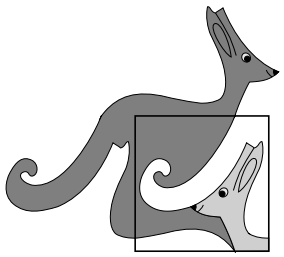
UK Maths Trust



Junior Kangaroo

© 2025 UK Mathematics Trust

a member of the Association Kangourou sans Frontières

proudly sponsored by [XTX] MARKETS

Solutions

These are polished solutions and do not illustrate the process of failed ideas and rough work by which candidates may arrive at their own solutions.

It is not intended that these solutions should be thought of as the 'best' possible solutions and the ideas of readers may be equally meritorious.

Enquiries about the Junior Kangaroo should be sent to:

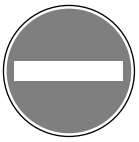
challenges@ukmt.org.uk

www.ukmt.org.uk

supported by Overleaf

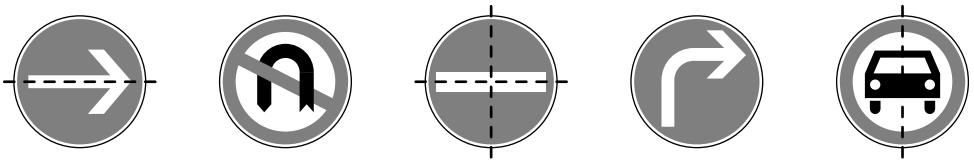
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	E	B	C	B	A	B	C	D	B	A	D	A	C	E	D	B	B	D	A	B	D	C	E	C

1. Which of the following traffic signs has the greatest number of lines of symmetry?

A B C  D E

SOLUTION **C**

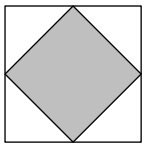
The diagram shows all the lines of symmetry of the given traffic signs.



As can be seen, the second and fourth signs have no lines of symmetry while the first and the fifth signs have one line of symmetry. However, the third sign has two lines of symmetry. Hence the sign with the greatest number of lines of symmetry is shown in option C.

2. Joseph draws a square with side-length 10 cm. He joins the midpoints of the sides to make a smaller square, as shown in the diagram. What is the area, in cm^2, of the smaller square?

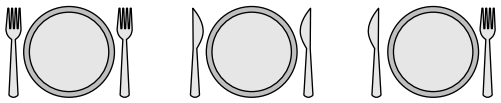
A 10 B 20 C 30 D 40 E 50



SOLUTION **E**

The vertices of the smaller square are at the midpoints of the sides of the larger square. Therefore these vertices are each 5 cm from the vertices of the larger square. Hence the area of each of the four right-angled triangles formed is, in cm^2, $\frac{1}{2} \times 5 \times 5 = 12.5$. Therefore the area of the smaller square, in cm^2, is $10 \times 10 - 4 \times 12.5 = 100 - 50 = 50$.

3. Millie's mother likes her to set the table with a knife on the right-hand side of the plate and a fork on the left-hand side. Starting with the arrangement in the diagram, what is the smallest number of times Millie needs to swap the positions of a knife and a fork in order to satisfy her mother?

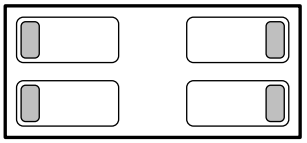


A 1 B 2 C 3 D 5 E 6

SOLUTION **B**

There are four items of cutlery in the wrong place. Since swapping two items which are incorrectly placed will then place only two items correctly, the smallest number of times Millie needs to swap a knife and a fork is $4 \div 2 = 2$. She can do this, for example, by swapping the right-hand fork from the first plate with the left-hand knife from the second plate and by swapping the knife and fork from the third plate.

4. On the left-hand side of the room, Jia and Lottie are sleeping with their heads on the pillows and facing each other. On the right-hand side of the room, Anaya and Isla are sleeping with their heads on the pillows with their backs to each other. How many of the girls are sleeping with their right ear on their pillow?

