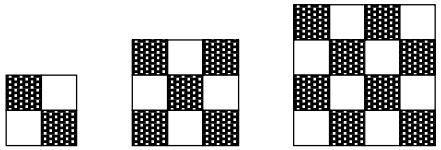
**not all black and white**

Take some square grids . . . now, starting with the top row, colour the small squares black, white, black, white . . .



Next, count the number of small squares in each grid which have been coloured black . . . As you can see, the answers are 2, 5 and 8 for the grids above. Try to find how – without drawing and counting – you could work out the number of black squares in a grid of any size.

Find how many small black squares there would be in

**a** an 11 x 11 grid **b** a 12 x 12 grid **c** a 17 x 17 grid and **d** a 100 x 100 grid





**almost there!**

Take a pair of whole numbers which are just 2 apart from each other and multiply them together. Do the same for a few pairs of numbers like this (2 apart from each other)

for example, 3, 5 → 15

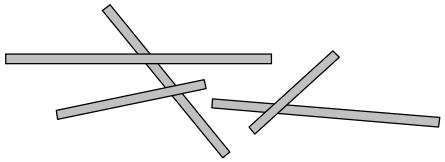
7, 9 → 63

What do you notice about your results? If you're stuck, try 19 x 21 or 29 x 31 and then think again. If you still can't see a pattern, think about the number which lies in the middle (that's to say between the two you're looking at).

**a** Once you've seen the pattern, try putting it into words.

**b** Can you think of a simple way of showing with a diagram just why this works?

**a likely story**



There are five sticks in a bag and their lengths are :

3cm, 4cm, 5cm, 6cm and 7cm

John puts his hand into the bag and pulls out two sticks. Next, John puts these two sticks next to each other, end to end. What's the probability that the combined length of the two sticks is exactly 9cm?





**4-wheel drive**

Hans is an explorer. Last year he was driving across some pretty difficult terrain in South America. One particular journey of his involved travelling for six hours at a steady 15 km/hr and then for two and a half hours at 24 km/hr.

**a** How far did Hans travel altogether on this journey?

**b** If Hans set off at 8 am, what time was it when he reached the half-way point in his journey?

**cup winners**

Francesca has four eggs in her fridge. One of these eggs is bad, although she doesn't know which. Francesca reaches into the fridge and takes out three eggs. What's the probability that she's chosen the three good eggs?

**two-way journey**

Daniel is a lorry-driver. On Monday he has some logs to deliver. He sets off from town A and drives along the straight road to town B, his final destination and a distance of 120 km from town A. He starts his journey at 9 am and he keeps his speed to a steady 20 km/hr all the way.

Daniel delivers the logs and then, after a good night's sleep, he begins the return journey. Once again, he starts off at 9 am but this time he keeps up a steady 40 km/hr as he heads back (along the same road) towards town A.

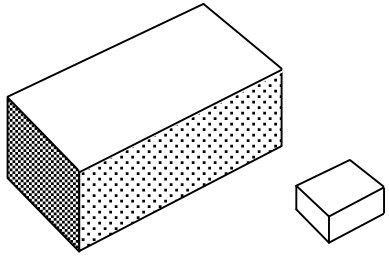
As Daniel passes Marcel's café, he checks the time and chuckles to himself. He's passing the café at exactly the same time as on the outward journey! Can you work out where Marcel's café must be along the road?





**in mint condition**

The Varmint Chocolate Factory is famous for its mint chocolates. Nothing tastes better at the end of a fine meal!



**a** The standard Varmint chocolate box measures 8cm x 4cm x 3cm and each chocolate measures 3cm x 2cm x 1cm. So, how many chocolates do you get in a box?

**b** One of Varmint's newest products is the avocado-and-mint chocolate. Each of these chocolates measure 3cm x 2cm x 1.5 cm and you get 24 of them in a box. This box, though, has a rather special shape. What shape do you think it is?

**factor parade**

30 ○ What are all the factors of 30?

182 ○ What are all the factors of 182?

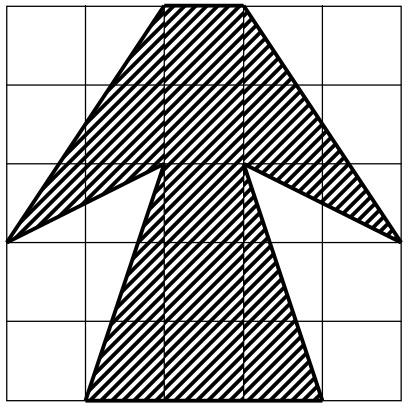
1034 ○ What are all the factors of 1034?





