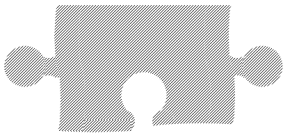
living on the edge



A jigsaw puzzle has 180 pieces. The finished puzzle is a rectangular array 18 pieces by 10 pieces. How many edge pieces does the puzzle have? (You might find it helpful to draw a diagram.)

take four numbers

1 2 3 4

Look at the set of numbers above. If you take all four numbers and combine them in a certain way, you can make 6. Here's how :

$$6 = (21 + 3) \div 4$$

By combining the same numbers in a different way, you can make 7, for example like this :

$$7 = (24 \div 3) - 1$$

Try to make 8, 9, 10, 11 and 12 by combining these same four numbers in different ways.

the Johnsons

The Johnson family has four children. There's Kate (the eldest) and then there's Tom and Ben and Sally (she's the youngest). Here are some facts about their ages :

- The children are all under 10.
- Tom is 2 years older than Ben.
- The sum of the boys' ages is exactly the same as the sum of the girls' ages.
- Kate is twice as old as Sally.
- A year ago, Tom's age was exactly double Sally's age.

How old are the Johnson children?

odd one out

2 10 16 33

Take a look at this set of numbers and think about what you'd say if someone asked you to choose the 'odd one out'. You might well go for 33 (because it's the only odd number) or you might choose 2 (the only prime number) or 10 (the only triangle number) or perhaps 16 (the only square number).

Now look at these numbers

7 15 28 49

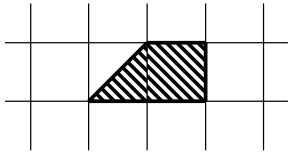
and try to find a reason (something interesting if possible!) for each of them being the 'odd one out'.

Finally, try to do the same for this set of numbers :

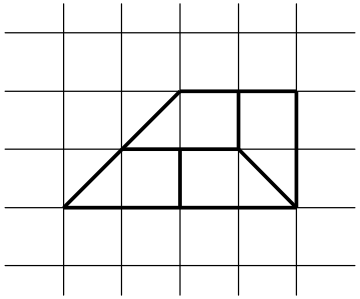
3 8 25 40

rep-tiles

Emily has some tiles like this one :



She finds that she can put four of these tiles together to make a 2 x enlargement, like this :



Using square grid-paper,

- **a** Draw a 3 x enlargement of the original tile and find a way of filling it with the smaller tiles.
- **b** Do the same for a 4 x enlargement.
- **c** How many tiles would you need for a 10 x enlargement? (Don't draw it, just look at the answers you've already got!)

quality product

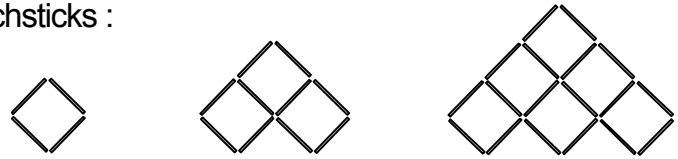
Choose two whole numbers which add up to 100; what's the product of these two numbers? Now choose two new numbers and find their product. What's the largest product you can make by taking two numbers which add up to 100 and multiplying them together?

free butter

Marcel has 28 metres of fencing and he wants to make a rectangular enclosure for his goat. What's the largest area Marcel's goat can hope for?

matchstick maths

Here are three shapes which Joe has made out of matchsticks :



shape 1 shape 2 shape 3

As you can see, in shape 1 he's made a square and he's used 4 matches, in shape 2 he's made three squares and he's used 10 matches.

a How many matches has Joe used in shape 3?

b Draw shape 4 and write down how many matches it would take for Joe to make it.

c How many matches would it take to complete shape 20? (Don't draw it, work it out!)

digit sums

There's something rather special about number 18 – it's exactly double the sum of its digits (1 + 8). Number 27 is also special – it's exactly three times the sum of its digits.

a Find a 2-digit number which is exactly four times the sum of its digits.

b Find a 2-digit number which is exactly five times the sum of its digits.

c Find a 2-digit number which is exactly seven times the sum of its digits.

serial sums

A number which you make by adding together two or more consecutive numbers is called a ‘serial sum’. For example, 10 is a serial sum, since you can write it as 1 + 2 + 3 + 4. 54 is another example, because 17 + 18 + 19 = 54.

