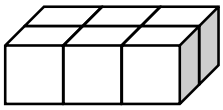
1. The diagram shows a cuboid made up of six cubes, each measuring $1\,\text{cm} \times 1\,\text{cm} \times 1\,\text{cm}$.



What is the surface area of the cuboid?

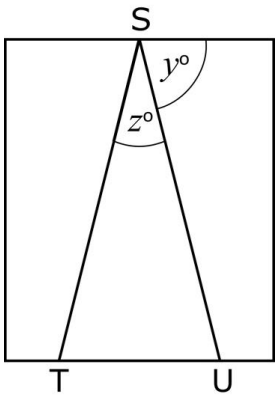
Answer: _____

2. The difference between the first two square numbers is 3, e.g. $4 - 1 = 3$.

How many consecutive square numbers, up to the ninth and tenth square numbers, do **not** have a prime number as their difference?

Answer: _____

3. The diagram shows a triangle inside a rectangle, where the length of ST = SU.



Complete the equation below, using the angles given.

180° – _____ = z°

4. Write a calculation that uses the number 4 four times and gives an answer of 2.

You can use any of the operations +, –, x, ÷ and brackets as many times as you want.

Answer: _____

5. $2222 \times H = 8888 \times \frac{1}{H}$

What is the value of H?

Answer: _____

6. Wayne must form a password with three characters.
The first character must be a capital letter: A, B, C, D or E.
The second character must be a small letter: f, g, h, i or j.
The third character must be a number: 1, 2, 3, 4 or 5.

How many different passwords can Wayne choose from?

Answer: _____

7. The difference between a certain positive number doubled and the same number halved is 21.

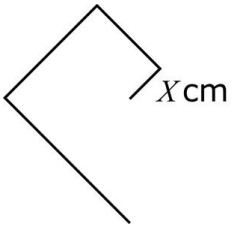
What is that number?

Answer: _____

8. The diagram shows the first four lines in a 'spiral' sequence.

The first line measures x cm, the second measures $2x$, the third $3x$, and so on.

The direction of the line rotates by 90° each time to form a 'spiral' as shown.



If an ant walks along the lines from the start, how far will it have walked when it turns to face northeast for the third time?

Answer: _____

9. What is the number of seconds in one week, rounded to the nearest half million?

Answer: _____

10. There are 33 children in a club.

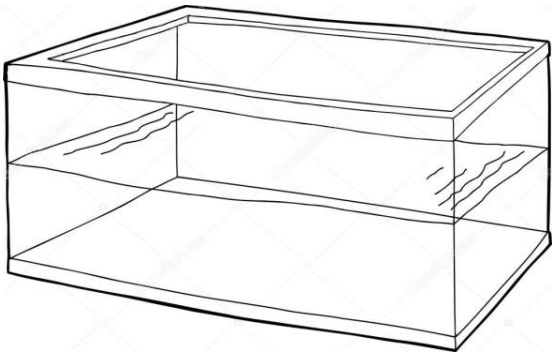
The children are divided equally into 3 football teams.

Team A is all girls, Team B is all boys and Team C is a mixture of girls and boys.

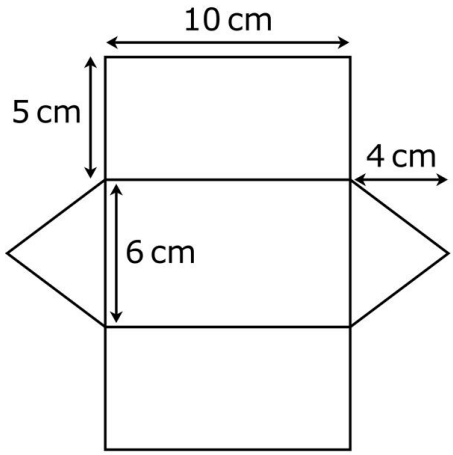
If the ratio of the number of girls to boys in the club is 6 : 5, how many boys are in Team C?

Answer: _____

11. A fish tank measuring 40 cm × 20 cm × 20 cm is half full of water.



What is the largest number of solid triangular prisms, with the net shown, that can be placed into the tank without the tank overflowing?
(The prisms are made of a dense material and will sink.)



(Not drawn to scale)

Answer: _____

12. In the multiplication shown, each letter represents a different non-zero digit.

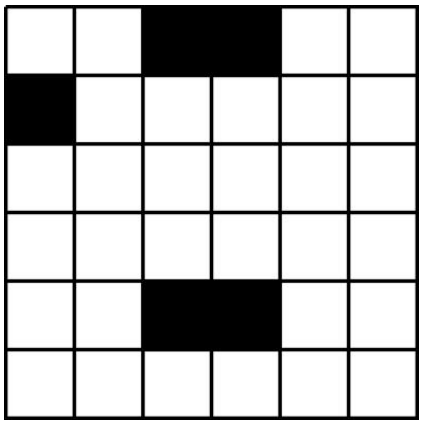
$$\begin{array}{cccccc} & Q & Q & T & T \\ \times & & & & T \\ \hline S & Q & R & Q & Q \end{array}$$

What digit does S represent?

Answer: _____

13. Each of the 36 small squares in this grid can be coloured either black or white.

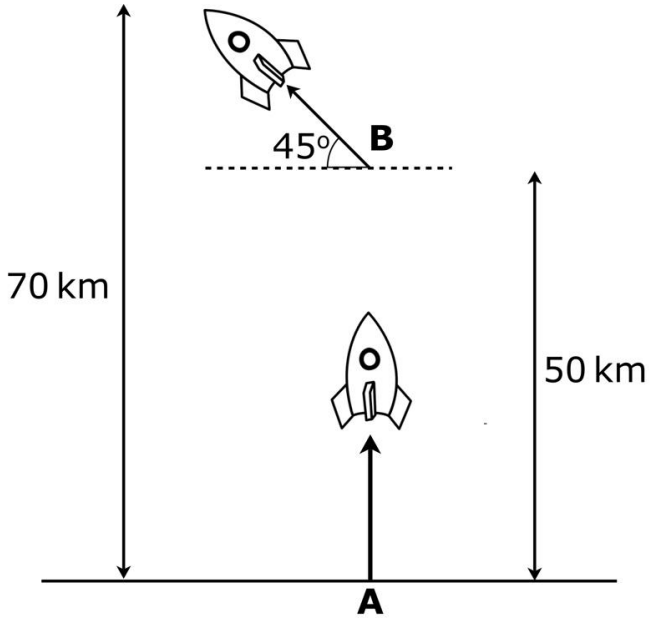
Five are already coloured black.



How many more squares need to be coloured black so that the grid has four lines of symmetry?

Answer: _____

14. A rocket travels straight up from a point, A, on Earth.
When it reaches B, it turns through an angle of 45° as shown.
The distance from A to B is 50 km.



When the rocket reaches a total height of 70 km, it runs out of fuel, stops and falls straight back down to Earth.

How far from A does the rocket land?

Answer: _____

15. What is the value of 5% + 0.5 + $\frac{1}{5}$?

Answer: _____

16. A box is full of pairs of gloves, but they are all mixed up.
The Smith triplets want to each find a pair of gloves to wear.

If there are twenty pairs of gloves in the box, how many individual gloves must be taken from the box before the triplets can be sure to have at least three pairs of matching gloves?

Answer: _____

17. The halfway point between two numbers is –3.
The product of the numbers is –40.

What is the difference between the numbers?

Answer: _____

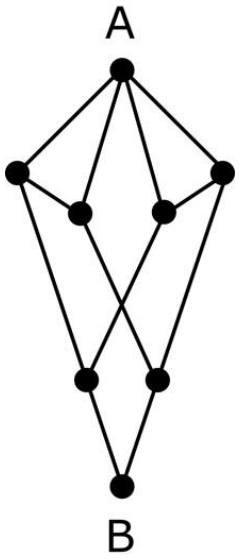
18. I have an equal number of 20 p coins and 10 p coins.
The total value of the coins is £2.40.

If 10 p coins each weigh 6.5 g and 20 p coins each weigh 5 g, what is the total weight of my coins?

Answer: _____

19. How many different routes are there from A to B?

You cannot pass through the same junction marked with a black dot more than once on each route.



Answer: _____

20. A secretary types two characters per second.

How long, in minutes, will it take the secretary to type a document containing 2400 characters?

Answer: _____

21. Anton plays six games of chess in a tournament.
The numbers of moves in games one to five are:
30, 40, 45, 35 and 50.
After game six, the mean number of moves per game is 42.

For how many moves did game six last?

Answer: _____

22. Consider the following statements:

i) A number ending in 4 is never divisible by 3.

ii) A number ending in 3 is never divisible by 4.

iii) A number ending in 0 is always divisible by 5.

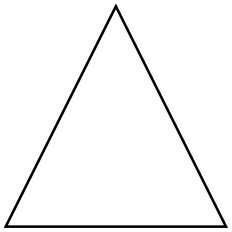
iv) A number ending in 5 is never divisible by 10.

v) A number ending in 1 can be a prime number.

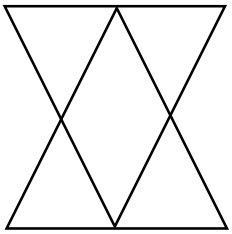
How many of the statements are true?

Answer: _____

23. The diagram shows an isosceles triangle with a base and height of 3 cm.



An identical triangle is inverted and placed on top of the upright triangle to make the following symmetrical shape.

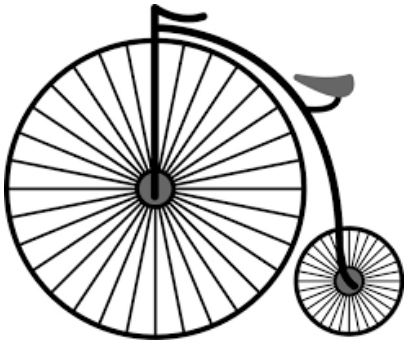


What is the area of diamond formed at the centre of the shape?

Answer: _____

24. This old-fashioned penny farthing bicycle has a front wheel with a circumference that is five times the circumference of the back wheel.

Both wheels have to be replaced when they have made 200 000 revolutions.



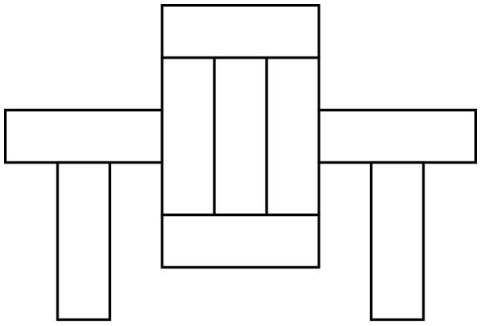
If the larger wheel has a circumference of 2 m, after how many km does the small wheel have to be replaced?

Answer: _____

25. What is the value of $17 \times 13 + 19 \times 17 - 2 \times 17$?

Answer: _____

26. The following shape is made from identical rectangles that each measure $1\,\text{cm} \times 3\,\text{cm}$.



(Not drawn to scale.)

What is the perimeter of the shape?

Answer: _____

27. What is the smallest prime number that is 1 less than a multiple of 10?

Answer: _____

28. The village in England with the smallest population is Fordham, with about 400 inhabitants.

Shanghai is the most populated city in the world, with about 24 million inhabitants.

How many times greater is the population of Shanghai than the population of Fordham?

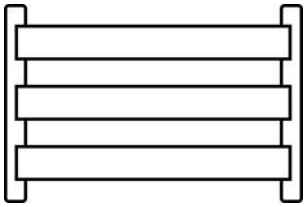
Answer: _____

29. In 2010, Ben was twice Tom's age.
In 2016, Ben was four years older than Tom.

How old was Tom in 2018?

Answer: _____

30. A farmer has 50 fence panels with which to make an enclosed area.
Each fence panel is 1 m wide.



The farmer will use all of the fence panels and the enclosed area will be a rectangle.

What is the difference between the largest and smallest areas that the farmer can make?

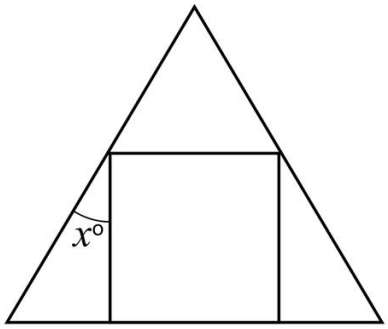
Answer: _____

31. If 12 kronor buy 1 pound and 180 dinars buy 1 pound, how many dinars can be purchased with 1 krona?

(*Kronor* is the plural of *krona*.)

Answer: _____

32. A square is placed inside an equilateral triangle.



What is the size of angle x?

Answer: _____

33. Ann takes 55 from 10 000 and then rounds the answer to the nearest 100.

Ann then takes the new number and repeats the process of subtracting 55 and then rounding to the nearest 100.

How many times altogether does Ann need to carry out this process before she reaches zero?

Answer: _____

34. Which multiple of 7 is nearest to 9999?

Answer: _____

35. A clock shows the time in digital 24-hour format.

There are always four digits displayed.

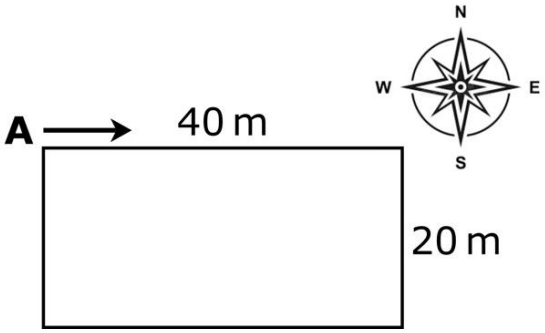
The digit 1 requires 2 bars of light, the digit 2 requires 5 bars and the digit 0 requires 6 bars.

One bar of light uses 60 joules of energy per minute.

Rounded to the nearest thousand, how many joules of energy will be used in 9 minutes starting at exactly 12:00 noon?

Answer: _____

36. The diagram shows a rectangular field.



A student started at point A and headed east, running around the field's perimeter many times.

The student stopped after 3050 m.

In which direction was the student facing when he stopped?