**problem area**

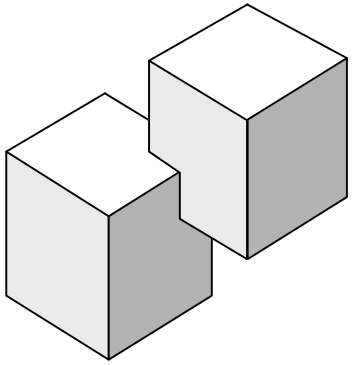
Draw a 5 x 5 grid and then copy this shape onto it:



Now work out the exact area of the shape. (It's not quite as easy as it looks!)

**surface area**

Simon has 53 small wooden cubes, with each cube measuring 1cm x 1cm x 1cm and he glues them together to make this shape :



As you can see, Simon's shape is just like two larger cubes joined together. What's the surface area of this shape?



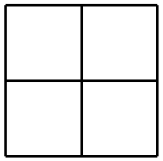


**mean spenders**


On Saturday the average (mean) amount spent by customers at the Whistle Stop Café was £4. On Sunday there were just half as many customers as on Saturday but the 'average spend' was up to £7.

What was the average (mean) amount spent by customers over these two days?

**3D thinking**



You can find 5 squares altogether in this shape (that's 1 large one and 4 small ones, as you can see).

How many different 1cm unit cubes could you find in a 3cm x 3cm x 3cm cube?

**John and Alice**

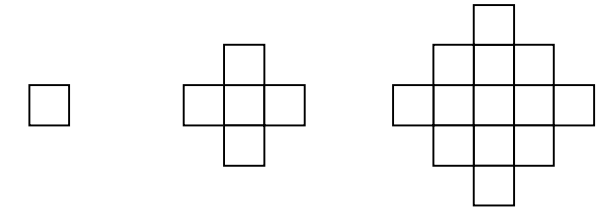
John is twice as old as Alice was three years ago. She is now the same age as he was then. How old are John and Alice now?





**more and more squares . .**

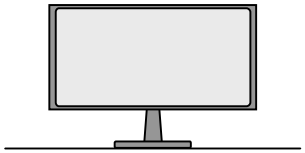
First of all, look at these three shapes :



shape 1 shape 2 shape 3

You can think of the shapes as collections of small squares. Draw the next shape in the sequence (shape 4) and count how many small squares it contains. Can you see anything regular about how many squares are used in shapes 1, 2, 3, 4 ? If not, draw shape 5 to give you a bit more information. Once you've spotted the pattern, work out (no drawing allowed!) how many small squares shape 8 must contain.

**outnumbered**



Here are some facts about Lucy's class :

**a** In the annual School Survey, half the boys in this class gave 'computer games' as their favourite pastime; just one quarter of the girls gave the same answer.

**b** The class has twice as many girls as boys.

Use these facts to work out what fraction of the class as a whole chose computer games as 'favourite pastime'.





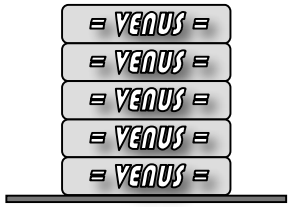
**le sport**

21 children on a school holiday in France are given 'free time' on their last afternoon. Their hotel has tennis courts and a swimming pool. Here are some facts about what they choose to do :

- The number of children who swim and play tennis during the afternoon is exactly the same as the number of children who do neither of these things.
- 9 children swim but don't play tennis
- The number of children who play tennis but don't swim is exactly the same as the number of children who do both of these things.

Using a Venn Diagram to help you, work out how many of the children do both activities.

**chocolate surprise**




When the new Venus chocolate bars were launched last year, there was a special offer available at all sweet shops and supermarkets : for every 5 wrappers you trade in, you get 1 Venus bar free. Toby could never resist a bargain and so when he heard of this amazing offer he went straight out and bought 50 bars! How many free chocolate bars was he able to claim?