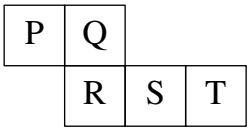


A 0 B 1 C 2 D 3 E 4

SOLUTION **C**

On the left-hand side of the room, Jia and Lottie are facing each other and hence exactly one of them has their right ear on their pillow. On the right-hand side of the room, Anaya and Isla are facing away from each other and hence exactly one of them will have their right ear on their pillow. Therefore exactly two of the girls are sleeping with their right ear on their pillow.

5. The piece of paper shown is folded along the dotted lines to make an open box. The box is placed on the table with the top open. What is the letter on the face that is on the table?



A P B Q C R D S E T

SOLUTION **B**

When the paper is folded to try to make a box, the face labelled P will be opposite the face labelled S. Similarly, the face labelled R will be opposite the face labelled T. However, no face will be opposite the face labelled Q. Hence, when an open box is made with the top open, the face labelled Q will be on the table.

6. Which of the following figures *cannot* be formed by gluing these two identical squares of paper together?

A
B
C
D
E

SOLUTION **A**

To form the figure in option A, the triangle at the top of the figure would be equilateral as all its sides would be the same length. However, this is not the case as the angle at the top of the figure is an interior angle of a square and hence is 90°. Therefore the figure that cannot be formed is the figure in option A. The diagram below shows how the remaining figures could be formed from two identical squares (with one square shown in lighter grey to aid clarity).

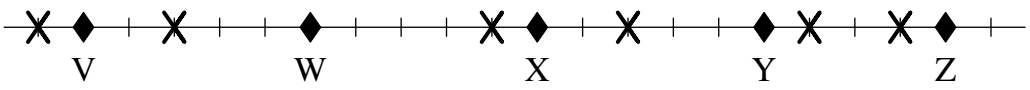
7. 2025 is a square. How many distinct primes divide exactly into 2025?

A 1 B 2 C 3 D 4 E 5

SOLUTION **B**

Note first that $2025 = 45^2$ and that $45 = 3 \times 3 \times 5$. Therefore $2025 = 3^4 \times 5^2$ and hence there are only two primes, 3 and 5, that divide exactly into 2025.

8. Five squirrels V, W, X, Y and Z are sitting on the line shown below.

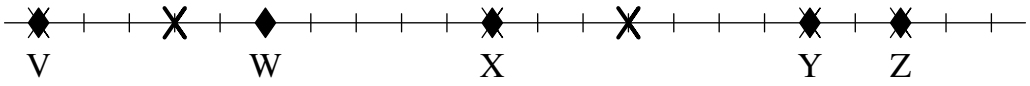


There are six nuts on the line, marked with crosses. At one instant, the five squirrels start running towards the nearest nut at the same speed. As soon as a squirrel reaches a nut, it picks it up and starts running towards the next nearest nut. Which squirrel will get two nuts?

A V B W C X D Y E Z

SOLUTION **C**

Let us consider time as being measured by the time each squirrel takes to move one space on the line. After one unit of time, squirrels V, X, Y and Z will each have reached their nearest nut and will then be 3 spaces, 3 spaces, 4 spaces and 6 spaces respectively from the next nearest nut, as shown in the diagram.



Squirrel W will not have reached its nearest nut but will only be 2 spaces away from it and so will reach it before squirrel V. The only remaining nut then is the one that all of squirrels X, Y and Z are running towards and squirrel X is the closest to it. Hence squirrel X will get two nuts.

9. There are 30 students in a class. They sit in pairs so that each boy is sitting next to a girl and exactly half of the girls are sitting next to a boy. How many boys are there in the class?