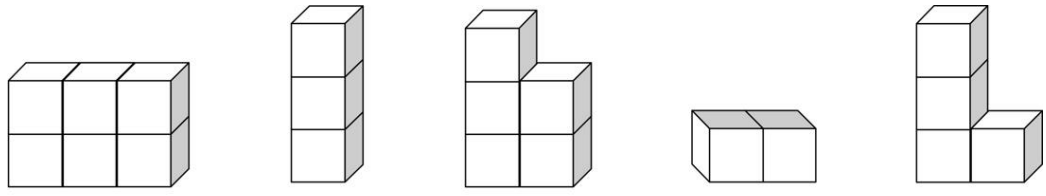
Answer: _____

37. One-quarter of a packet of biscuits has been eaten.
Two more biscuits are then taken, leaving 10 in the packet.

How many biscuits were in the packet before it was opened?

Answer: _____

38. The following shapes are made from 1 cm^3 cubes.



Together, four of the shapes can form a cuboid of volume 18 cm^3.

Which shape (A, B, C, D or E) is not required?

Answer: _____

39. Kim has eaten one-eighth of her grapes.

What percentage of Kim's grapes are yet to be eaten?

Answer: _____

40. In a class of 30 children, 20 play football, 19 play tennis and 6 play neither football nor tennis.

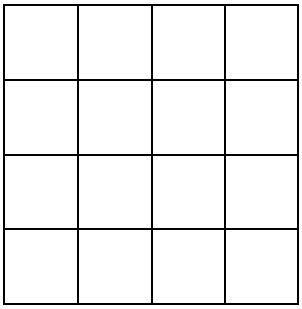
How many children play both football and tennis?

Answer: _____

41. What is the answer to $1000 - (2.5 \times 40 + 10) \div 11$?

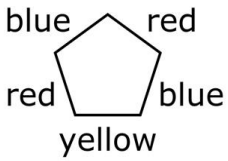
Answer: _____

42. Each line of unit length in the grid below is to be coloured.



What is the minimum number of colours that are required if lines of the same colour cannot meet?

For example, a triangle would need 3 different coloured lines and a pentagon would also need 3.



Answer: _____

43. If $3 \div D = \frac{1}{4}$, what is the value of D^2?

Answer: _____

44. The result of the calculation $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9$ ends in which digit?

Answer: _____

45. C ($A \times B - D$) = 56, when A = 2, B = 5 and C = 7.

What is the value of D?

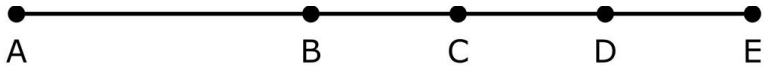
Answer: _____

46. A choir is made up of men and women in the ratio of 3 : 2.
Five men leave the choir and the new ratio is 5 : 4.

How many women are in the choir?

Answer: _____

47. Five towns, A–E, are positioned along a straight road.



From A to D is 160 km.
From C to E is 80 km.
From A to E is 200 km.

How far is it between C and D?
The diagram is not to scale.

Answer: _____

48. A ball is dropped from a height of 64 m.

The ball bounces back up to half of the original height.

Each time the ball drops back down to the ground, it bounces back up to half of the previous height.

After how many bounces will the height of the ball's bounce be less than 1 cm?

Answer: _____

49. A company wants to use a rainbow shape with five different colours as its logo.

The company will choose colours from the existing seven colours of the rainbow: red, orange, yellow, green, blue, indigo and violet.

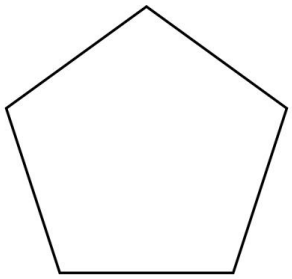
How many different rainbows could be produced?

Answer: _____

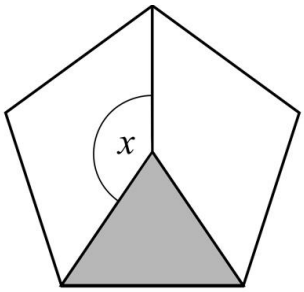
50. What is the difference between half of 260 and 0.25×400?

Answer: _____

51. The diagram shows a regular pentagon.



A grey isosceles triangle is placed inside the pentagon with a vertex touching the centre of the pentagon, as shown.



What is the size of angle x?

Answer: _____

52. How many 0.25 ml drips of water would it take to fill a 1 litre jug?

Answer: _____

53. What fraction of the word DECIMALISATION is made up of vowels? Write your answer in its simplest form.

Answer: _____

54. A carton of milk contains 4 litres.

After being opened, a fifth of the carton is consumed at breakfast, 400 ml is used for a hot chocolate drink at lunch and then half of what is left is used to make a cheese sauce for supper.

How much milk is left in the carton?

Answer: _____

55. The sizes of the angles in an irregular quadrilateral are in the ratio 1 : 2 : 4 : 5.

What is the size of the largest angle?

Answer: _____

56. **N** is a four-digit number in which all of the digits are different.

When 2345 is taken away from **N**, the result contains four identical digits, i.e. A A A A, where A is a positive integer.

When 2345 is reversed to make 5432 and then taken away from **N**, the result is a positive four-digit number.

What is the value of **N**?

Answer: _____

57. Two friends, 350 m apart, spot each other on opposite sides of a park.

Tom begins to jog at a speed of 1 m per second towards Joe, whilst Joe cycles at a speed of 2.5 m per second towards Tom.

After how much time do the friends meet?
Give your answer in minutes and seconds.

Answer: _____

58. A hive has one queen bee, about 200 drone bees and 50 000 worker bees.

The hive produces approximately 60 kg of honey per year.

The honey is sold in 500 g jars.

What is the ratio of worker bees to jars of honey produced?
Give your answer in its simplest form.

Answer: _____

59. A student sits a multiple-choice test.

There are with four possible answers for each question.

The student knows the answer to half of the questions but has to completely guess the answer to one-quarter of the questions.

For each of the remaining questions, the student is able to narrow down the options to two possible answers.

If there are 80 questions in the test and one mark is awarded for each correct answer, what is the most likely total to be scored by the student?

Answer: _____

60. The individual digits of 2222, multiply together to make 16, i.e. $2 \times 2 \times 2 \times 2 = 16$.

How many four-digit numbers have individual digits that multiply together to make 5?

Answer: _____

61. A supermarket has a parking area for trollies and scooters.

The trollies have one handle and the scooters have two handles.

A shop worker calculates that there are 40 handles and 30 items parked in the area.

How many of the items are scooters?

Answer: _____

62. Three consecutive numbers multiply together to make 1716.

What is the mean of the three numbers?

Answer: _____

63. The year is 2040 and Dr Science has invented a time machine that enables people to travel in time.

A year is entered into the machine and the person loses one hour of time for each year they travel backwards or forwards.

Dr Science chooses to travel back to the year 2000 where he stays for 2 hours before returning to 2040.

If Dr Science leaves at 10 a.m. on 1 April, at what time and date does he return?

Answer: _____

64. Mr and Mrs Love's daughter gave her parents a sapphire wedding anniversary card in 2018, knowing that they had been married for 45 years.

If Mrs Love was 21 when she married, in what year was Mrs Love born?

Answer: _____

65. At an amusement park, five stations are equally spaced round a circular track that is 2 km in circumference.

Five trains travel at an average speed of 8 km per hour and stop at every station they pass simultaneously, i.e. they all stop at a station at the same time and then move on to the next at the same time.

If the Smith family arrive at a station, what is the longest amount of time they will have to wait for a train?

Answer: _____

66. What is the answer to the following calculation?

$$\frac{22 \times 20 \times 18 \times 16 \times 14 \times 12 \times 10}{5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11}$$

Answer: _____

67. How many fewer quarters are there in 99 than in 130?

Answer: _____

68. Using the information that $22 \times 35 = 770$, how many factors, excluding 1 and 770, does 770 have?

Answer: _____

69. A bookcase has five shelves and contains 125 books in total.

The top shelf has twice as many books as the bottom shelf.

There are five more books on the second shelf than the third shelf.

The fourth shelf has the same number of books as the third and bottom shelf combined.

If there are 20 books on the third shelf, how many books are on the top shelf?

Answer: _____

70. What is the answer to $30 - (1 + (3 - 1)^2)^2$?

Answer: _____

71. What comes next in the following sequence?

99 96 91 84 75 ……

Answer: _____

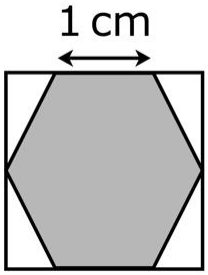
72. The fastest ever time for running 100 m is 9.6 seconds (to 1 d.p.). Stan can run 100 m in 10.8 seconds.

What percentage decrease in time, to the nearest one percent, does Stan need to achieve in order to equal the world record?

Answer: _____

73. This shape, which has two lines of symmetry, consists of a grey hexagon inside a square.

The area of the square is 4 cm².



What is the area of one of the small white triangles shown?

Answer: _____

74. Annual membership to a gym costs £330.

The alternative is to pay £3 per visit.

What is the minimum average number of times that Hal would have to visit the gym each week, to make it better value to opt for annual membership?

Your answer must be an integer (whole number).

Answer: _____

75. Which square number lies between 1300 and 1400?

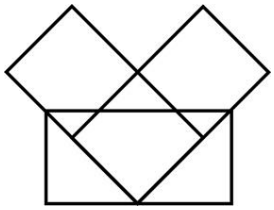
Answer: _____

76. Aunt May says, "My age is a square number and a cube number."
Nephew Neil says, "My age is neither a square number nor a cube number, but it is made from the same digits as your age, Auntie May."
Cousin Cary says, "Neil, I am 10 years less than half of your age."

How old is Cary?

Answer: _____

77. This shape is made from three identical overlapping rectangles.



If the measurements of each rectangle are 1 cm × 2 cm, what is the area of the shape?

Answer: _____

78. A car park is fitted with a security system that enables only guests with the code to gain access.

The code is made up of three different digits from 1 to 9, in any order, and a new code is automatically generated every day.

The system began on 1 September 2018 and will stop working when all possible codes have been generated.

In what year will the security system stop working?

Answer: _____

79. A map has a scale of 1 : 1000.

The area of the surface of a swimming pool is 1000 m^2 in real life.

What is the area of the pool in cm^2 on the map?

Answer: _____

80. ABCD is a quadrilateral.

Angle ABC = 90°.

Angle DAB = angle BCD.

Angle CDA < 90°.

What is the shape ABCD?

Answer: _____

81. I have 64 individual cubes of 1 cm^3.

I stick them together to make 1 large cube of 64 cm^3 and then paint the outside.

The shape is then separated into single cubes again.

What fraction of the total number of faces is painted?

Answer: _____

82. Which one of the integers from 1 to 9 is **not** a factor of 51 840?

Answer: _____

83. A large group of people who had taken driving lessons 10 years earlier were interviewed.

Half of the group passed their driving test first time, one-quarter passed on the second attempt, one-eighth passed on the third attempt, and one in 8 never passed.

What percentage of those who failed their first test have still not passed?

Answer: _____

84. A palindrome is a number that reads the same forwards and backwards.

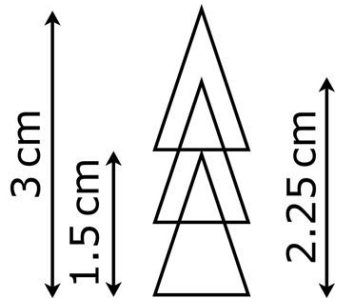
For example, 12321 is a 5-digit palindrome that uses three different digits.

Which 5-digit palindrome that uses three different digits is closest to 50 000?

Answer: _____

85. Three triangles of base 1 cm and height 1.5 cm are put together as shown.

The central triangle is positioned equal distance from the top and bottom of the compound shape.



What is the area of the shape?

Answer: _____

86. Fay presses five random buttons on her calculator to make a 5-digit number.

What is the probability that Fay's number is divisible by 5?

Answer: _____

87. Together, Ann and Ali have £7.80.
Ali has 40 p more than Ann.

How much money does Ann have?

Answer: _____

88. Mr Rhyme can write 3 limericks in the same time that it takes to write 1 long poem.

Mr Rhyme can write 2 long poems in 3 hours.

How long does it take Mr Rhyme to write 2 limericks?

Answer: _____

89. The rule for the following sequence is:

'After the first two terms, each number is the product of the two previous terms.'

……, ……, 6, 18, ……, 1944

What is the sum of the three missing terms?

Answer: _____

90. In 2019, Len's birthday was on Wednesday 2 January.

In which year will Len's birthday next fall on a Wednesday?

It may help to know that there are 365 days in a year with a leap year every four years.

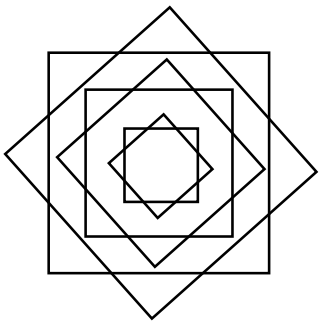
Answer: _____

91. How many positive numbers less than 500 are divisible by both 6 and 7?

Answer: _____

92. The diagram below is made from six squares, three of which have been rotated 45°.

What is the ratio of the number of triangles seen to squares used?



Answer: _____

93. What is $0.02 \times 0.03 \times 0.04$?

Answer: _____

94. Consider a square and a rectangle.

The side lengths of both shapes are all whole numbers.

The area of the square is the same as its perimeter.

The area of the rectangle is the same as its perimeter.

What is the difference between the area of the square and the area of the rectangle?

Answer: _____

95. Eve thinks of a number.

She adds three, divides 20 by the result, multiplies that result by 2 and then, finally, subtracts that result from 15.

The final answer is 7.

What was Eve's original number?

Answer: _____

96. The difference between adding 3 to a certain positive number, **N**, and doubling **N** is 8.

What is the number **N**?

Answer: _____

97. House prices have gone up by 450% since 1996.

If a house cost £80 000 in 1996, what is its value now?