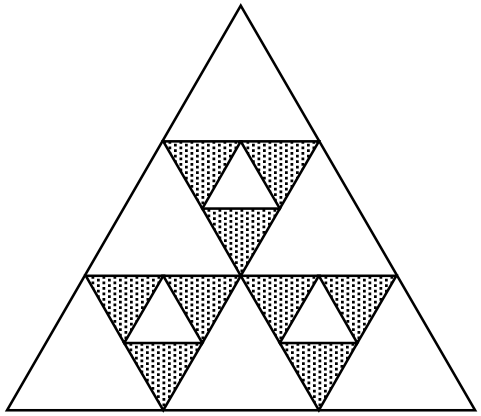
**scalene quadrilateral**

Draw x- and y- axes, each going from 0 to 10, and then put on these four points :

A (1, 4) B (3, 7) C (9, 6) D (7,1)

Join up the four points to form the scalene quadrilateral ABCD. Now work out the exact area of this shape. (It isn't easy!)

**equilateral triangles**



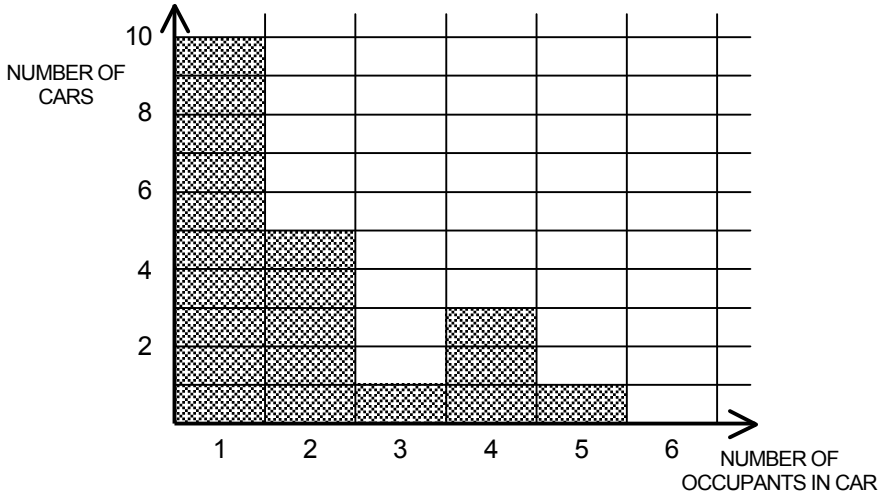
Exactly what fraction of this shape is shaded?





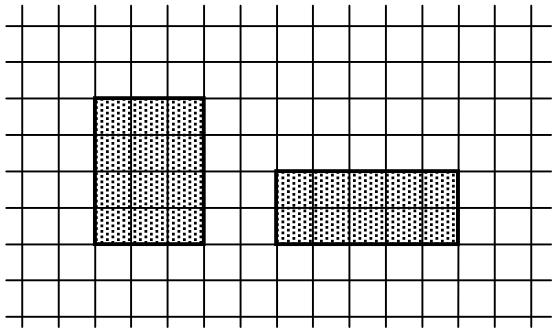
**bridge party**

A recent survey looked at cars crossing Chelsea Bridge in the early morning and how many people were in them.




The chart above shows you the results for cars crossing the bridge on one particular day in November between 7 am and 7:05 am. What was the mean (average) number of occupants per car during this five-minute period ?

**rectangle challenge**



Can you arrange five 3 cm x 4 cm rectangles and five 2 cm x 5cm rectangles so that they fit exactly (no gaps and no overlaps) into a 10cm x 10cm square?





**sequences**

Fill in the gaps in these sequences :

3 - 4 - 7 - 11 - 18 - ___ - ___ - - - -

625 - 125 - ___ - ___ - 1 - 0.2 - - -

___ - 79 - 71 - 64 - 58 - 53 - ___ - - - -

1 - 3 - 7 - ___ - ___ - 63 - ___ - - - -

6 - 1 - 9 - 3 - 12 - ___ - ___ - 27 - -

**fraction patterns**

Notice that $1 = \frac{1}{1}$

and $1 + \frac{1}{2} = \frac{3}{2}$

Now work these out for yourself :

$1 + \frac{1}{2} + \frac{1}{4}$

$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$

$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16}$

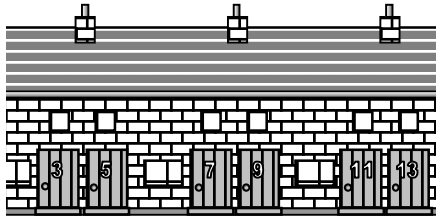
Look for the pattern in these sums and then write down what this one must come to :

$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64} + \frac{1}{128}$





**Edward counts**




Edward is walking home along Laburnum Avenue; he's on the odd side, of course, because that's the side where he lives. As he goes along, he adds the door-numbers together in his head, starting, naturally, with number 1 and finishing with his own door-number. He loves doing this because the total is always 100 (unless he makes a mistake). What's Edward's address?

