counters displaying 1, 2 and 4. This now leaves two cards displaying R, one card displaying S, two counters displaying 2 and one counter displaying 4. So the last three pairings are R2, R4 and S2. Therefore, of the options given, only S4 is a pairing which Ibraheem does not make.

20. B Let the length of RS be x cm.
Then the length of QR is $(x + 1)$ cm.
Therefore $x + x + 1 = 4$. So $x = (4 - 1) \div 2 = 1.5$.
As can be seen from the diagram (where all distances are in cm), the length of PS is $(6 + x)$ cm, that is 7.5 cm.

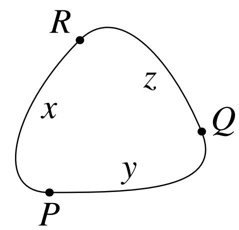


21. B Let the side-length of square $PQRS$ be $3l$.
Then the lengths of MP and PJ are $2l$ and l respectively.
Therefore, by Pythagoras' Theorem,
$MJ^2 = MP^2 + PJ^2 = (2l)^2 + l^2 = 4l^2 + l^2 = 5l^2$.
So the area of square $JKLM$ is $5l^2$.
Also, the area of square $PQRS$ is $(3l)^2 = 9l^2$.
Hence the required ratio is $5l^2 : 9l^2$, that is 5 : 9.



22. D Let x be the number of bags which contain 3 mints, 4 toffees and a fudge, y the number of bags containing 4 mints, 5 toffees and 2 fudges and z the number of bags containing 6 mints and 3 fudges. We know that $x + y + z = 12$.
The total number of toffees is $4x + 5y$ and so $4x + 5y = 31$. Hence $31 - 5y = 4x$ which is a multiple of 4. As y varies, the possible values of $31 - 5y$ are 31, 26, 21, 16, 11, 6 and 1. Of these, only 16 is a multiple of 4. So $4x = 16$, that is $x = 4$.
Hence $y = (31 - 16) \div 5 = 15 \div 5 = 3$. Therefore $z = 12 - (x + y) = 12 - 7 = 5$.
Finally, the total number of fudges is given by $x + 2y + 3z = 4 + 6 + 15 = 25$.

23. D Let the lengths, in kilometres, of the direct routes between the towns be as shown on the diagram.
Then, $y + z = 2x \ldots [1]$; $x + z = 3y \ldots [2]$.
Now the length of the route, in kilometres, from P back to P via Q and R is $x + y + z$.
From equation 1: $x + y + z = 3x$; from equation [2]: $x + y + z = 4y$.



So the length of the route from P back to P is both a multiple of 3 and a multiple of 4. Hence it is a multiple of 12. Of the options given, only 108 satisfies this condition. It corresponds to the values of x, y and z being 36, 27 and 45 respectively.

24. A As 180 leaves remainder 5 when divided by the positive integer N, we see that $180 = kN + 5$, where k is a positive integer.
Hence $kN = 175$ and we deduce that N is a factor of 175. Also, as the remainder in a division must be less than the divisor, we know that $N > 5$.
Now $175 = 5 \times 35 = 5 \times 5 \times 7$, so the factors of 175 which are greater than 5 are 7, 25, 35 and 175. These are the four different possible values of N.

25. D The only equilateral triangles whose vertices are three vertices of the cube are those whose edges are diagonals of faces of the cube, for example triangle VXQ. Now the cube has six faces and each face has two diagonals. Each of these diagonals forms an edge of two triangles. For example, in the case of diagonal VX, it is an edge of both triangle VXQ and triangle VXS.
Although this suggests that there are $6 \times 2 \times 2$, that is 24, such triangles, each triangle has been counted three times in this process. Therefore the number of equilateral triangles whose vertices are three vertices of the cube is $24 \div 3 = 8$.
They are triangles $VXQ, VXS, YWP, YWR, QSV, QSX, PRW, PRY$.