Answer: _____

98. Point **A** starts at the coordinates (3, 2).

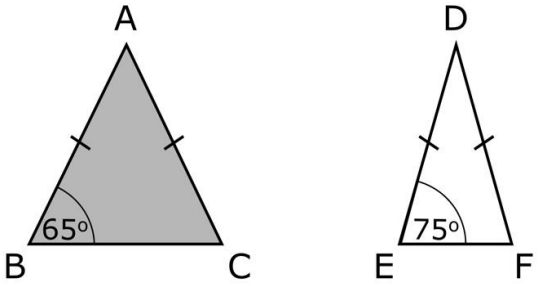
It travels down 1 unit and left 2 units.

It is then reflected in the y-axis and finally rotated 90° anticlockwise using the origin as the centre of the rotation.

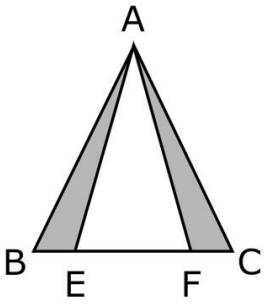
What are the final coordinates of point **A**?

Answer: _____

99. Two isosceles triangles, ABC and DEF, are shown.



The smaller triangle is placed inside the larger triangle as shown to create a shape with one line of symmetry.



What is the size of angle BAE?

Answer: _____

100. The cost of mailing a parcel in pence is given as:

$P = 150 + W \times 0.2$, where W is the weight in grams.

What is the cost in pounds to mail a parcel that weighs 10 g more than 1 kg?

Answer: _____

101. The smaller angle between two hands of a clock is 130°.

If the time is somewhere between 8 a.m. and 9 a.m., what is the 24-hour time?

Answer: _____

102. The four digits on the display of a 24-hour clock are all the same digit, but not zero.

What is the fewest number of minutes it could be until midnight?

Answer: _____

103. What is the value of C in the following long division sum, in which C and B stand for different numbers?

$$\begin{array}{r} 1\ C\ C\ C\ \text{r3} \\ 5\overline{)\,B\ B\ B\ B} \end{array}$$

Answer: _____

104. 40% of American households own a dog and there are around 120 million households in America.

25% of English households own a dog out of about 24 million households.

How many times more households in the USA own a dog than in England?

Answer: _____

105. Each letter in the following calculation stands for a different digit:

$B \times C^2 \times D^3 = 360$

What is the value of B?

Answer: _____

106. The rectangles below are all identical and have a length that is four times the width.

Three rectangles are coloured grey and three are coloured black.

They are placed together with the three black rectangles underneath the grey rectangles and perpendicular to them, as shown.

What fraction of the area of one rectangle is the area of one of the small white squares formed?

Answer: _____

107. A square has two diagonals.

How many diagonals does an octagon have?

Answer: _____

108. Daisy says,
"Mum, you are 2 years older than 5 times my age.
Dad, you are 3 years less than 6 times my age."
Daisy's dad is 1 year older than Daisy's mum.

How old is Daisy?

Answer: _____

109. A company charges a booking fee of 2½% when selling tickets.

If Mr Singh purchases 4 tickets for £45 each, what is the total cost including the booking fee?

Answer: _____

110. There are 135 pupils in Year 6 at Learnalot School.

More than 100 of these pupils are present on Monday but some of them are away.

In Monday's assembly, the Year 6 pupils who are present sit in equal lines of 12 and then file out in equal rows of 5.

How many Year 6 pupils are away?

Answer: _____

111. If $5(b + 3) = 35$, what is the value of b?

Answer: _____

112. Dan writes down the largest 3-digit number that can be made with three different 1-digit prime numbers.

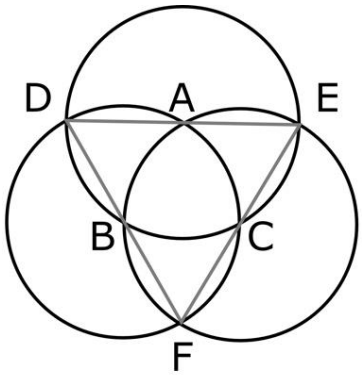
He then writes down the largest 3-digit number that can be made with three different 1-digit square numbers.

Finally, Dan works out the difference between his two numbers.

How many different 1-digit cube numbers are found in the digits of Dan's final number?

Answer: _____

113. Three identical circles join together to form a new shape.



A, B and C represent the centre of each circle and the place where the other two circles intersect.

DE, EF and FD are the diameters of the circles and 3 cm in length.

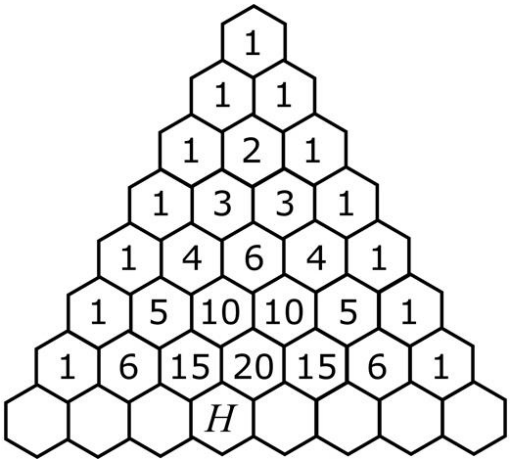
A beetle walks from D to A, from A to C, from C to B and then finally, from B to D.

It always moves in a straight line.

How far does the beetle walk?

Answer: _____

114. The following pattern shows Pascal's triangle, which has important mathematical qualities.



Which number belongs in the hexagon marked H?

Answer: _____

115. $\frac{5}{8}$ of a bag of flour has been used up.

A further 250 g of flour from the bag is used for a cake, leaving $\frac{1}{8}$ of the original amount in the bag.

How much flour was in the bag originally?

Answer: _____

116. What is the minimum number of pairs of brackets that is required to make this calculation correct?

$12 + 3 - 2 + 9 = 1 + 1^2$

Answer: _____

117. This magic square, in which all columns, rows and diagonals add up to the same amount, has some missing numbers.

1		25		19
	9		3	
18		12		6
	21		20	
10		4		23

What is the total of the missing numbers?

Answer: _____

118. The following shapes make a pattern that goes on and on…
The first 13 shapes are shown.

Draw or name the 200th shape in the pattern.

Answer: _____

119. Which fraction is halfway between $\frac{1}{2}$ and $1\frac{1}{3}$?

Answer: _____

120. A bag of sweets weighs 900 g minus half of its own weight.

How much does the bag of sweets weigh?

Answer: _____

EXAM PAPERS PLUS

11+ Maths: Problem Solving

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Pack 1

Answers and Step-by-Step Solutions

1. **Step 1:** Work out the surface area of one face of one cube.

$1\,\text{cm} \times 1\,\text{cm} = 1\,\text{cm}^2$

Step 2: Then use your answer to find the area of each different face of the cuboid.

Area of top or bottom face $= 1\,\text{cm}^2 \times 6 = 6\,\text{cm}^2$

Area of each side $= 1\,\text{cm}^2 \times 3 = 3\,\text{cm}^2$

Area of each end $= 1\,\text{cm}^2 \times 2 = 2\,\text{cm}^2$

Step 3: Finally, add the areas of all the faces to find the total surface area of the cuboid.

Total surface area $= (2 \times 6) + (2 \times 3) + (2 \times 2)$

$= 12 + 6 + 4$

$= 22\,\text{cm}^2$

Answer: **$22\,\text{cm}^2$**

2. **Step 1:** Start by writing down the first ten square numbers:

$1^2 = 1$, $2^2 = 4$, $3^2 = 9$, $4^2 = 16$, $5^2 = 25$,

$6^2 = 36$, $7^2 = 49$, $8^2 = 64$, $9^2 = 81$, $10^2 = 100$

Step 2: Then work out the difference between each pair of consecutive square numbers.

$4 - 1 = 3$

$9 - 4 = 5$

$16 - 9 = 7$

$25 - 16 = 9$

$36 - 25 = 11$

$49 - 36 = 13$

$64 - 49 = 15$

$81 - 64 = 17$

$100 - 81 = 19$

Step 3: Finally, identify the differences that are *not* prime numbers and count how many there are in total.

Only 9 and 15 are not prime, so the answer is 2.

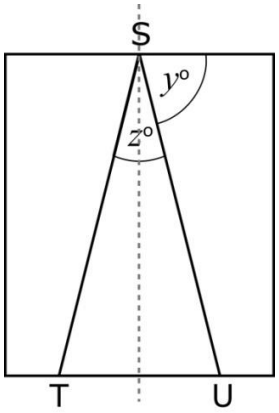
Answer: **2**

Remember, a prime number has only two factors: 1 and itself.

3. **Step 1:** Consider the information that you are given.

If ST = SU, then the triangle is isosceles.

Since the triangle is isosceles, the shape is symmetrical (with a vertical mirror line through point S).



Step 2: Write an equation using the information in the diagram and your knowledge of angles on a straight line.

Since angles on a straight line add up to 180°:

$180° = y° + z° + y°$

$180° = 2y° + z°$

Step 3: Rearrange your equation to match the equation in the question and then identify the missing information.

$180° = 2y° + z°$

$180° - 2y° = z°$

Hence, the answer required is $2y°$.

Answer: **$2y°$** (Accept $2y$)

4. **Step 1:** Start by considering the results of calculations that use only two 4s.

$4 + 4 = 8$, $4 - 4 = 0$, $4 \times 4 = 16$, $4 \div 4 = 1$

Step 2: Then think about how they can be combined to produce a calculation involving four 4s that gives an answer of 2.

For example:

$\mathbf{4 \div 4 + 4 \div 4} = 1 + 1 = 2$

$\mathbf{4 \times 4 \div (4 + 4)} = 16 \div 8 = 2$

Answer: **Accept any calculation that works, but it must use the number 4 four times.**

Remember the rules of BIDMAS / BODMAS when writing your calculation.

5. **Step 1:** First, remove the fraction from the equation.

$2222 \times H = 8888 \times \frac{1}{H}$

$2222 \times H = 8888 \div H$

Remember, multiplying a number by a unit fraction (a fraction with a numerator of 1) is the same as dividing the number by the denominator of the fraction, e.g.

$10 \times \frac{1}{2} = 5$ *and* $10 \div 2 = 5$.

Step 2: Multiply both sides by H.

$2222 \times H^2 = 8888$

Step 3: Divide both sides by 2222.

$H^2 = 4$

Step 4: Square root both sides to find the value of H.

$H = 2$ or -2

Answer: ***H* = 2 or −2** (Full marks for either or both answers.)

6. **Step 1:** Consider the information you are given.

The password has three characters.

There are 5 different possibilities for the first character.

There are 5 different possibilities for the second character.

There are 5 different possibilities for the third character.

Step 2: Multiply to find the total number of different combinations possible for Wayne's password.

$5 \times 5 \times 5 = 125$

Answer: **125 passwords**

7. **Step 1:** Use the information you are given to write an equation.

If the number doubled = $2 \times N$

Then the number halved = $N \div 2$

So:

$2 \times N - N \div 2 = 21$

$$2N - \frac{N}{2} = 21$$

Step 2: Multiply all of the terms of both sides by 2.

$4N - N = 42$

$3N = 42$

Step 3: Divide both sides by 3 to find the value of N.

$N = 14$

Step 4: Check your answer.

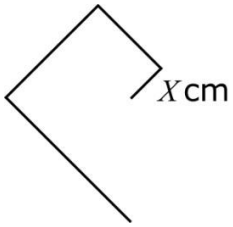
$2 \times 14 = 28$

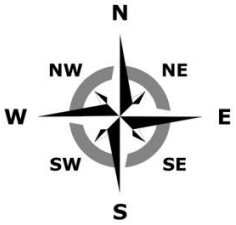
$14 \div 2 = 7$

$28 - 7 = 21$

Answer: **14**

8. **Step 1:** Identify the starting direction of the ant.





The ant starts off facing northeast.

Step 2: Work out how far the ant will have travelled when it turns to face northeast for the 2nd time.

The ant will turn to face northeast again after walking along the 4th line, so:

$x + 2x + 3x + 4x = 10x$ cm

Step 3: Work out how far the ant will have travelled when it turns to face northeast for the 3rd time.

The ant will turn to face northeast again after walking along the 8th line, so:

$10x + 5x + 6x + 7x + 8x = 36x$ cm

Answer: **$36x$ cm**

9. **Step 1:** Work out the number of seconds in one week.

There are 60 seconds in 1 minute.

There are 60 minutes in 1 hour.

There are 24 hours in 1 day.

There are 7 days in 1 week.

So, number of seconds in 1 week = $60 \times 60 \times 24 \times 7$

$= 604\,800$

Step 2: Round your answer to the nearest half million (500 000).

604 800 rounds to 500 000 seconds

Answer: **500 000 seconds**

10. **Step 1:** Work out how many boys are in the club.

There are 33 children and the ratio of girls to boys is 6 : 5.

6 + 5 = 11

$$\text{Number of boys} = \frac{33}{11} \times 5$$

$$= 3 \times 5$$

$$= 15$$

Step 2: Then work out how many boys are in Team C.

There are 11 boys in team B.

Boys in Team C = 15 – 11 = 4

Answer: **4 boys**

11. **Step 1:** Work out the total volume of the tank.

Volume = $40\,\text{cm} \times 20\,\text{cm} \times 20\,\text{cm} = 16\,000\,\text{cm}^3$

Step 2: Then work out half of the volume of the tank.

$16\,000\,\text{cm}^3 \div 2 = 8000\,\text{cm}^3$

Half of the tank is empty so prisms with a total volume of $8000\,\text{cm}^3$ can be added before it begins to overflow.

Step 3: Work out the volume of one prism.

Volume of prism = area of triangle $\times$ length

$$= (\frac{1}{2} \times \text{base} \times \text{height}) \times \text{length}$$

$$= (0.5 \times 6 \times 4) \times 10$$

$$= 120\,\text{cm}^3$$

Step 4: Divide $8000\,\text{cm}^3$ by the volume of one prism to see how many can be placed into the tank before it overflows.

$8000 \div 120 = 66.67$ (2 d.p.)

So, 66 prisms can be placed into the tank without it overflowing (it will overflow if 67 prisms are put in).

Answer: **66 prisms**

12. **Step 1:** Start by looking at the digits in the units column and the tens column.