A 25 B 20 C 15 D 10 E 5

SOLUTION **D**

Let the number of boys in the class be x. Therefore the number of girls sitting next to a boy is also x. Since we are told that exactly half the girls are sitting next to a boy, the total number of girls in the class is $2x$ and hence the total number of students is $2x + x = 3x$. Therefore, since there are 30 students in the class, $3x = 30$ which has solution $x = 10$. Therefore there are 10 boys in the class.

10. The number 2581953764 is written on a strip of paper. Dilraj cuts the strip twice and gets three numbers. Then he adds these three numbers. What is the smallest possible sum he could get?

A 2675 B 2975 C 2978 D 4217 E 4298

SOLUTION **B**

Since there are 10 digits in the number written and Dilraj cuts it to get three numbers, at least one of Dilraj's numbers will have four or more digits. There are three possible ways to split the 10-digit number into one four-digit number and two three-digit numbers with the four digit number first, in the middle or last. The sums of the three numbers in these three cases are $2581 + 953 + 764 = 4398$, $258 + 1953 + 764 = 2975$ and $258 + 195 + 3764 = 4217$. There are also three possible ways to split the 10-digit number into two four-digit numbers and one two-digit number but it is easy to see that these will all give sums larger than the ones above as will any addition containing a five-digit number or larger. Hence the smallest possible sum he could get is 2975.

11. My granny bought enough cat food to last her four cats for twelve days. However, on her way home, she found two stray cats and brought them home. Each cat was given the same amount of food each day. How many days did her cat food last?

A 8 B 7 C 6 D 5 E 4

SOLUTION **A**

Since she had enough food for four cats for twelve days, my granny had (4×12) days of cat food. When this amount is shared between her four cats plus the two extra cats, the number of days it will last is $(4 \times 12) \div 6 = 8$.

12. Each letter in the eight-digit integer '$BENJAMIN$' represents one of the digits 1, 2, 3, 4, 5, 6 or 7. Different letters represent different digits. The integer '$BENJAMIN$' is odd and divisible by 3.
Which digit is represented by N?

A 1 B 3 C 4 D 5 E 7

SOLUTION **D**

In '$BENJAMIN$', the letter N occurs twice and every other letter occurs once. Since we are told that letters represent the digits 1 to 7 in some order, the sum of the digits of the integer '$BENJAMIN$' is $1 + 2 + 3 + 4 + 5 + 6 + 7 + N = 28 + N$. We are also told that the integer is odd and divisible by 3. Therefore N is odd and $28 + N$ is divisible by 3. The possible values of $28 + N$ when N is odd and between 1 and 7 are 29, 31, 33 and 35 and of these only 33 is divisible by 3. Therefore the value of N is 5.

© 2025 UK Mathematics Trust

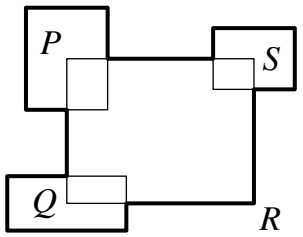
13. Tim, Tom and Jim are triplets. Their brother Carl is three years younger. Which of the following could be the sum of the ages of the four brothers?

A 53 B 54 C 56 D 59 E 63

SOLUTION **A**

Let Tim's, Tom's and Jim's age be x. Therefore Carl's age is $x - 3$ and the sum of their ages is $x + x + x + (x - 3) = 4x - 3$. Of the options given, only 53 is 3 less than a multiple of 4. Hence the only value that could be the sum of their ages is 53 when Tim, Tom and Jim would be 14 and Carl would be 11.

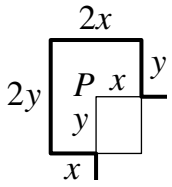
14. The perimeter of the rectangle $PQRS$ is 30 cm. A new shape is formed by placing three other rectangles so that their centres are at the points P, Q and S, as shown in the diagram. The sum of the perimeters of the three added rectangles is 20 cm. What is the total perimeter of the new shape?