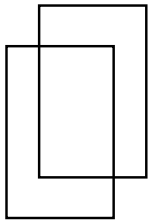
a 414 is a serial sum. Find some consecutive numbers which you can add together to get 414.

b 515 a also a serial sum. Find some consecutive numbers which add up to 515.

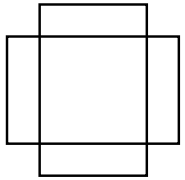
c Is 616 a serial sum?

rectangle regions

If you draw a rectangle and then draw an identical rectangle on top of it, you might get a shape something like this one :



or perhaps like this :



The first of these shapes has 3 regions, as you can see, and the second has 5 regions. What’s the **largest** number of regions you can get by overlapping two identical rectangles?

weigh it up!

When Amy and Bill go to visit their cousins, Chris and Debbie, they find an old see-saw in the garden. The cousins say they never use the see-saw because Debbie is heavier than Chris, so it doesn't balance. Now :

- Amy and Bill together weigh 60 kg
- Amy and Chris together weigh 35 kg
- Bill and Chris together weigh 55 kg
- Bill and Debbie together weigh 75 kg
- Chris and Debbie together weigh 50 kg

Is there any way of getting two children on one side of the see-saw and two children on the other side so that it balances? (To answer this, you'll first have to work out what each of the children weighs.)

strange things about Simon

- Simon's address has a 3-digit number in it. He notices that if you find the product of any two of these digits and then add the other one, you get the answer 2. What is the 3-digit number in Simon's address ?
- Simon's age plus his father's age gives you his grandfather's age exactly. Simon's grandfather is three times as old as Simon and twice as old as Simon's father. What are their ages?

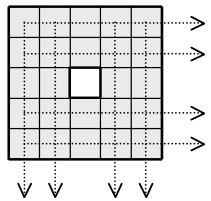
product recall

a The product of two numbers is four times as big as their sum. One of the numbers is double the other. What are the two numbers?

b Find three consecutive whole numbers whose product is the same as eight times their sum.

magic ring

How does a magic ring work? Well, when you've got all the numbers in place, the totals along the four rows and down the four columns must all be the same :



Here's one for you to solve. Copy it carefully and then find numbers to make it work. The line / column total is 60.

	21	8		
1	13			19
18			24	6
		4	11	23
22	9	16		

keep it in proportion!

a At King Edward's School (300 children) they use 4500kg of potatoes per year in the School kitchen. How much would they use if they had to feed 400 children ?

b Five young seal-cubs eat 24kg of fish daily. How much fish per day would you expect nine seal-cubs to get through ?

c Poor Mrs Walker! Her eight children get through 4kg of shoe-leather every year. How much shoe-leather would three similar children get through in a year ?

d If it takes Leonardo ten days to paint a wall measuring 5m x 11m, how long would it take him to paint a similar wall measuring 3m x 22m ?

a binary operation

A binary operation is just a way of combining two things to get another. Addition is one example of a binary operation ($5 + 3 = 8$) and subtraction is another ($9 - 5 = 4$).

Here we're going to use a new binary operation, with its own symbol $*$, where

$$a * b = ab - (a + b)$$

In other words, $a * b$ just means the product of these two numbers minus their sum eg $4 * 6 = 24 - 10 = 14$

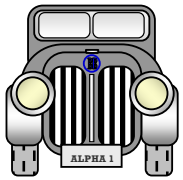
So, if you've understood this, try to work out :

a What's $5 * 9$?

b What's $10 * 10$?

c The answer to part b isn't 10 of course. But can you find a number n which will give you $n * n = n$?

desert sands



Alphonse has taken on a difficult challenge: he's trying to cross 11,250 kilometres of north African desert in a veteran car. Why people do things like this we're not really sure but anyway, we do know that along the way he must pass through Adra; this settlement is exactly twice as far from the start of Alphonse's journey as it is from the end. So, when (or perhaps if) he reaches Adra, how far will Alphonse still have to drive?

a binary operation

In this question a and b stand for ordinary numbers and

a O b means 2a – b (double a then take away b).