Since $T \times T = Q$ in both columns, there is nothing being carried over so Q must be a digit less than 10.

T is being multiplied by itself, so Q is also a square number.

Step 2: Identify all of the square numbers that are less than 10.

Square numbers less than 10: 1, 4 and 9.

Step 3: Narrow down the possible values.

T cannot be 1 as that would give $T \times T = T$.

So, T is 2 and Q is 4 OR T is 3 and Q is 9.

Step 4: Now consider the thousands column.

$T \times Q = Q$

If T is 2 and Q is 4, the answer would be 8 and we would not have the extra S in the ten thousands column of the answer.

Hence, T is 3 and Q is 9.

Step 5: Substitute your values into the multiplication and complete the calculation to find S.

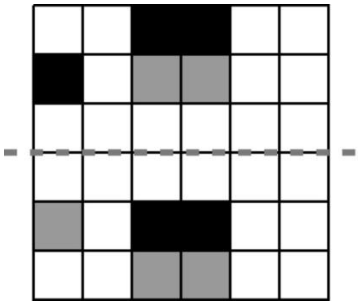
$$\begin{array}{cccccc} & 9 & 9 & 3 & 3 \\ \times & & & & 3 \\ \hline 2 & 9 & 7 & 9 & 9 \\ \hline {\scriptstyle 2} & {\scriptstyle 2} & & & \end{array}$$

So, S is 2.

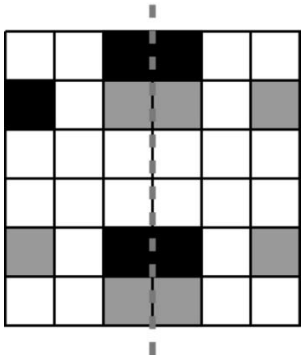
Answer: **2**

13. **Step 1:** First consider the horizontal line of symmetry.

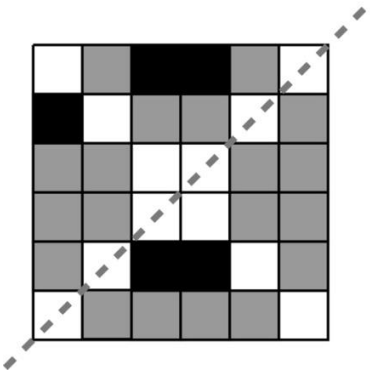
The grey squares show which squares need to be coloured black to create symmetry.



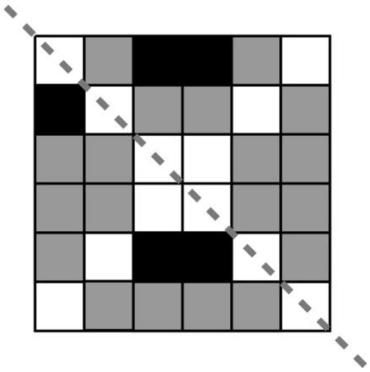
Step 2: Next consider a vertical line of symmetry.



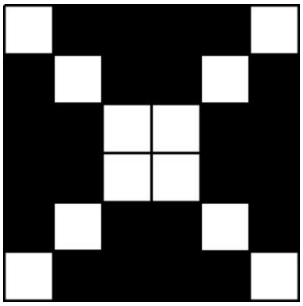
Step 3: Next consider one diagonal line of symmetry.



Step 4: Finally, consider the second diagonal line of symmetry.



This has symmetry, so no further squares need to be coloured.



Step 5: Count the total number of black squares and then work out the final answer.

24 black squares – 5 (in original diagram) = 19

So, 19 more squares need to be coloured so that the grid has four lines of symmetry.

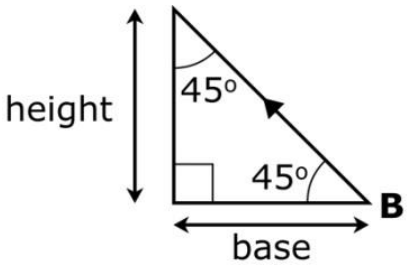
Answer: **19 squares**

14. **Step 1:** Consider the information you are given.

The rocket travels straight up from point A to B, so you only need to look at its path after it turns at point B to calculate its distance from A when it lands.

Step 2: Use the information given to draw a triangle.

The angle of turn is 45°, so the triangle is a right-angled isosceles triangle.



Step 3: Work out the height of the triangle.

The rocket reaches a total height of 70 km and it was 50 km from A to B, so:

Height of triangle = 70 – 50 = 20 km

Step 4: Use the height of the triangle to deduce how far the rocket will land from A.

The rocket falls straight back down to Earth, so the distance that it will land from A is the length of the base of the triangle.

As the triangle is isosceles, the base is equal to

the height.

So, the distance the rocket lands from A is 20 km.

Answer: **20 km**

15. **Step 1:** Convert the fraction and percentage to equivalent decimal numbers.

5% = 0.05

$\frac{1}{5}$ = 0.2

Step 2: Substitute the decimals into the calculation and complete the sum.

0.05 + 0.5 + 0.2 = 0.75

Answer: **0.75** (Accept $\frac{3}{4}$ or 75%)

16. **Step 1:** Work out how the number of individual gloves in the box.

20 pairs of gloves = 40 individual gloves

Step 2: Consider taking gloves from the box one at a time at random.

It is possible to take 20 gloves from the box and have no matches (i.e. to take one from each pair).

Only when 3 further gloves are taken out can the triplets be sure of having three matching pairs.

Step 3: Work out the final answer.

20 + 3 = 23 gloves

Answer: **23 gloves**

17. **Step 1:** Let the two numbers be A and B and use the given information to set up two equations.

The halfway point between A and B (or the mean) is –3, so:

$(A + B) \div 2 = -3$

$(A + B) = -3 \times 2$

$A + B = -6$

The product of A and B is –40, so:

$A \times B = -40$

Step 2: $A \times B = -40$, so write down the factor pairs of –40.

1 and –40, 2 and –20, 4 and –10, 5 and –8,

–1 and 40, –2 and 20, –4 and 10, –5 and 8

Step 3: $A + B = -6$, so look for a factor pair with a total of –6.

4 and –10 are the only factor pair with a total of –6, so these are the two numbers A and B.

Step 4: Find the difference between the two numbers.

$4 - (-10) = 14$

Answer: **14**

18. **Step 1:** Consider the information that you are given and work out the smallest share.

There is an equal number of 20 p and 10 p coins, so the smallest share is 20 p + 10 p = 30 p.

Step 2: Work out how many shares there are altogether and the number of coins.

£2.40 = 240 p

240 p ÷ 30 p = 8 shares

So, there are 8 × 20 p coins and 8 × 10 p coins.

Step 3: Calculate the total weight of the coins.

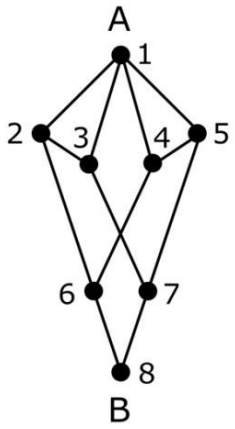
Total weight of coins = (8 × 5 g) + (8 × 6.5 g)

= 40 g + 52 g

= 92 g

Answer: **92 g**

19. **Step 1:** Number the junctions marked with black dots.



Step 2: Systematically work though the possibilities, starting with routes that begin 1, 2, …

1, 2, 6, 8

1, 2, 6, 4, 5, 7, 8

1, 2, 3, 7, 8

1, 2, 3, 7, 5, 4, 6, 8

Step 3: Next, look at routes that begin 1, 3, …

1, 3, 7, 8

1, 3, 7, 5, 4, 6, 8

1, 3, 2, 6, 4, 5, 7, 8

1, 3, 2, 6, 8

Step 4: Use this information to find the total number of different routes from A to B.

The pattern is symmetrical, so there will be the same number of routes beginning 1, 4, … and 1, 5, … as there were for 1, 2, … and 1, 3, …

So, the total number of routes is $4 \times 4 = 16$.

Answer: **16 routes**

20. **Step 1:** First work out the number of seconds it will take to type 2400 characters.

2 characters are typed every second, so

2400 ÷ 2 = 1200 seconds

Step 2: Then convert your answer to minutes.

1200 seconds ÷ 60 = 20 minutes

Answer: **20 minutes**

21. **Step 1:** Work out the total number of moves in the first five games.

$30 + 40 + 45 + 35 + 50 = 200$

Step 2: Then work out the total number of moves in all six games.

The average number of moves for all six games is 42, so the total is $42 \times 6 = 252$

Step 3: Calculate the difference, to find the number of moves in game six.

$252 - 200 = 52$ moves

Answer: **52 moves**

22. **Step 1:** Look at each statement in turn and decide if it is true or false. Try to think of examples that help to prove / disprove each statement.

vi) A number ending in 4 is never divisible by 3.

24 is divisible by 3 so this is false.

vii) A number ending in 3 is never divisible by 4.

An odd number cannot be divisible by 4 so this is true.

viii) A number ending in 0 is always divisible by 5.

A number ending in 0 is always divisible by 10 and, therefore, always divisible by 5 so this is true.

ix) A number ending in 5 is never divisible by 10.

Numbers divisible by 10 must end in a 0 so this is true.

x) A number ending in 1 can be a prime number.

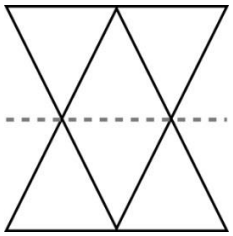
11 is a prime number ending in 1 so this is true.

Step 2: Count up the number of true statements.

Four are true.

Answer: **4**

23. **Step 1:** Draw a horizontal line through the shape to divide it into six equal triangles.



Step 2: Write an equation for the area of one small triangle.

As the base and height of the original triangle is 3 cm, the base and height of each small triangle is 1.5 cm.

$$\text{Area of a small triangle} = \frac{1}{2} \times \text{base} \times \text{height}$$
$$= 0.5 \times 1.5 \times 1.5$$

Step 3: Use your equation to find the area of the diamond.

The diamond is made from 2 small triangles, so:

$$\text{Area of a diamond} = \text{base} \times \text{height}$$
$$= 1.5 \times 1.5$$
$$= 2.25\,\text{cm}^2$$

Answer: **$2.25\,\text{cm}^2$**

24. **Step 1:** Work out the circumference of the small wheel.

$2\,\text{m} = 200\,\text{cm}$

$200\,\text{cm} \div 5 = 40\,\text{cm}$

Step 2: Calculate the distance travelled by the small wheel in 200 000 revolutions.

$200\,000 \times 40\,\text{cm} = 8\,000\,000\,\text{cm}$

$8\,000\,000\,\text{cm} = 80\,000\,\text{m} = 80\,\text{km}$

Answer: **80 km**

25. **Step 1:** First take out the common term to simplify the calculation.

$\times 17$ is common to all three parts of the calculation, so take this out to leave:

$13 + 19 - 2 = 30$

Step 2: Now bring in the common term.

$30 \times 17 = 510$

Answer: **510**

26. **Step 1:** Count the number of long side lengths around the perimeter of the shape.

There are 8 long side lengths of 3 cm:

$8 \times 3\,\text{cm} = 24\ \text{cm}$

Step 2: Then count the number of short side lengths around the perimeter of the shape.

There are 16 short side lengths of 1 cm:

$16 \times 1\,\text{cm} = 16\ \text{cm}$

Step 3: Add them together to find the total perimeter of the shape.

$24 + 16 = 40\,\text{cm}$

Answer: **40 cm**

27. **Step 1:** List the multiples of 10.

10, 20, 30, 40, 50, …

Step 2: Subtract 1 from each multiple of 10.

9, 19, 29, 39, 49, …

Step 3: Identify the smallest prime number.

9 is not prime but 19 is.

Therefore, 19 is the smallest prime number that is one less than a multiple of ten (20).

Answer: **19**

28. **Step 1:** Divide the population of Shanghai by the population of Fordham to find the scale factor.

$24\,000\,000 \div 400 = 60\,000$

Shanghai's population is 60 000 times greater.

Answer: **60 000 times**

29. **Step 1:** Use the given information to set up two equations.

Let B = Ben's age in 2010 and T = Tom's age in 2010.

In 2010: $B = 2 \times T$

In 2016: $B + 6 = T + 6 + 4$

$B = T + 4$

Step 2: Substitute your second equation (2016) into the first (2010) to remove B and find the value of T.

$T + 4 = 2 \times T$

$T + 4 = 2T$

$4 = 2T - T$

$T = 4$

Step 3: Use your answer to find Tom's age in 2018.

T = Tom's age in 2010, so:

Tom's age in 2018 = 4 + 8 = 12

Answer: **12 years old**

30. **Step 1:** Find the smallest area that the farmer can make using all of the fence panels.

Area of rectangle = length × width

Total length of fencing = 50 m, so

one length + one width = 25 m

Therefore, possible widths and lengths could be:

1 and 24, 2 and 23, 3 and 22, 4 and 21, etc.

The smallest area will be a rectangle with a width of 1 m and a length of 24 m.

Smallest area = 24 m × 1 m = 24 m²

Step 2: Find the largest area the farmer can make using all of the fence panels.

The largest area will be a rectangle with a width of 12 m and a length of 13 m.

Largest area = 13 m × 12 m = 156 m²

Step 3: Calculate the difference between the largest area and the smallest area.

156 – 24 = 132 m².

Answer: **132 m²**

31. **Step 1:** Consider the information you are given.

12 kronor = £1

180 dinars = £1

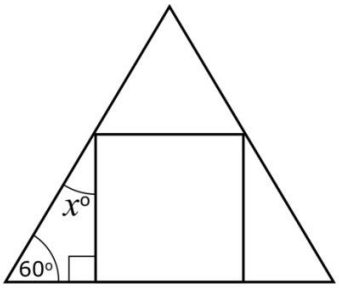
So, 180 dinars = 12 kronor

Step 2: Use this information to calculate how many dinars are equal to 1 krona.

180 dinars ÷ 12 = 15 dinars

Answer: **15 dinars**

32. **Step 1:** Look at the diagram and identify any known angles.



You are told that the large triangle is equilateral, so all of its angles are 60°.