**parallel lines**

In your book draw x- and y- axes, each going from +5 to -5 and then :

- **a** Put on the points A (1, -1), B (-4, -1) and C (-3, 3).
- **b** Find a point D with positive co-ordinates which will make ABCD a parallelogram. What are D's co-ordinates?
- **c** Join A, B, C and D to form a parallelogram. Now work out the exact area of this parallelogram.





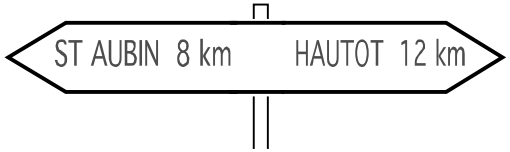
**missing kilometre**

In Normandy there's a road which goes directly from St Aubin to Hautot.

At St Aubin a road-sign tells you that it's 21 km to Hautot . . .


. . . and when you get to Hautot the road-sign there tells you that it's 21 km back to St Aubin.


This is all as you'd expect but – there's also a sign somewhere between these two towns which shows :




Can you explain how this could be?

* *road-signs in Normandy give distances to the nearest km*

**not bacon yet . . .**

At the last summer fare in their village, John and his wife Sally both had a go at the 'guess the weight of the pig' competition. When the winner was announced, it wasn't either of them! The pig actually weighed 99kg but John had guessed too high and Sally had guessed too low.

'99kg is just 10% higher than my guess, so I've done well!' said Sally.

'Well,' said John (who never liked to be beaten), 'It's exactly 10% lower than my guess, so really I've done just as well!'

**a** What were the guesses which John and Sally made?

**b** Is it really true that John's guess was just as good as his wife's?



MATHS CHALLENGE CARDS SET C

**squares and primes**

Some numbers can be written as a square number times a prime number. For example, $1100 = 10^2 \times 11$.

**a.** Write 80 as a square number times a prime number.

**b.** Write 92 as a square number times a prime number.

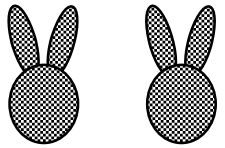
**c.** Write 245 as a square number times a prime number.

**d.** Can 40, 50 and 60 be written in this way? If not, can you prove why?





**run rabbit, run!**



Two rabbits, Ronnie and Reggie, are in training for the Fur and Feather Marathon next spring. Each evening, Ronnie runs an exact number of times round a 20m x 50m field whilst at the same time Reggie runs an exact number of times round a 25m x 25m field. Although they're running round different fields, they each cover the same distance.

What's the minimum distance the rabbits' training run could be?

**odd sums**

Here's something you get when you add odd numbers :

$$1 + 3 = 2 \times 2$$

$$1 + 3 + 5 = 3 \times 3$$

$$1 + 3 + 5 + 7 = 4 \times 4$$

– The pattern is easy enough to see. Now do these :

**a.** Work out what the question mark stands for in this sum : $1 + 3 + 5 + \ldots ? = 16 \times 16$

**b.** Work out what the question mark stands for in this sum : $1 + 3 + 5 + \ldots ? = 50 \times 50$

**c.** How many odd numbers are there in the sum $1 + 3 + 5 + \ldots + 115 + 117 + 119$ ?





**missing trapezium**

**a** On a co-ordinate grid, plot these points :

A (3,0) C (3,7) D (7,6) E (7,0)

Now join the points to form a trapezium ACDE.

**b** Work out the area of this trapezium.

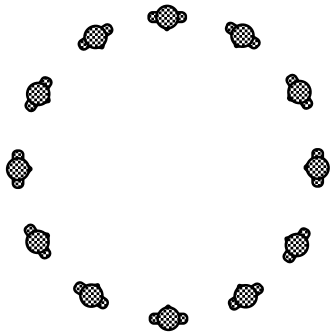
**c** Mark on your diagram point B (3,2) and join this to point D. Now work out the area of the trapezium ABDE.

**d** From your answers to (b) and (c) work out the area of the triangle BCD.

**e** Use the same method to work out the area of triangle PQR, where P = (2,2), Q = (2,8) and R = (6,3). Use a fresh co-ordinate grid for your diagram.