Here are two examples :

2 O 3 = 4 – 3 = 1 5 O 7 = 10 – 7 = 3

Now work out :

a 3 O 5 = ☐ **b** 3 O 6 = ☐

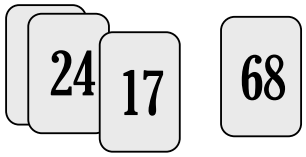
c 9 O 9 = ☐

The next ones are harder :

d ☐ O 2 = 12 **e** 9 O ☐ = 11

f ☐ O ☐ = 15

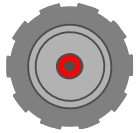
eliminator



Miss Fortune is going to play ‘eliminator’ with her maths class. She gets out her usual set of 1 – 100 cards but before giving them out she has a small problem for the class to solve :

‘How many of these one hundred cards don’t have a 3 on them?’, she asks. After some time (and a bit of help) the class comes up with the right answer. What is the right answer?

share the wear



Mark is taking his 4-wheel drive truck on a 1200 km journey across rough terrain. He decides that it would be a good idea to rotate the 5 tyres (4 on the road plus the spare) so that they all get equal wear. How far will each tyre travel?

making 100

$$111 - 11 = 100$$

As you can see, we've made five 1s equal to 100 by arranging them in a certain way. Can you find a way of arranging five 5s so that they make 100?

sum and product

Find two numbers whose product is exactly twice as big as their sum.

it's my party

Max is a rich mouse who lives on an island in the pacific (plenty of sunshine there!). His best friends on the island are goldfish, parrots and, of course, other mice. When it's his 10^{th} birthday Max has a big party. There are different numbers of goldfish, parrots and mice at the party – and that's where the challenge begins. If you started to count different features of the guests, you'd find :

- there are twice as many goldfish as mice
- the guests have 52 legs altogether
- the guests have 72 eyes altogether

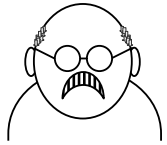
Of course, the parrots are the noisiest. Can you work out how many parrots Max has invited to his party?

hard maths

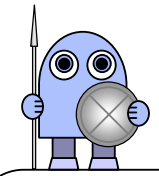
Look for the pattern in each row (you get the number in the circle by doing something with the other three numbers) and then work out what the missing number must be.

3 — (12) — 5 — 4	6 — (9) — 2 — 1	3 — (20) — 7 — 10	4 — ( ) — 5 — 8
3 — (16) — 4 — 5	5 — (13) — 3 — 2	2 — (27) — 10 — 5	4 — ( ) — 4 — 4
5 — (13) — 2 — 3	6 — (3) — 9 — 2	3 — (7) — 5 — 4	4 — ( ) — 10 — 5

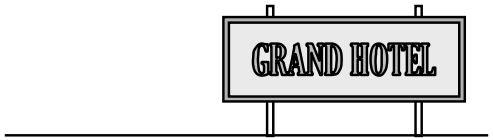
grandad makes a difference



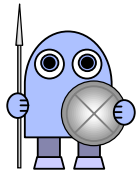
Sam lives at home with his mum and dad. He works out that the average age of those in the house is 32. One day Sam's grandfather comes to visit and it crosses Sam's mind that the average age of those in the house must now have gone up a bit. He works out the new average age and finds that it's 42. How old is Sam's grandfather?



bold as brass



The new Grand Hotel in Blackheath will have exactly 200 rooms, every one of which is to be numbered with individual brass numerals. (For example, Room 34 will have two brass numerals, a 3 and a 4, whilst Room 151 will have three brass numerals, two 1s and a 5.) Tom has the job of ordering all the brass numerals from the sign-makers; these numerals are pretty expensive, so he'd better get it right! How many brass 0s altogether should he order ?