This means that two of the angles of the triangle in which angle x is positioned are known: one is 60° and one is a right angle (90°).

Step 2: Calculate the size of angle x.

x = 180° – 90° – 60°

= 30°

Answer: **30°**

33. **Step 1:** Consider the information you are given.

$10\,000 - 55 = 9945 \rightarrow 9900$ (to the nearest 100)

$9900 - 55 = 9845 \rightarrow 9800$ (to the nearest 100)

Every time Ann takes away 55 and then rounds to the nearest 100, she is subtracting 100.

Step 2: Use this information to find the total number of times that Ann must carry out this process to reach 0.

$10\,000 \div 100 = 100$, so Ann needs to repeat the process 100 times to reach 0.

Answer: **100 times**

34. **Step 1:** Divide 9999 by 7.

9999 ÷ 7 = 1428 r 3

Step 2: Use this information to find the closest multiple of 7 to 9999.

9999 ÷ 7 = 1428 r 3

Hence, 3 less than 9999 will be a multiple of 7.

9999 – 3 = 9996

Answer: **9996**

35. **Step 1:** Work out the total number of bars required for 12:00 noon.

2 + 5 + 6 + 6 **=** 19 bars

Step 2: Use your answer to work out the number of bars for each time from 12:00 to 12:08.

12:00 is 19 bars

12:01 is 4 less than 12:00 so 15 bars.

12:02 is 1 less than 12:00 so 18 bars.

12:03 is the same as 12:02 so 18 bars.

12:04 is 2 less than 12:00 so 17 bars.

12:05 is the same as 12:02 so 18 bars.

12:06 is the same as 12:00 so 19 bars.

12:07 is 3 less than 12:00 so 16 bars.

12:08 is 1 more than 12:00 so 20 bars.

Step 3: Add up the total number of bars for the 9 minute period.

19 + 15 + 18 + 18 + 17 + 18 + 19 + 16 + 20 = 160

You might find it easier to calculate 9 × 20 = 180 *and then subtract the amounts less than 20 each time.*

Step 4: Calculate the amount of energy used.

Each set of bars is used for 1 minute, so:

160 × 60 joules = 9600 joules

Step 5: Round your answer to the nearest thousand.

9600 → 10000 joules (to the nearest thousand)

Answer: **10000 joules**

36. **Step 1:** Calculate the perimeter of the field.

$40 + 20 + 40 + 20 = 120\,\text{m}$

Step 2: Work out how many laps the student ran.

$3050\,\text{m} \div 120 = 25\text{ r }50$

Step 3: Use this information to work out the direction the student is facing when he stops running.

The student is 50 m past the beginning of the track when he stops, so halfway down the right-hand side facing south.

Answer: **South**

37. **Step 1:** Work out how many biscuits were left after one-quarter were eaten.

10 + 2 = 12 biscuits

12 biscuits represent $\frac{3}{4}$ of the pack.

Step 2: Work out how many biscuits there are in $\frac{1}{4}$ of the pack.

12 ÷ 3 = 4 biscuits

Step 3: Add to find the original number of biscuits in the pack before it was opened.

12 + 4 = 16 biscuits

Answer: **16 biscuits**

38. **Step 1:** Consider the information you are given.

The cuboid has a volume of 18 cm^3.

Therefore, you are looking for four shapes that are made of 18 cubes altogether.

Step 2: Look at shapes A–E.

The five shapes are made from 20 cubes altogether, so a shape made from 2 cubes must be omitted.

This is shape D.

Answer: **D**

39. **Step 1:** Convert the fraction to its equivalent percentage.

$\frac{1}{8}$ = 12.5%

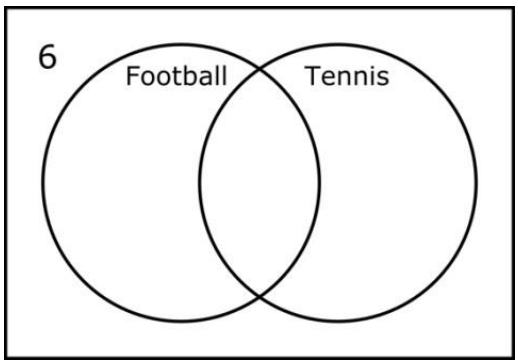
Step 2: Subtract to find the percentage of grapes not yet eaten.

100% – 12.5% = 87.5%

Answer: **87.5%**

40. **Step 1:** Sketch a Venn diagram.

If 6 pupils play neither sport, 30 – 6 = 24 play one or both of the sports.



Step 2: Work out how many children play both sports.

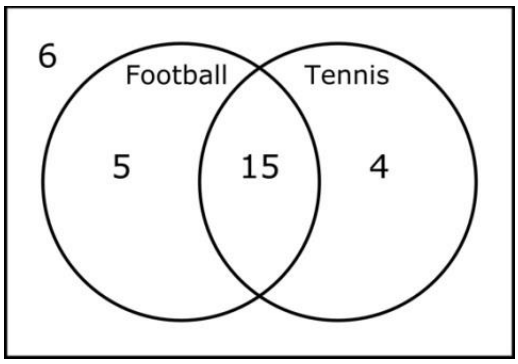
20 + 19 = 39

However, only 24 children play one or both of the sports.

39 – 24 = 15

15 represents the overlap – the children who play both sports.

Step 3: Complete the Venn diagram to check your answer.



6 + 5 + 15 + 4 = 30 ✓

Answer: **15 children**

41. **Step 1:** Using BIDMAS / BODMAS, carry out the operations in the brackets first.

$2.5 \times 40 + 10 = 100 + 10 = 110$

Step 2: Next carry out the division.

$110 \div 11 = 10$

Step 3: Finally, carry out the subtraction.

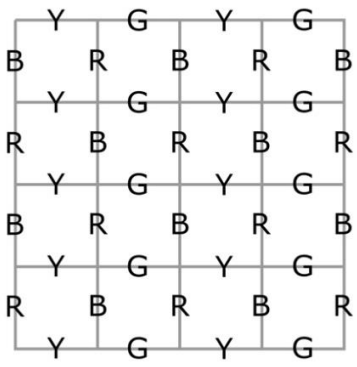
$1000 - 10 = 990$

Answer: **990**

42. **Step 1:** Consider the grid.

There are points where four lines meet, so 4 different colours are needed to ensure that lines of the same colour do not meet.

For example, if blue = B, green = G, yellow = Y and red = R:



Answer: **4 colours**

43. **Step 1:** Write the equation as two fractions and then solve to find D.

$$\frac{3}{D} = \frac{1}{4}$$

$$\frac{12}{D} = 1$$

$$12 = D$$

Step 2: Now multiply D by itself to find D^2.

$D^2 = 12 \times 12 = 144$

Answer: **144**

44. **Step 1:** Consider the numbers being multiplied.

You have even numbers being multiplied by 5, which will always produce a multiple of 10, ending in 0, e.g.

$4 \times 5 = 20$

Therefore, the final answer will be a multiple of 10 ending in 0.

Answer: **0**

The answer to the calculation is

$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 = 362\,880$

45. **Step 1:** Substitute the given numbers into the calculation.

$C\,(A \times B - D) = 56$

$7\,(2 \times 5 - D) = 56$

Step 2: Divide both sides by 7.

$(2 \times 5 - D) = 8$

Step 3: Carry out the multiplication in the brackets and solve to find D.

$10 - D = 8$

$D = 2$

Answer: **2**

46. **Step 1:** Multiply both parts of the first ratio by 2 so that the two ratios can be directly compared.

$3:2 = 6:4$

$6:4$ men to women (original number in choir)

$5:4$ men to women (new number in choir)

Step 2: Compare the ratios.

The difference is 1 out of ten parts.

Hence, one-tenth of the choir leaves.

You are told that 5 men left the choir, so 5 is $\frac{1}{10}$ of the original number of choir members.

Step 3: Work out how many women are in the choir.

The original ratio of men to women was $6:4$, so $\frac{4}{10}$ were women.

Number of women in choir $= 4 \times 5 = 20$

Answer: **20 women**

47. **Step 1:** Look at the first two given distances.

A to D = 160 km

C to E = 80 km

160 + 80 = 240 km

There is an overlap; both distances include C to D.

Therefore, 240 km is A to E plus an extra C to D.

Step 2: Use this information to calculate C to D.

C to D = 240 – A to E

= 240 – 200

= 40 km

Answer: **40 km**

48. **Step 1:** Work out the height of each bounce in turn, halving each time.

1st bounce = 32 m

2nd bounce = 16 m

3rd bounce = 8 m

4th bounce = 4 m

5th bounce = 2 m

6th bounce = 1 m

7th bounce = 50 cm

8th bounce = 25 cm

9th bounce = 12.5 cm

10th bounce = 6.25 cm

11th bounce = 3.125 cm

12th bounce = slightly more than 1.5 cm

13th bounce = less than 1 cm

Hence, after 12 bounces the height of the ball's bounce will be less than 1 cm.

Answer: **12 bounces**

49. **Step 1:** Consider the information you are given.

The rainbow has five stripes and each one must be a different colour.

There are seven colours to choose from in total.

Therefore:

- the 1st stripe can be one of 7 colours
- the 2nd stripe can be one of 6
- the 3rd stripe can be one of 5
- the 4th stripe can be one of 4
- the 5th stripe can be one of 3.

Step 2: Use this information to calculate the number of different combinations possible.

$7 \times 6 \times 5 \times 4 \times 3 = 2520$

Answer: **2520 different rainbows**

50. **Step 1:** First work out half of 260.

$260 \div 2 = 130$

Step 2: Then work out 0.25×400.

$0.25 = \frac{1}{4}$

$400 \div 4 = 100$

Step 3: Find the difference.

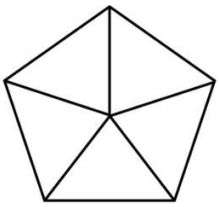
$130 - 100 = 30$

Answer: **30**

Being able to recall decimal and fraction equivalents is very helpful when solving problems like this one.

51. **Step 1:** Work out the size of the vertex angle of the grey isosceles triangle.

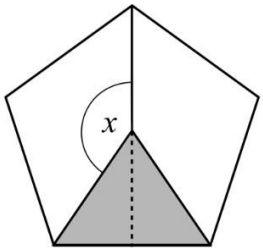
A regular pentagon can be divided into five identical isosceles triangles.



Hence, the vertex angle of the triangle (the angle touching the centre of the pentagon) = 360° ÷ 5 = 72°

Step 2: Use symmetry to calculate the size of angle x.

The isosceles triangle has a line of symmetry.



72° ÷ 2 = 36°

36° + x° = 180°

x° = 180° – 36°

x° = 144°

Answer: **144°**

52. **Step 1:** First work out how many drips make 1 ml.

$1\,\text{ml} \div 0.25\,\text{ml} = 4$ drips

Step 2: Then work out how many drips make 1 litre.

1 litre = 1000 ml

4 drips $\times$ 1000 = 4000 drips

Answer: **4000 drips**

53. **Step 1:** Count the number of vowels in the word.

D**E**C**I**M**A**L**I**S**A**T**IO**N

There are 7 vowels.

Step 2: Count the total number of letters in the word.

There are 14 letters altogether.

Step 3: Write this information as a fraction and then simplify.

$\frac{7}{14} = \frac{1}{2}$

Answer: $\mathbf{\frac{1}{2}}$

54. **Step 1:** Convert 4 litres to ml.

4 litres **=** 4000 ml.

Step 2: Work out how much is left after breakfast.

$\frac{1}{5}$ of 4000 = 4000 ÷ 5 = 800 ml

4000 – 800 = 3200 ml

Step 3: Work out how much is left after lunch.

3200 ml – 400 ml = 2800 ml

Step 4: Finally, work out how much is left after supper.

2800 ml ÷ 2 = 1400 ml

Answer: **1400 ml**

55. **Step 1:** Look at the ratio.

$1 : 2 : 4 : 5$

There are $1 + 2 + 4 + 5 = 12$ parts altogether, so the largest angle is $\frac{5}{12}$ of the sum of the angles in a quadrilateral.

Step 2: Use this information to calculate the size of the largest angle.

Sum of angles in a quadrilateral = 360°

$$\text{Largest angle} = \frac{5}{12} \text{ of } 360°$$
$$= (360° \div 12) \times 5$$
$$= 150°$$

Answer: **150°**

56. **Step 1:** Consider the information you are given.

N – 2345 = A A A A

Therefore, possible values for **N** can be found by adding different four-digit numbers made up of the same digit to 2345, i.e.

2345 + 1111 = 3456

2345 + 2222 = 4567

2345 + 3333 = 5678

2345 + 4444 = 6789

These are the only possible values for **N**, as adding 5555 or 6666 produces numbers in which 2 digits are the same, and adding 7777 produces a 5-digit number.

Step 2: Use trial and error to test the possible values for **N**.

You are told that **N** – 5432 = a positive four-digit number.

3456 – 5432 = a negative number

4567 – 5432 = a negative number

5678 – 5432 = a three-digit number

6789 – 5432 = 1357

So, **N** must be 6789.

Answer: **6789**

57. **Step 1:** Work out the combined speed of the two friends.

Tom **=** 1 metre per second

Joe = 2.5 metres per second

Combined speed = 3.5 metres per second

Step 2: Work out how long it would take to travel 350 m at the combined speed.

350 ÷ 3.5 = 100 seconds

Step 3: Convert your answer to minutes and seconds.

100 seconds = 1 minute 40 seconds

Answer: **1 minute 40 seconds**

The two friends speeds are in a ratio of 2 : 5, so Tom will cover $\frac{2}{7}$ *of the distance before they meet and Joe will cover* $\frac{5}{7}$ *of the distance.*

58. **Step 1:** Start by writing the ratio of worker bees to mass of honey produced.

50 000 workers : 60 kg of honey

Step 2: Then convert the mass of honey to jars of honey.

60 kg = 60 000 g

60 000 g ÷ 500 g = 120 jars

50 000 workers : 120 jars

Step 3: Simplify the ratio.

50 000 workers : 120 jars

5000 workers : 12 jars

2500 workers : 6 jars

1250 workers : 3 jars

Answer: **1250 : 3**

59. **Step 1:** First work out how many questions the student definitely got correct.