A 50 cm B 45 cm C 40 cm D 35 cm
E 33 cm

SOLUTION **C**

Consider the effect on the total perimeter of adding a rectangle with centre P. Suppose this rectangle has dimensions $2x$ cm $\times$ $2y$ cm, as shown in the diagram. As can be seen, the effect of adding this rectangle is to add $(x + 2y + 2x + y)$ cm to the the total perimeter and to remove $(x + y)$ cm from the total perimeter. Hence, the overall effect is to increase the total perimeter by $(2x + 2y)$ cm. This is half of the perimeter of the added rectangle with centre P.



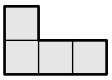
When a rectangle is added at Q and at R, the same effect will be seen. Hence the total effect of adding the three rectangles is to increase the total perimeter of the shape by half the total length of the perimeters of the three added rectangles, which is $\frac{1}{2} \times 20\,\text{cm} = 10\,\text{cm}$. Therefore the total perimeter of the new shape is $30\,\text{cm} + 10\,\text{cm} = 40\,\text{cm}$.

15. Run Ze writes down all the integers with the following properties: the first digit is 1; each of the following digits is at least as large as the digit before it; the sum of the digits of the integer is 5.
How many integers does he write?

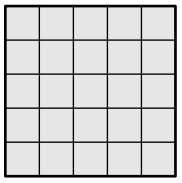
A 9 B 8 C 7 D 6 E 5

SOLUTION **E**

The integers that Run Ze can write down so that the sum of the digits is 5, the first digit is 1 and the digits are not decreasing when read from left to right are 11111, 1112, 113, 14 and 122. Hence he writes down five integers.

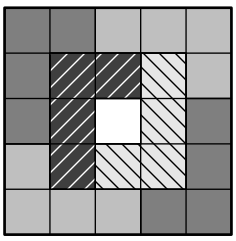
16. What is the largest number of shapes of this form  that can be cut out from the 5×5 square shown on the right?

A 2 B 4 C 5 D 6 E 7



SOLUTION **D**

Each shape consists of four small squares while the 5×5 square consists of 25 small squares. Since $25 = 4 \times 6 + 1$, the maximum number of shapes that could be cut out of the large square is 6. The diagram below shows one way it is possible to cut out six shapes. Hence the largest number of shapes that can be cut out is 6.



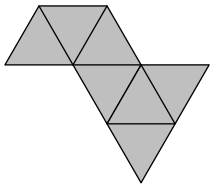
17. Luigi opened a small restaurant. His friend Giacomo gave him some square tables and some chairs. When he tried to arrange all the tables as single tables with four chairs each, he found he had six chairs too few. When he decided to arrange the tables in pairs with six chairs for each pair of tables, he found he had four chairs left over. How many tables did Luigi receive from Giacomo?

A 8 B 10 C 12 D 14 E 16

SOLUTION **B**

Let the number of tables be $2x$. Since Luigi has six chairs too few when he arranges four chairs around each table, the total number of chairs he has is $4 \times 2x - 6 = 8x - 6$. When he arranges the tables in pairs, he will have x pairs. Since he has four chairs left over when he arranges six chairs around each pair of tables, the total number of chairs he has is given by $6x + 4$. Therefore $8x - 6 = 6x + 4$ and hence $2x = 10$. Therefore the number of tables Luigi received is 10.

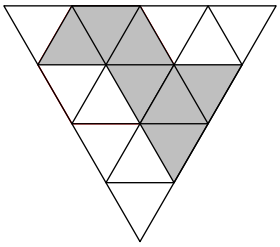
18. Lily wants to make a large triangle from small triangular tiles. She has already put some tiles together, as shown in the diagram. What is the smallest number of small tiles that she now needs to complete a large triangle?



A 5 B 9 C 12 D 15 E 18

SOLUTION **B**

The shape shown contains a line of five tiles with further tiles on each side. Therefore the parallel line of tiles next to this line (on the left in the diagram) must contain at least seven tiles. The diagram shows that it is possible to complete a large triangle around the given shape where the longest line of triangles contains seven tiles.