**circle time**

12 children are standing in a circle. Suppose they're all numbered 1, 2, 3 and so on (like on a clock face).



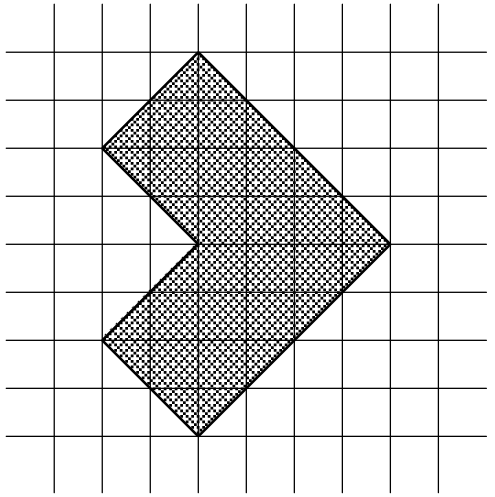
It's easy to see that number 1 will be directly opposite number 7, number 2 will be directly opposite number 8 . . . you get the idea.

On a different day there are more children standing in the circle. This time number 7 is opposite number 18. How many children are there in the circle now?





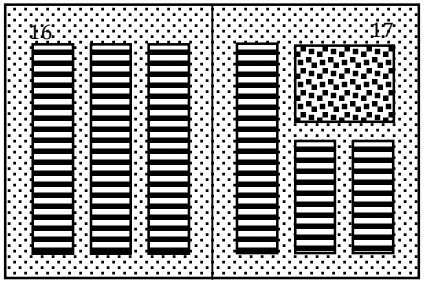
**half measures**



Copy this figure onto squared paper. On the same sheet draw a figure which is exactly the same shape but only half the area.

**not all black and white**

A newspaper is made up of separate large sheets folded in half; each of these large sheets carries two pages of the newspaper on each side. For example, here are the middle two pages on one side of a large sheet. (Pages 15 and 18 are on the other side).



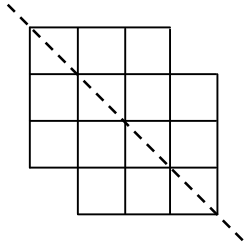

**a.** What number is the last page of this newspaper?

**b.** How many large sheets have been put together to make the whole newspaper?





**square symmetry**



For these questions, you'll need squared paper and you'll need to make several copies of the shape above.

**a.** Find as many ways as you can of shading two squares to make the shape symmetrical about the dotted line. Don't include any patterns where the dotted line crosses a shaded square.

**b.** Find as many ways as you can of shading two squares to make the shape symmetrical about the dotted line – but this time use only squares crossed by the dotted line.

**prime pairs**

Goldbach was a famous mathematician. One well-known thing he said was this :

You can make any even number greater than 2 by adding two prime numbers.

For example, 8 = 3 + 5 and 18 = 7 + 11

Often this can be done in more ways than one, for example 14 = 3 + 11 and 14 = 7 + 7

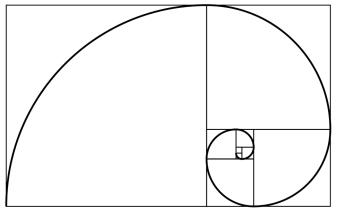
**a.** Find as many ways as you can of writing 36 as the sum of two prime numbers.

**b.** Find as many ways as you can of writing 50 as the sum of two primes.





**Fibonacci**



In a Fibonacci sequence you just add two terms to get the next one. Here's an example :

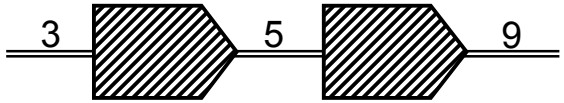
3, 5, 8, 13, 21, 34 . . .

**a.** Find two numbers to start off a Fibonacci sequence and give you 10 as the $5^{th}$ number.

**b.** Find two starting numbers for a Fibonacci sequence which will give you 14 as the $5^{th}$ number. There are two different pairs which will work here; try to find them both.