The student knows the answer to half of the questions.

80 ÷ 2 = 40 correct

Step 2: Then work out the most likely score for the questions that were a complete guess.

The student completely guesses the answer to $\frac{1}{4}$ of the questions.

80 ÷ 4 = 20 complete guesses

There are four possible options, so the probability of getting the correct answer is 1 in 4 or $\frac{1}{4}$.

$\frac{1}{4}$ of 20 = 5 correct

Step 3: Finally, work out the most likely score for the remaining questions.

For each of the remaining questions, the student is able to narrow down the options to two possible answers.

80 – 40 – 20 = 20 questions narrowed down

He has narrowed it down to two possible options, so the probability of getting the correct answer is one in two or $\frac{1}{2}$.

$\frac{1}{2}$ of 20 = 10 correct

Step 4: Add to find the most likely total score.

40 + 5 + 10 = 55 correct at 1 mark per question

Answer: **55 marks**

60. **Step 1:** Consider the digits involved.

If the product of the four digits is 5, the only digits that can be used are 1, 1, 1 and 5.

Step 2: Work out how many different numbers can be produced from those digits.

1115

1151

1511

5111

Four different numbers can be produced, so 4 four-digit numbers have individual digits that multiply together to make 5.

Answer: **4**

61. **Step 1:** Set up two equations using the given information.

Let T be the number of trollies and S be the number of scooters.

You are told there are 40 handles and T has one handle and S has two, so:

$T + S \times 2 = 40$

You are told there are 30 items, so

$T + S = 30$

Step 2: Rearrange the second equation to make T the subject.

$T + S = 30$

$T = 30 - S$

Step 3: Substitute $30 - S$ for T in the first equation and solve to find S.

$$T + S \times 2 = 40$$

$$30 - S + S \times 2 = 40$$

$$30 - S + 2S = 40$$

$$30 + S = 40$$

$$S = 40 - 30$$

$$S = 10$$

Answer: **10 scooters**

62. **Step 1:** To find roughly where to start, you need a number that has a cube close to 1716.

$10 \times 10 \times 10 = 1000$, so it will be slightly higher than this.

$12 \times 12 \times 12 = 1728$

Step 2: Use your cube number to make a sensible assumption.

$12 \times 12 \times 12 = 1728$

Therefore, it is likely that the three consecutive numbers that will multiply to make 1716 are:

$11 \times 12 \times 13$

Step 3: Sense check your answer.

The endings match as $1 \times 2 \times 3 = 6$, so it is possible to finish there if you are in a rush.

However, it is better carry out the calculation.

$11 \times 12 \times 13 = 1716$

Step 4: Find the mean.

As they are three consecutive numbers, the mean (average) will be the middle number, i.e. 12.

Answer: **12**

63. **Step 1:** Work out how many hours Dr Science loses by travelling back to 2000.

2040 – 2000 = 40 years

1 hour for each year = 40 hours lost

Step 2: Use this information to work out the total number of hours that Dr Science loses.

40 hours lost travelling to 2000

2 hours spent in 2000

40 hours lost travelling back to 2040

Total time lost = 82 hours

Step 3: Convert your answer to hours and minutes.

82 hours = 3 days 10 hours

Step 4: Work out the date and time at which Dr Science returns.

1 April + 3 days $\rightarrow$ 4 April

10 a.m. + 10 hours $\rightarrow$ 8 p.m.

So he returns at 8 p.m. on 4 April.

Answer: **8 p.m. on 4 April**

64. **Step 1:** Work out the year in which Mr and Mrs Love got married.

In 2018, they had been married for 45 years, so they got married in 2018 – 45 = 1973.

Step 2: Work out the year in which Mrs Love was born.

Mrs Love was 21 in 1973, so she was born in

1973 – 21 = 1952.

Answer: **1952**

65. **Step 1:** Work out the distance between the stations.

2 km = 2000 m

2000 m ÷ 5 = 400 m apart

Step 2: Work out how long it takes a train to travel the distance between two stations.

8 km per hour = 8000 m per hour

400 m is one-twentieth of 8000 m, so the trains will take one-twentieth of an hour to travel 400 m.

One-twentieth of an hour is 3 minutes (60 ÷ 20 = 3).

Therefore, 3 minutes is the longest amount of time the Smith family will have to wait for a train.

Answer: **3 minutes**

66. **Step 1:** Look at the calculation carefully to see if any of the numbers will cancel down.

$$\frac{22 \times 20 \times 18 \times 16 \times 14 \times 12 \times 10}{5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11}$$

You should notice that each number below the line is a multiple of one of the numbers above the line.

This is clearer if the numbers below the line are reversed:

$$\frac{22 \times 20 \times 18 \times 16 \times 14 \times 12 \times 10}{11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5}$$

Step 2: Cancel down and complete the calculation.

22 and 11 have a common factor of 11, so divide both by 11 to leave 2.

20 and 10 have a common factor of 10, so divide both by 10 to leave 2.

18 and 9 have a common factor of 9, so divide both by 9 to leave 2.

And so on.

This leaves:

$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 128$

Answer: **128**

67. **Step 1:** Find the difference between 130 and 99.

130 – 99 = 31

Step 2: Work out how many quarters there are in this difference.

There are 4 quarters in 1, so in 31 there are:

31 $\times$ 4 quarters = 124 quarters

Answer: **124 quarters**

68. **Step 1:** Find the factors of 22 and 35.

Factors of 22: 1, 22, 2, 11

Factors of 35: 1, 35, 7, 5

These must all be factors of 770.

Step 2: Work out the factor pairs for 770.

You know that **2** is a factor of 770 and that will pair with (770 ÷ 2 =) **385**.

You know that **11** is a factor of 770 and that will pair with (770 ÷ 11 =) **70**.

As 70 is an even number, it can be divided by 2 to give another factor of 770: 70 ÷ 2 = 35.

If you divide one of the factors in a pair by 2, then the other has to be multiplied by 2 to keep the product the same: 11 × 2 = 22.

So, **22** and **35** are a factor pair for 770.

You know that **7** is a factor of 770 and that will pair with (770 ÷ 7 =) **110**.

As 110 is an even number, it can be divided by 2 to give another factor of 770: 110 ÷ 2 = 55.

Multiply the other number in the pair by 2 to keep the product the same: 7 × 2 = 14.

So, **14** and **55** are a factor pair for 770.

You know that **5** is a factor of 770 and that will pair with (770 ÷ 5 =) **154**.

Again, as 154 is an even number, it can be divided by 2 to find another factor of 770: 154 ÷ 2 = 77.

Multiply the other number in the pair by 2 to keep the product the same: 5 × 2 = 10.

So, **10** and **77** are a factor pair for 770.

Step 3: Count up the number of factors.

There are 14 factors of 770 excluding 1 and 770.

Answer: **14 factors**

69. **Step 1:** Work out the number of books on the second shelf.

You are told that the third shelf has 20 books and there are 5 more books on the second shelf that the third, so the second shelf has 25 books.

Step 2: Set up expressions for the number of books on the other shelves.

Let the number of books on the bottom shelf be L.

Bottom shelf = L

Top shelf = $2L$

Fourth shelf = 20 + L

Step 3: Add all five shelves together to form one equation and then solve to find L.

There are 125 books in total, so:

$$20 + 25 + L + 2L + 20 + L = 125$$
$$4L + 65 = 125$$
$$4L = 125 - 65$$
$$4L = 60$$
$$L = 60 \div 4$$
$$L = 15$$

Step 4: Work out the number of books on the top shelf.

Top shelf = $2L$

$= 2 \times 15$

$= 30$

Answer: **30 books**

70. **Step 1:** Complete the central bracket first.

$(3 - 1)^2 = 2^2 = 4$

Step 2: Then the remaining bracket.

$(1 + 4)^2 = 5^2 = 25$

Step 3: Now complete the calculation.

$30 - 25 = 5$

Answer: **5**

71. **Step 1:** Look at the difference between each pair of numbers.

99		**96**		**91**		**84**		**75**
	–3		–5		–7		–9	

Step 2: Identify the pattern.

Consecutive odd numbers are being subtracted.

Step 3: Work out the next number in the sequence.

The next odd number is 11, so subtract 11 from the last number in the sequence.

75 – 11 = 64

Answer: **64**

Alternatively, you might have noticed that each number in the sequence can be found by subtracting consecutive square numbers from 100, i.e.

100 – 1 = 99, 100 – 4 = 96, 100 – 9 = 92, etc.

So, the next number is 100 – 6^2 = 100 – 36 = 64.

72. **Step 1:** Find the difference between Stan's time and the world record time.

10.8 – 9.6 = 1.2 seconds

Step 2: Calculate this as a percentage of Stan's time.

1.2 secs out of 10.8 seconds = 1.2 ÷ 10.8 = 0.111…

0.111… × 100 = 11.11…%

Step 3: Give you answer to the nearest percent.

11.11…% = 11% to the nearest percent.

Answer: **11%**

73. **Step 1:** Work out the height of the hexagon.

If the area of the square is $4\,\text{cm}^2$, it has a side length of $2\,\text{cm}$.

Hence, the height of the hexagon is $2\,\text{cm}$.

(The hexagon is not regular.)

Step 2: Use your answer to work out the height and base of one white triangle.

One triangle is half the height of the hexagon.

Height of triangle $= 2\,\text{cm} \div 2 = 1\,\text{cm}$

Base of triangle $= (2\,\text{cm} - 1\,\text{cm}) \div 2 = 0.5\,\text{cm}$

Step 3: Calculate the area of one white triangle.

$$\text{Area of triangle} = \frac{1}{2} \times \text{base} \times \text{height}$$

$$= \frac{1}{2} \times 0.5 \times 1$$

$$= 0.25\,\text{cm}^2$$

Answer: **$0.25\,\text{cm}^2$**

74. **Step 1:** Work out how much it would cost for Hal to visit the gym once a week for a year.

There are 52 weeks in a year

$52 \times £3 = £156$

Step 2: Scale up your answer to find out how many visits Hal would need to make each week for annual membership to be better value.

If Hal goes to the gym twice a week, he would pay:

$£156 \times 2 = £312$

This is slightly less than the annual membership fee of £330.

So, if Hal pays the membership of £330, he would have to go to the gym at least 3 times a week on average to make it better value.

Answer: **3 visits**

75. **Step 1:** Use your knowledge of square numbers to narrow down the range of possible numbers.

$3 \times 3 = 9$, so $30 \times 30 = 900$

$4 \times 4 = 16$, so $40 \times 40 = 1600$

So, a square number that lies between 1300 and 1400 will be the square of a number around 36 to 38.

Step 2: Test your options to identify the correct answer.

$36 \times 36 = 1296$

$37 \times 37 = 1369$

$38 \times 38 = 1444$

The square number that lies between 1300 and 1400 is 1369.

Answer: **1369**

76. **Step 1:** First work out Aunt May's age.

The only number under 100 that is square and cube, excluding 1, is 64.

So Aunt May is 64.

Step 2: Then work out Neil's age.

Neil's age contains the same digits as Aunt May's, but it is not a square or cube.

So Neil must be 46.

Step 3: Finally, work out Cary's age.

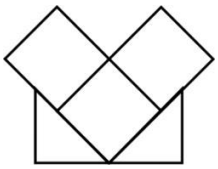
$(46 \div 2) - 10 = 23 - 10 = 13$

Answer: **13 years old**

77. **Step 1:** Break down the shape.

The shape can be broken down into:

- 3 squares
- 2 triangles.



Step 2: Work out the area of the individual shapes.

Area of one square = $1\,\text{cm} \times 1\,\text{cm} = 1\,\text{cm}^2$

Area of three squares = $3 \times 1\,\text{cm}^2 = 3\,\text{cm}^2$

The two triangles together make up half of a rectangle.

Area of two triangles = $(1\,\text{cm} \times 2\,\text{cm}) \div 2 = 1\,\text{cm}^2$

Step 3: Add to find the total area of the shape.

$3\,\text{cm}^2 + 1\,\text{cm}^2 = 4\,\text{cm}^2$

Answer: **$4\,\text{cm}^2$**

78. **Step 1:** Consider the information you are given.

As the three digits have to be different:

- the 1st digit can be one of 9 digits
- the 2nd digit can be one of 8 digits
- the 3rd digit can be one of 7 digits.

Step 2: Calculate the number of different combinations possible.

$9 \times 8 \times 7 = 504$

Step 3: Work out the year in which the system will run out of new combinations.

There are 365 days in a year.

504 = 1 year and 139 days

The system began on 1 September 2018.

1 year takes you to 1 September 2019.

The months of September to December contain 122 days altogether, so 139 days takes you into 2020.

Answer: **2020**

79. **Step 1:** Consider the dimensions of the swimming pool.

The pool has an area of 1000 m², so its length and width could sensibly be 10 m × 100 m or 20 m × 50 m.

Step 2: Convert the length and width of the pool to cm.

10 m × 100 m = 1000 cm × 10 000 cm

or

20 m × 50 m = 2000 cm × 5000 cm

Step 3: Work out what the length and the width of the pool will be on the map.

Since the scale is 1 : 1000:

1000 cm × 10 000 m → 1 cm × 10 cm

or

2000 cm × 5000 cm → 2 cm × 5 cm

Step 4: Calculate the area of the pool on the map.

1 cm × 10 cm = 10 cm²

or

2 cm × 5 cm = 10 cm²

Answer: **10 cm²**

To go from m² to cm² you must multiply by 100 × 100, i.e. 10 000.

So, the pool's real life area is 1000 m² = 10 000 000 cm²

Remember, the scale of a map gives the ratio of lengths. The numbers must be squared to find the ratio of areas:

1 cm : 1000 cm → 1 cm² : 1 000 000 cm²

So, the pool's area on the map is

10 000 000 cm² ÷ 1 000 000 = 10 cm².

80. **Step 1:** Use the given information to sketch a diagram.

Angle ABC = 90°

Angle DAB = angle BCD

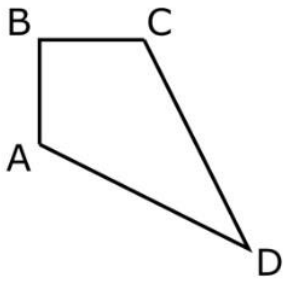
Angle CDA < 90°

The shape has four sides and four vertices.