The total number of tiles in this large triangle is $7 + 5 + 3 + 1 = 16$ and hence, since the number of tiles in the given shape is 7, the smallest number of small tiles needed to complete a large triangle is $16 - 7 = 9$.

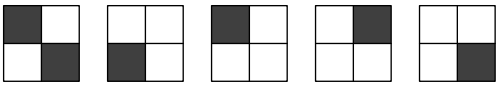
19. Three vertices of the rectangle $PQRS$ are at $P(1, 1)$, $Q(7, 4)$ and $R(5, 8)$.
What are the co-ordinates of S?

A $(-1, 4)$ B $(0, 5)$ C $(-2, 6)$ D $(-1, 5)$ E $(-1, 6)$

SOLUTION **D**

Since $PQRS$ is a rectangle, the sides PQ and SR are parallel and equal. To get from P to Q, you move 6 units right and 3 units up. Therefore to get from S to R, which is at (5, 8), you also move 6 units right and 3 units up. Hence the co-ordinates of S are $(5 - 6, 8 - 3) = (-1, 5)$.

20. A large cube was built from eight equally-sized small cubes, some of which were painted black and some painted white. Five of the faces of the large cube are shown in the diagram.
What does the sixth face of the large cube look like?



A B C D E

SOLUTION **A**

Each small cube will have three of its square faces on three different faces of the large cube. Therefore, the total number of black squares visible on the six faces of the large cube is a multiple of three. The total number of black squares visible on the five given faces of the large cube is $2 + 1 + 1 + 1 + 1 = 6$, which is a multiple of three. Therefore the number of black squares on the missing face is also a multiple of three. Hence only options A and E need to be considered.

However, if the sixth face were the one shown in option E, then two other faces would have two black squares on the same edge and none of the given faces has two such black squares. Therefore there are no squares on the sixth face, as shown in option A.

[The completed cube is made up of six cubes painted white and two painted black with the two black cubes in opposite corners of the top layer when the cube is oriented so that the sixth face is on the bottom.]

© 2025 UK Mathematics Trust

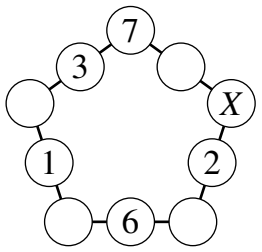
21. A rectangular swimming pool of length 20 m is surrounded on all four sides by a path 2 m wide. The area of the path is the same as the area of the pool.
What is the width, in metres, of the pool?

A 6.5 B 6 C 5.5 D 5 E 4.5

SOLUTION **B**

Let the width of the pool be Y m. Since the pool is 20 m long and the path is 2 m wide, the length of the rectangle formed by the pool and the path is $(2 + 20 + 2)$ m = 24 m and the width of this rectangle is $(Y + 4)$ m. The information in the question tells us that the area of the path is equal to the area of the pool and hence $24 \times (Y + 4) - 20 \times Y = 20 \times Y$. Therefore $24Y + 96 = 40Y$ and hence $96 = 16Y$. This has solution $Y = 6$ and therefore the width, in metres, of the pool is 6.

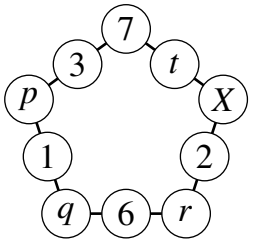
22. Kirsten wrote numbers in five of the ten circles arranged around a pentagon, as shown in the diagram. She wants to write a number in each of the remaining five circles so that the sums of the three numbers along each side of the pentagon are equal.
Which number should she write in the circle marked X?



A 7 B 8 C 11 D 13 E 15

SOLUTION **D**

Let the numbers to be written in the remaining five circles be p, q, r, t and X, as shown in the diagram. Since the sum of the three numbers along each side of the pentagon are equal we have $7 + 3 + p = p + 1 + q$ and $q + 6 + r = r + 2 + X$. From the first equation, we have $q = 9$ and from the second, we have $X + 2 = q + 6$. Therefore, the number Kirsten should write in the circle marked X is 13.