**number-crunching**

In the Function Factory there's a machine where if you put a number in, the machine doubles it and takes 1 away. One day two of these machines are joined up. You can see here what happens when we put in number 3 :




**a.** What number would you put in to get 17 as the final result?

**b.** Could you ever end up with the same number you put in at the beginning? If so, what number?

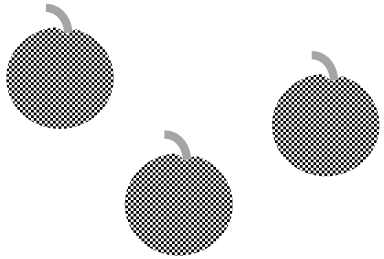
**c.** Apart from your answer to (b) above, which square numbers under 50 could you get as a final result?

**d.** Could you ever get an even number as the final result?





**apple pie**

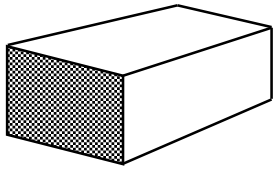


Alfred, Bella and Chris have picked some apples. They share them out but not very fairly. Alfred takes 40% of the apples, Bella takes 1/5 of them and Chris takes the rest. In fact, Chris ends up with 30 apples.

**a.** How many apples are there altogether?

**b.** If they decide that, after all, it would be better for them all to have equal shares, who would have to give some apples, how many would they have to give and who would get them?

**cuboid faces**



The areas of the faces of a cuboid are 30 $cm^2$, 12 $cm^2$ and 40 $cm^2$.

**a.** What are the lengths of the sides of the cuboid?

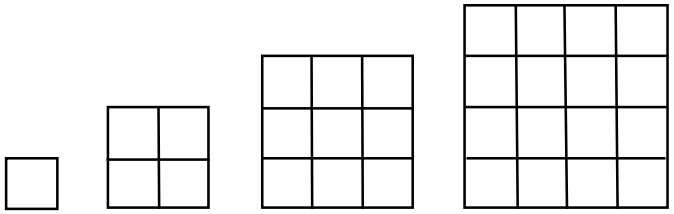
**b.** What's the volume of the cuboid?

**c.** A different cuboid has one quarter of the volume of this one; what could its dimensions be?





**family of squares**



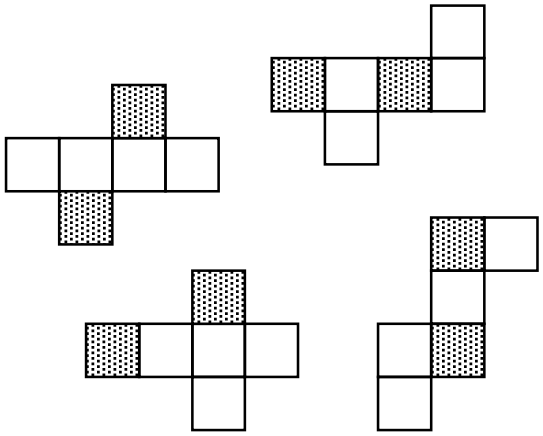
**a.** Look at these four different figures. In the first one you can see just one square. In the second one you can find 5 squares altogether. How many squares altogether can you find in the third figure?

**b.** How many squares can you find in the fourth figure?

**c.** Without drawing it, can you say how many squares will be contained in the next figure in the sequence?

**odd cube out**

Here are four different nets. Each one of them when cut out and folded will make a cube.



Try to imagine the four different cubes made up. Which one will be the odd one out? What makes this one different?





**follow my leader**

Find the missing numbers in each of these :

**a.** 92, □, 77, 71, 66, 62, □

**b.** □, 5, 11, 23, 47, □, 191

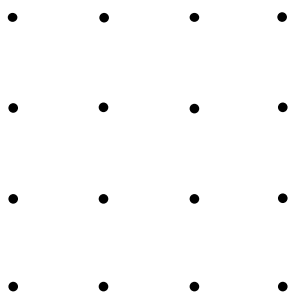
**c.** 6.3, □, 5.1, 4.5, 3.9, 3.3, □

**d.** 195, 168, □, 120, 99, 80, □

**e.** 2, 3, □, 7, 11, □, 17, 19

**f.** 64, □, 16, 8, 4, 2, 1, □

**isosceles triangles**

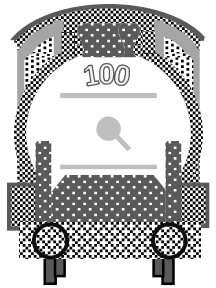


You'll need to make several copies of the 4 x 4 dot lattice above to answer this question. Using the dots in the lattice as your corners, how many different shapes / sizes of isosceles triangle can you make?