Vertex B must be a right angle.

Vertex D (opposite B) must be an acute angle.

The other two angles are equal (so the shape is symmetrical).



Step 2: Identify the shape.

The shape produced is a kite.

Answer: **Kite**

81. **Step 1:** Calculate the total number of faces on the 64 individual cubes.

Total number of faces = 64×6 faces = 384 faces

Step 2: Work out the number of faces that were painted when the large cube was formed.

The large cube is formed from 64 cubes.

64 is the cube of 4, so the dimensions of the large cube are $4 \times 4 \times 4$.

So, each face of the large cube is made up of $4 \times 4 = 16$ small cube faces.

Therefore, the number of faces painted = $16 \times 6 = 96$

Step 3: Write the numbers as a fraction and simplify.

$$\frac{96}{384} = \frac{8}{32} = \frac{1}{4}$$

Answer: $\mathbf{\frac{1}{4}}$

82. **Step 1:** Look at each integer from 1 to 9 in turn.

1 is a factor of all integers.

2 is a factor of 51 840 as it is an even number (ends in 0).

3 is a factor of 51 840 as the digits add up to 18 (which is a multiple of 3).

4 is a factor of 51 840 as halving and halving again produces an integer (12 960).

5 is a factor of 51 840 as it ends in a 0.

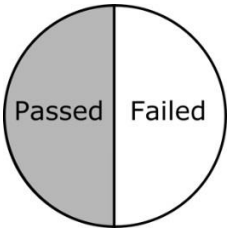
6 is a factor of 51 840 because it is divisible by 2 and by 3.

51 840 is not divisible by 7 (51 840 ÷ 7 = r 5), so 7 is not a factor.

Answer: **7**

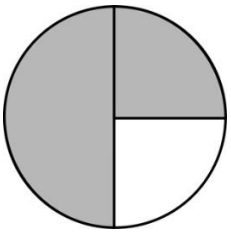
83. **Step 1:** First establish the people that you are looking at.

Half of the people failed their driving test first time and it is these people you are looking at.



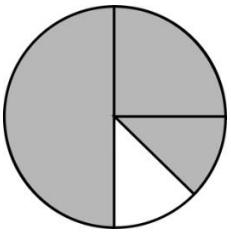
Step 2: Work out how many of those people passed on the second attempt.

One-quarter of the whole group passed on the second attempt, which represents half of the people who failed their first test.

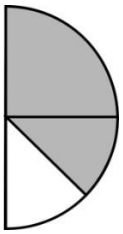


Step 3: Work out how many of those who failed their first test passed on their third attempt.

One-eighth of the whole group passed on the third attempt, which represents one-quarter of the people who failed their first test.



Step 4: Work out the percentage of people who failed their test first time and have still not passed.



Of the people who failed their first test, half passed the second time and one-quarter passed the third time, leaving one-quarter who have still not passed.

So, 25% of those who failed their first test have still not passed.

Answer: **25%**

84. **Step 1:** Start by narrowing down the number range.

To be close to 50 000, you need to consider numbers in the late 40 000s and early 50 000s.

Step 2: Find a palindrome in the late 40 000s.

Your palindrome must begin and end with 4, and have the highest possible digits in the other three positions.

49894

This is 106 away from 50 000.

Step 3: Find a palindrome in the early 50 000s.

Your palindrome must begin and end with 5, and have the lowest possible digits in the other three positions.

50105

This is 105 away from 50 000.

So, 50105 is the closest palindrome to 50 000 that uses three different digits.

Answer: **50105**

85. **Step 1:** Consider the shape.

The area of the shape is made from the three large triangles, minus two small triangles where the large triangles overlap.

Step 2: Work out the area of the three large triangles.

Area of one large triangle = $0.5 \times 1 \times 1.5 = 0.75\,\text{cm}^2$

Area of three large triangles = $0.75 \times 3 = 2.25\,\text{cm}^2$

Step 3: Work out the area of the two small triangles.

Area of one small triangle = $0.5 \times 0.5 \times 0.75$

Area of two small triangles = $1 \times 0.5 \times 0.75 = 0.375\,\text{cm}^2$

Step 4: Subtract to find the area of the composite shape.

$2.25 - 0.375 = 1.875\,\text{cm}^2$

Answer: **$1.875\,\text{cm}^2$**

86. **Step 1:** Consider the information you are given.

Fay presses five random buttons on her calculator to make a 5-digit number.

The fifth button that Fay presses could be any of 10 digits: 0–9.

Each button has an equal chance of being pressed.

Step 2: Identify which numbers must be pressed for the 5-digit number to be divisible by 5.

The fifth digit must be 0 or 5 for the number to be divisible by 5.

Step 3: Work out the probability of pressing one of these two buttons.

There is a 2 out of 10 change of pressing 0 or 5, so the probability is $\frac{2}{10} = \frac{1}{5}$.

Answer: $\mathbf{\frac{1}{5}}$ **(Accept 0.2 or 20%)**

87. **Step 1:** Work out how much money Ann and Ali would have if they had equal amounts.

£7.80 ÷ 2 = £3.90

Step 2: Adjust this amount to take into account the fact that Ali has 40 p more.

Since Ali has 40 p more, add 20 p on to £3.90.

This will automatically reduce Ann's amount by 20 p, leaving a total difference of 40 p.

Ali = £3.90 + 20 p = £4.10

Ann = £3.90 – 20 p = £3.70

Answer: **£3.70**

88. **Step 1:** Work out how long it takes Mr Rhyme to write 1 long poem.

Mr Rhyme can write 2 long poems in 3 hours, so he can write 1 long poem in $3 \div 2 = 1.5$ hours.

Step 2: Work out how long it takes Mr Rhyme to write 1 limerick.

Mr Rhyme can write 3 limericks in the same time that it takes to write 1 long poem, so he can write 1 limerick on $1.5 \div 3 = 0.5$ hours.

Step 3: Multiply to find out how long it takes Mr Rhyme to write two limericks.

$0.5 \text{ hours} \times 2 = 1 \text{ hour}$

Answer: **1 hour**

89. **Step 1:** Use the rule to work out the missing second term.

18 is the product of 6 and the second term, so:

Second term = 18 ÷ 6 = 3

Step 2: Work out the missing first term.

6 is the product of the second term (3) and the first term, so:

First term = 6 ÷ 3 = 2

Step 3: Work out the missing fifth term:

The fifth term is the product of 6 and 18, so:

Fifth term = 6 × 18 = 108

Step 4: Add to find the sum of the three missing terms.

3 + 2 + 108 = 113

Answer: **113**

90. **Step 1:** Consider the information you are given.

There are 365 days in a year and 7 days in a week.

365 ÷ 7 = 52 r 1

So, for 3 out of 4 years, the date will fall 1 day later than the previous year.

One in four years is a leap year, which has an extra day (29 February).

So, for 1 out of 4 years, the date will fall 2 days later than the previous year.

Leap years are every four years so there is one in 2020, 2024 and 2028.

Step 2: Work out the day on which day 2 January will fall from 2020 onwards, until you reach another Wednesday.

2019:	Wednesday
2020:	Thursday
2021:	Saturday (due to the extra day at the end of February in 2020)
2022:	Sunday
2023:	Monday
2024:	Tuesday
2025:	Thursday (due to the extra day at the end of February in 2024)
2026:	Friday
2027:	Saturday
2028:	Sunday
2029:	Tuesday (due to the extra day at the end of February in 2028)
2030:	Wednesday

Answer: **2030**

91. **Step 1:** Multiply 6 by 7.

$6 \times 7 = 42$

Step 2: Count the multiples of 42 that are less than 500.

There are 10 multiples of 42 up to and including 420, and then 462 is one more.

Hence, there are 11 positive numbers less than 500 that are divisible by both 6 and 7.

Answer: **11**

92. **Step 1:** Look closely at the diagram.

There are three pairs of overlapping squares.

Each pair of overlapping squares produces an octagon with a triangle on each side, so 8 triangles in total.

Step 2: Use this information to work out the total number of triangles.

8×3 pairs of squares = 24 triangles

Step 3: Write the ratio of triangles to squares and then simplify.

Ratio of number of triangles seen to squares used is

$24 : 6 = 4 : 1$

Answer: **4 : 1**

93. **Step 1:** Disregard the decimal places.

$2 \times 3 \times 4 = 24$

Step 2: Work out the number of digits needed after the decimal place needed in the final answer.

There are six digits after the decimal points in 0.02, 0.03 and 0.04, so there need to be six digits after the decimal point in the answer.

$0.02 \times 0.03 \times 0.04 = 0.000\,024$

Answer: **0.000 024**

94. **Step 1:** Work out the perimeter and area of the square.

A square's area is the same as its perimeter when the length of each side is 4 cm.

$4\,\text{cm} \times 4\,\text{cm} = 16\,\text{cm}^2$

$4\,\text{cm} + 4\,\text{cm} + 4\text{ cm} + 4\,\text{cm} = 16\,\text{cm}$

Step 2: Work out the perimeter and area of the rectangle.

A rectangle's area is the same as its perimeter when its length is 6 cm and its width is 3 cm.

$6\,\text{cm} \times 3\,\text{cm} = 18\,\text{cm}^2$

$6\,\text{cm} + 3\,\text{cm} + 6\text{ cm} + 3\,\text{cm} = 18\,\text{cm}$

Step 3: Find the difference between the areas of the two shapes.

$18\,\text{cm}^2 - 16\,\text{cm}^2 = 2\,\text{cm}^2$

Answer: **$2\,\text{cm}^2$**

95. Work through the problem backwards, starting with 7.

Step 1: Subtract 7 from 15.
$15 - 7 = 8$

Step 2: Divide by 2.
$8 \div 2 = 4$

Step 3: Divide 20 by your result.
$20 \div 4 = 5$

Step 4: Subtract 3.
$5 - 3 = 2$
Hence, Eve's original number was 2.

Answer: **2**

Careful: some of these functions are self-inverses.
For example, 7 subtracted from 15 gives 8 and 8 subtracted from 15 gives 7.

96. **Step 1:** Put the information you are given into an equation.

$2\mathbf{N} - (\mathbf{N} + 3) = 8$

Step 2: Solve to find **N**.

$$2\mathbf{N} - (\mathbf{N} + 3) = 8$$
$$2\mathbf{N} - \mathbf{N} - 3 = 8$$
$$\mathbf{N} - 3 = 8$$
$$\mathbf{N} = 8 + 3$$
$$\mathbf{N} = 11$$

Answer: **11**

97. **Step 1:** Break the percentage down to help with the calculation.
450% = 4 × 100% + 50%

Step 2: Work out 450% of £80 000.
4 × 100% of £80 000 = 4 × £80 000 = £320 000
50% of £80 000 = £80 000 ÷ 2 = £40 000
450% of £80 000 = £320 000 + £40 000 = £360 000

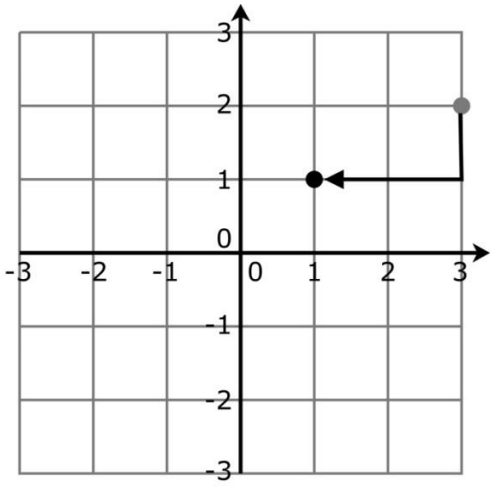
Step 3: Work out the value of the house after this increase.
£360 000 is the increase in price so:
Value now = £80 000 + £360 000 = £440 000

Answer: **£440 000**

98. **Step 1:** Work out the coordinates of the point after it is translated.

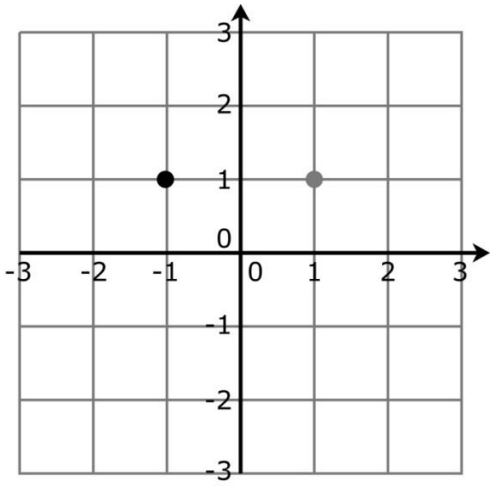
The point goes down 1 unit, so the y-coordinate goes down 1: (3, 1)

The point goes left 2 units, so the x-coordinate goes down 2: (1, 1)



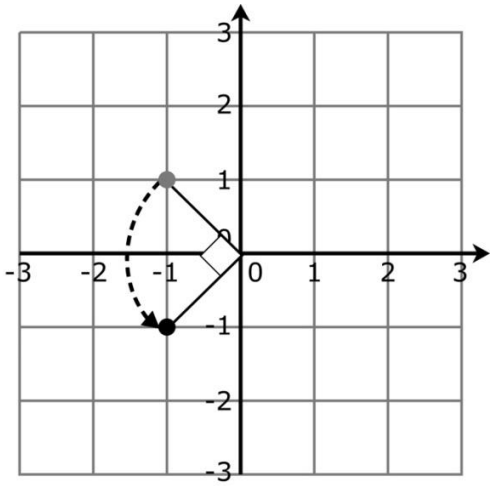
Step 2: Work out the coordinates of the point after the reflection.

The point is reflected in the y-axis, so the x-coordinate changes sign: (−1, 1)



Step 3: Finally, work out the coordinates after the rotation.