Note: the remaining three numbers are not uniquely determined but do satisfy $t = p - 10$ and $r = p - 5$ whatever value is chosen for p.

23. Joey is playing with his calculator. He starts with the number 12 and then multiplies or divides by 2 or by 3 until he has done 60 calculations. Which of the following could *not* be his answer?

A 12 B 18 C 36 D 72 E 108

SOLUTION **C**

Note first that it is possible to leave any number unchanged after two calculations by either multiplying by 2 and then dividing by 2 (or vice versa) or by multiplying by 3 and then dividing by 3 (or vice versa). Note also that it is impossible to add or remove powers of 2 by multiplying or dividing by powers of three (and vice versa). Hence Joey can only leave a number unchanged if he multiplies by 2 as often as he divides by 2, and multiplies by 3 as often as he divides by 3. Therefore an even number of calculations can leave a number unchanged, but an odd number of calculations cannot. Also, the order in which these calculations are carried out does not affect the final answer.

Starting from 12, Joey can obtain the value 36 in one calculation by multiplying by 3. It cannot be left unchanged by a further 59 calculations and so could not be Joey's answer.

Note that, starting from 12, Joey can obtain 18 by multiplying by 3 and dividing by 2. Similarly, he can obtain 72 by multiplying by 2 and then multiplying by 3 and he can obtain 108 by multiplying by 3 twice. Hence he could obtain all three values after a further 58 calculations. The number 12 can be left unchanged by 60 calculations and so could also be obtained.

24. The digits of the three-digit integer 'XYZ' are all different. The sum of the digits of the three-digit integer 'XXY' is the two-digit integer 'YZ'. The sum of the digits of the two-digit integer 'YZ' is the one-digit integer 'Y'. What digit does 'X' represent?

A 4 B 5 C 6 D 8 E 9

SOLUTION **E**

Since the sum of the digits of the two-digit integer 'YZ' is the one-digit integer 'Y', we have $Y + Z = Y$ and hence $Z = 0$. Similarly, since the sum of the digits of the three-digit integer 'XXY' is the two-digit integer 'YZ', we have $2X + Y = 10Y$ and hence $2X = 9Y$. Therefore, $2X$ is a multiple of 9. Hence, as X is a digit, we have $X = 9$ and $Y = 2$.

© 2025 UK Mathematics Trust

25. Two three-digit integers have all six of their digits distinct. The first digit of the second integer is twice the last digit of the first integer. What is the smallest possible sum of two such integers?

A 597 B 546 C 537 D 535 E 301

SOLUTION **C**

To have the smallest possible sum of the two integers, we first require the sum of the digits in hundreds place to be as small as possible. There are two cases to consider.

First, if one of the digits in the hundreds place is 1, then the smallest possible value for the other digit in the hundreds place is 4 as it must be twice the last digit of the other integer and the smallest value for that last digit that will not result in repeating digits is 2. In this case, the sum of the digits in the hundreds places is $1 + 4 = 5$ and the digits 1, 2 and 4 have been placed.

Second, if neither of the digits in the hundreds place is 1, then 1 can be a final digit of one integer and hence 2 would be the first digit of the other integer. In this case, the smallest the first digit of the first integer could be is 3. The sum of the digits in the hundreds places is $2 + 3 = 5$ and the digits 1, 2 and 3 have been placed.

In each of these cases, the smallest total for the digits in the hundreds places is the same. Hence we then need to consider the digits in the tens places.

In the first case, the smallest digits that could be used in the tens places to minimise the sum are 0 and 3 whereas in the second case the smallest digits available for the tens places digits are 0 and 4.

Since $0 + 3 < 0 + 4$, the smallest sum will come from having a 1 and a 4 in the hundreds places. One possible sum that will then give the smallest value is $102 + 435$ which is equal to 537.

© 2025 UK Mathematics Trust