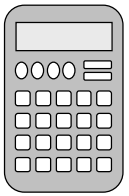
**fast travel !**




**a.** A typical speed for a modern high-speed train would be 90 metres / second. What would this speed be in kilometres / hour ?

**b.** A typical speed for a cruising jetliner would be 250 metres / second. What would this speed be in kilometres / hour ?

**calculator problems . . .**



**a.** Ben started with two numbers, both under 20. He divided one number by the other and got 7.5 as his answer. What were the two numbers he began with ?

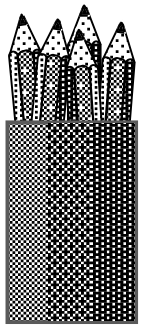
**b.** Joe did the same thing with two numbers both under 30 and he got 6.25 as his result. What were his two original numbers ?

**c.** Sally got 5.125 as her answer after she started with two numbers, both under 50, and divided one by the other. What were her two starting numbers ?





**pencil sharpener**

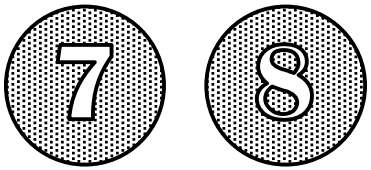


On my desk I have a number of pencils and a number of jars. Here's some information about them :

- If I put 8 pencils into each jar, I have one jar left over.
- If I put 5 pencils into each jar, I have 3 pencils left over.

How many jars have I got, and how many pencils ?

**counter example**




I find two counters at the back of the maths cupboard. They each have numbers written on both sides. By turning them over, I can get different combinations – in fact, I can get totals of 13, 14, 15 or 16. What are the numbers written on the other sides of these two counters ?





**running dog**

Edward has been to visit his grandparents and after lunch he sets off to walk back home again. As he starts his journey, he's exactly 2½ km from his own home. Edward walks at a steady 5 km / hr, so he'll definitely be back in time for tea. All the time he's walking, Edward's dog Zorro runs back and forth, back and forth, between Edward and home. The dog's running speed is a steady 10 km / hr. How far altogether will the dog have run by the time Edward reaches his house ?

**even sums**

Here's a pattern involving sums of even numbers :

$$2 + 4 = 3^2 - 3$$

$$2 + 4 + 6 = 4^2 - 4$$

$$2 + 4 + 6 + 8 = 5^2 - 5$$

$$2 + 4 + 6 + 8 + 10 = 6^2 - 6$$

Now for the questions :

**a.** Work out $2 + 4 + 6 + \ldots + 38$

**b.** Work out $2 + 4 + 6 + \ldots + 98$

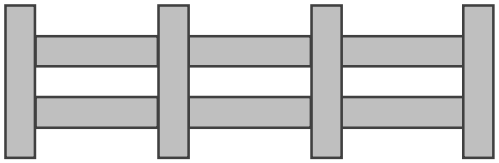
**c.** What is $x$, if $2 + 4 + 6 + \ldots + x = 870$ ?



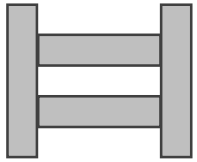


**champion fencing**

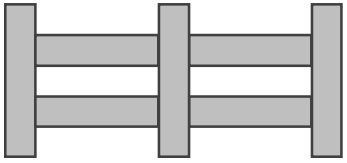
- This strip of fencing measures exactly 4 metres from one end to the other :

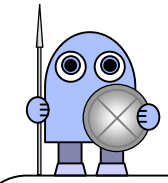


- This is the same kind of fencing but this time the strip measures 1.5 metres from one end to the other :



- How long is this strip from one end to the other ?







**ferret food and paint**

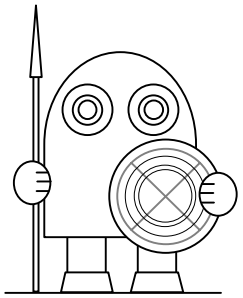


**a.** Sally's 6 ferrets eat altogether 3 kg per day of ferret food. At the start of the month she has 45 kg of ferret food on the shelf, all ready for them. After 10 days, sadly one of the ferrets dies. How many days in all will her 45 kg of ferret food last her ? (You may assume that all ferrets eat the same amount.)

**b.** It takes 3 men 3 days to paint 3 hotel rooms. How much painting would 1 man do in 1 day ? (You may assume all the rooms are the same size.)



four winds maths





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