The point rotates 90° anticlockwise about the origin, so the x-coordinate stays the same and the y-coordinate changes sign: (–1, –1)



Answer: **(–1, –1)**

99. **Step 1:** Work out the size of angle BAC.
Triangle BAC is isosceles, so:
Angle BAC = 180° – 65° – 65° = 50°

Step 2: Work out the size of angle EDF.
Triangle EDF is isosceles, so:
Angle EDF = 180° – 75° – 75° = 30°

Step 3: Calculate angle BAE.
Looking at the diagram:
BAE = (BAC – EDF) ÷ 2
BAE = (50° – 30°) ÷ 2
BAE = 20° ÷ 2
BAE = 10°

Answer: **10°**

100. **Step 1:** Work out the weight of the parcel.

1 kg = 1000 g

1000 g + 10 g = 1010 g

Step 2: Use the formula to calculate the cost to mail the parcel in pence.

$P = 150 + W \times 0.2$

$= 150 + 1010 \times 0.2$

$= 150 + 202$

$= 352$

The cost to mail the parcel is 352 p.

Step 3: Convert the price to pounds.

352 p = £3.52

Answer: **£3.52**

101. **Step 1:** Consider the information you are given.

If the time is between 8 a.m. and 9 a.m., the hour hand must be between the 8 and 9.

Step 2: Work out the size of the small angle between two consecutive numbers (5 minutes) on a clock face.

$360° \div 12 = 30°$

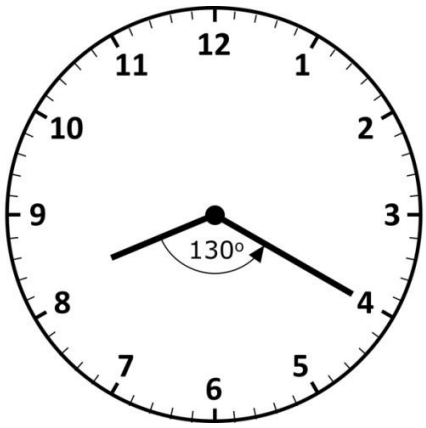
Step 3: Work out the position of the minute hand.

The minute hand is 130° away from the hour hand, which is $4 \times 30° + 10°$.

Since the hour hand is between the 8 and the 9, you need to work in an anticlockwise direction to find the position of the minute hand (moving in a clockwise direction would give a time after 9 a.m.).

So, the minute hand points at 4.

The extra 10° is accounted for by the fact that the hour hand is one-third of the way from 8 to 9.



The time is twenty past eight.

Step 4: Write the time as a 24-hour time.

Twenty past eight in the morning is 08:20.

Answer: **08:20**

102. **Step 1:** Narrow down the possible times.

There are 24 hours, so the only hours which have the same digits are 11 and 22.

Therefore, the only possible times it could be are

11:11 or 22:22.

22:22 is the closest time to midnight.

Step 2: Work out the number of minutes until midnight.

22:22 is 1 hour and 38 minutes away from midnight.

So, it is 60 + 38 = 98 minutes until midnight.

Answer: **98 minutes**

103. **Step 1:** Work out the value of B.

5 into B goes once, so B must be 5, 6, 7, 8 or 9.

B can't be 5 or there would be no remainder.

B can't be 6 or there would be remainder 1.

B can't be 7 or there would be remainder 2.

Hence, B must be 8, which creates a remainder of 3 each time.

Step 2: Work out the value of C.

$$\begin{array}{r} 1\ \ C\ \ C\ \ C\ \text{r3} \\ 5\overline{)\,8\ \ {}^{3}8\ \ 8\ \ 8} \end{array}$$

5 into 8 is 1 with a remainder of 3.

Carry the 3, to give 5 into 38.

5 into 38 is 7, with a reminder of 3.

So, C must be 7.

$$\begin{array}{r} 1\ \ 7\ \ 7\ \ 7\ \text{r3} \\ 5\overline{)\,8\ \ {}^{3}8\ \ {}^{3}8\ \ {}^{3}8} \end{array}$$

Answer: **7**

104. **Step 1:** Work out 40% of 120 million households.

40% of 120 = (120 ÷ 100) × 40 = 48

40% of 120 million = 48 million

Step 2: Work out 25% of 24 million households.

25% = $\frac{1}{4}$

24 ÷ 4 = 6

25% of 24 million = 6 million

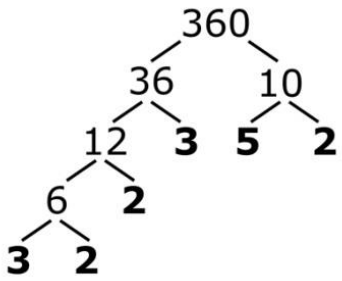
Step 3: Calculate how many times more households in the USA own a dog than in England.

48 ÷ 6 = 8

So, 8 times more households in the USA own a dog than in England.

Answer: **8 times**

105. **Step 1:** Write 360 as a product of its primes.



$360 = 3 \times 2 \times 2 \times 3 \times 5 \times 2$

$360 = 3^2 \times 2^3 \times 5$

Step 2: Rewrite the equation in the form given in the question to find B.

$B \times C^2 \times D^3 = 360$

$5 \times 3^2 \times 2^3 = 360$

Hence, $B = 5$

Answer: **5**

106. **Step 1:** Write an expression for the area of one rectangle.

Let the width of a rectangle be w.

Then the length of a rectangle is $4w$ and the area of a rectangle is:

$4w \times w = 4w^2$

Step 2: Write an expression for the area of one white square.

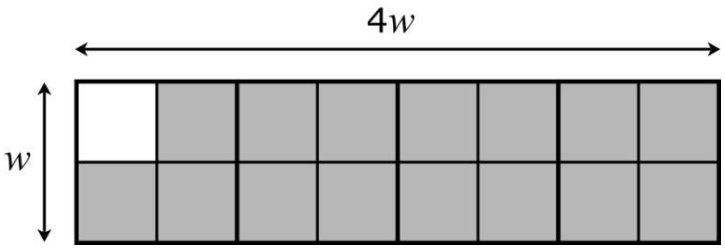
Looking at the diagram, you can see that the width of a small white square is $w \div 2$.

Hence, the area of a white square is:

$(w \div 2)^2 = (w^2 \div 4)$

Step 3: Work out the fraction of the area of one rectangle that one white square represents.

If the area of a white square is $\frac{1}{4}$ of w^2 and the area of a rectangle is $4 \times w^2$, then one white square is $\frac{1}{16}$ of a rectangle.



Answer: $\mathbf{\frac{1}{16}}$

107. **Step 1:** Consider the diagonals of a square.

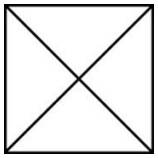
The diagonal of a square goes across the shape from vertex to vertex.

One diagonal can be drawn from each vertex:

$1 \times 4 = 4$

However, this counts each line twice, so divide by 2:

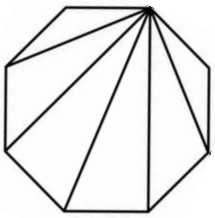
$4 \div 2 = 2$ diagonals



Step 2: Use this information to work out the number of diagonals in an octagon.

An octagon has eight vertices.

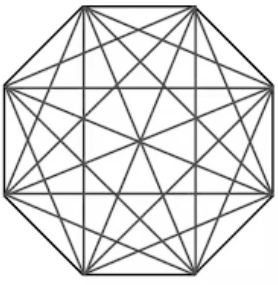
Five diagonals can be drawn from each vertex.



$8 \times 5 = 40$

However, this will count each line twice, so divide by 2:

$40 \div 2 = 20$



Answer: **20 diagonals**

108. **Step 1:** Set up two different expressions for Daisy's dad's age using the given information.

Let Daisy be D years old.

Daisy says her dad is 3 years less than 6 times her age.

So, Daisy's dad = $6 \times D - 3$

However, you are also told that Daisy's dad is one year older than her mum ($5 \times D + 2$), so his age can also be written as:

$5 \times D + 2 + 1$

Step 2: Put the two expressions into an equation and solve to find D.

$$5 \times D + 2 + 1 = 6 \times D - 3$$
$$5D + 3 = 6D - 3$$
$$5D + 6 = 6D$$
$$6 = D$$

So, Daisy is 6 years old.

Answer: **6 years old**

109. **Step 1:** Work out the price of four tickets.

£45 $\times$ 4 = £180.

Step 2: Work out 2.5% of the total ticket price.

A relatively simple way to work out 2.5% is to work out 10%, then halve it to get 5% and halve again to get 2.5%.

10% of £180 = £18

5% of £180 = £9

2.5% of £180 = £4.50

Step 3: Add to find the total cost including the booking fee.

Total cost = £180 + £4.50 = £184.50

Answer: **£184.50**

110. **Step 1:** Work through the problem systematically.

The number of pupils present must be a multiple of both 12 and 5.

$12 \times 5 = 60$

You are told that more than 100 of the 135 pupils are present, so double 60 (which maintains its qualities of being a multiple of 12 and 5):

$60 \times 2 = 120$

Step 2: Subtract to find how many pupils are away.

$135 - 120 = 15$

Hence, 15 pupils are away.

Answer: **15 pupils**

111. **Step 1:** Divide both sides of the equation by 5.

$5(b + 3) = 35$

$b + 3 = 7$

Step 2: Subtract 3 from both sides.

$b + 3 = 7$

$b = 4$

Answer: **4**

112. **Step 1:** Write down all of the 1-digit prime numbers.

2, 3, 5 and 7

Step 2: Write down the largest 3-digit number possible using these primes.

753

Step 3: Write down all of the 1-digit square numbers.

1, 4 and 9

Step 4: Write down the largest 3-digit number possible using these square numbers.

941

Step 5: Find the difference between your two numbers.

941 – 753 = 188

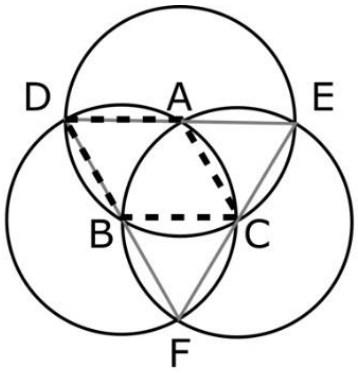
Step 6: Identify how many different cube numbers are found in the digits of your result.

1 and 8 are both cube numbers, so there are two different 1-digit cube numbers in Dan's final number.

Answer: **2**

113. **Step 1:** Look carefully at the diagram.

Each straight line walked by the beetle is a radius of a circle.



Step 2: Work out the radius of one circle.

Radius = diameter ÷ 2

Radius = 3 cm ÷ 2 = 1.5 cm

Step 3: Work out the total distance walked by the beetle.

$1.5 \times 4 = 6$ cm

Answer: **6 cm**

114. **Step 1:** Look closely at the diagram to work out the relationship between the numbers.

The number in each hexagon is the total of the two numbers directly above it.

Step 2: Work out the value of H.

H = 15 + 20 = 35

Answer: **35**

115. **Step 1:** Work out the fraction of flour left after $\frac{5}{8}$ is used.

$1 - \frac{5}{8} = \frac{3}{8}$

Step 2: Work out the fraction represented by 250 g of flour.

Removing 250 g of flour reduces $\frac{3}{8}$ of the bag to $\frac{1}{8}$.

So, 250 g = $\frac{2}{8} = \frac{1}{4}$

Step 3: Calculate the original amount of flour in the bag.

250 g = $\frac{1}{4}$

Original amount of flour = 250 g $\times$ 4 = 1000 g = 1 kg

Answer: **1000 g or 1 kg**

116. **Step 1:** Work out the value of the right-hand side of the equation without brackets and with brackets.

Without brackets: $1 + 1^2 = 1 + 1 = 2$

With brackets: $(1 + 1)^2 = 2^2 = 4$

Step 2: Look at the different operations on the left-hand side of the equation separately.

$12 + 3 = 15$

$3 – 2 = 1$

$2 + 9 = 11$

Step 3: Use this information to help you work out where the brackets should go in the equation.

$15 – 11 = 4$, so:

$12 + 3 – (2 + 9) = (1 + 1)^2$

Step 4: Count the minimum number of pairs of brackets required to make the calculation correct.

Two pairs of brackets are required.

Answer: **2 pairs of brackets**

117. **Step 1:** Look for a complete row, column or diagonal and work out its total.

There are two complete diagonals:

1 + 9 + 12 + 20 + 23 = 65

10 + 21 + 12 + 3 + 19 = 65

Step 2: Work out the total value of the numbers missing from each row.

Row 1: 65 – 1 – 25 – 19 = 20

Row 2: 65 – 9 – 3 = 53

Row 3: 65 – 18 – 12 – 6 = 29

Row 4: 65 – 21 – 20 = 24

Row 5: 65 – 10 – 4 – 23 = 28

Step 3: Add to find the total of all the missing numbers.

20 + 53 + 29 + 24 + 28 = 154

Answer: **154**

118. **Step 1:** Look at the shapes carefully.

There are 6 different shapes and they always appear in the same order, so you can use multiples of 6 to help you find the answer.

Step 2: Work out the multiple of 6 that is closest to 200.

$33 \times 6 = 198$

So, the 198th shape will be a ★.

Step 3: Count forwards from the star to work out the 200th shape.

The 200th shape will be 2 later, which is the  .

Answer:  **or Three overlapping circles or Trefoil**

(Accept any other appropriate description of the correct shape.)

119. **Step 1:** Write both fractions with the same denominator.

$\frac{1}{2} = \frac{3}{6} = \frac{6}{12}$

$1\frac{1}{3} = \frac{4}{3} = \frac{8}{6} = \frac{16}{12}$

Step 2: Work out the fraction that is halfway between the two.

$(6 + 16) \div 2 = 22 \div 2 = 11$

11 is the average or the halfway mark.

Hence, the answer is $\frac{11}{12}$.

Answer: $\mathbf{\frac{11}{12}}$

120. **Step 1:** Set up an equation using the given information.

Let w be the weight of the bag of sweets.

$900\,\text{g} - (w \div 2) = w$

Step 2: Solve to find w.

$900\,\text{g} - (w \div 2) = w$

$1800\,\text{g} - w = 2w$

$1800\,\text{g} = 3w$

$1800\,\text{g} \div 3 = w$

$w = 600\,\text{g}$

Answer: **600 g**

You can also use trial and error to work out the answer to this question.