MATHS CHALLENGE CARDS SET B

wrong number !

In the office where Kirsty works there are 45 telephones altogether; some are silver, some are black and some are grey. Here's some information about them :

a. There are twice as many grey phones as silver ones.

b. There are one and a half times as many black phones as silver ones.

c. The number of black phones is three-quarters of the number of grey phones.

How many phones are there of each colour ?

grid points

For this question you'll need to draw a co-ordinate grid with both axes numbered up to 10.

- Plot these points : A (2,3) B (2,6) C (6,3) D (6,0)
- Join up the four points to make a quadrilateral. What sort of quadrilateral is it ?
- Does this quadrilateral have a line of symmetry ?
- Draw in the two diagonals AC and BD. What's the point where these two lines cross ?
- Work out the area of the quadrilateral ABCD.

mean ages

Here are the ages of four children at the Little Tractor Nursery : Ralph is 3 yrs 1 mth, Millie is 4 yrs 5 mths, Ian is 3 yrs 6 mths and Naomi is exactly 4yrs old.

Work out the average (mean) age of these children.

keep in shape !

Work out what shape is being described in each of these :

a. A quadrilateral which has rotational symmetry but not bilateral (mirror-image) symmetry.

b. A quadrilateral which has all four sides equal but not all four angles equal.

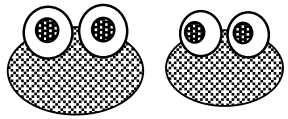
c. A triangle which has bilateral symmetry and two equal angles which add together to give the third angle.

d. A regular polygon whose internal angle is 120º.

e. A shape whose four corners are all the same distance apart.

f. A quadrilateral whose diagonals are lines of symmetry but whose angles are not all equal.

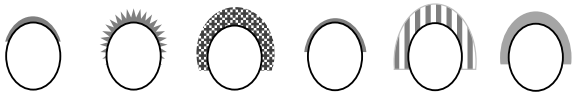
leap-frog romance



Two teen-age frogs, Rio and Emily, are boyfriend and girlfriend. Between one side of a river and the other there are 70 stepping-stones, all numbered (1, 2, 3, 4 . . . 69, 70). Just before midnight Emily is sitting on stone number 3 and Rio is sitting on stone number 66. At midnight, the bell on the church clock begins to ring. Each time it chimes, Emily leaps 3 stones towards Rio and Rio leaps 4 stones towards Emily.

Will the two frogs ever land on the same stone, and if so, which stone will it be ?

waiting in line



There are six pupils lining up at the water fountain. Here's some information about who is where in the queue :

- There are four pupils in front of Jane
- Peter is between Ben and Sue
- There are three pupils between Kate and Peter
- Alfred is fourth in the queue
- Jane and Kate are the only girls next to each other
- There are two pupils between Alfred and Ben

Work out who stands where in the queue.

odd squares

Look at this pattern :

$3^2 - 1^2 = 2 \times 4$

$5^2 - 3^2 = 4 \times 4$

$7^2 - 5^2 = 6 \times 4$

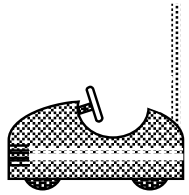
$9^2 - 7^2 = 8 \times 4$

a. Use the pattern to write down what $11^2 - 9^2$ and $13^2 - 11^2$ are equal to.

b. Work out the value of $51^2 - 49^2$

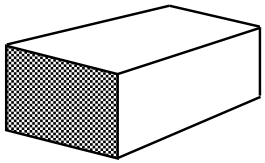
c. Work out the value of $101^2 - 99^2$

fair deal ?



- Three friends set off for the fair. After agreeing to share their money, they each end up with £8. On the way they meet Robin, who says he'll go with them. Again, they share all the money they have among them and this time they end up with £6 each. How much has Robin put into the total sum?
- Further on they meet Sally, who joins them and who also agrees to the idea of sharing all their money equally. This time they each end up with £8 (just like at first). How much has Sally put into the total sum?

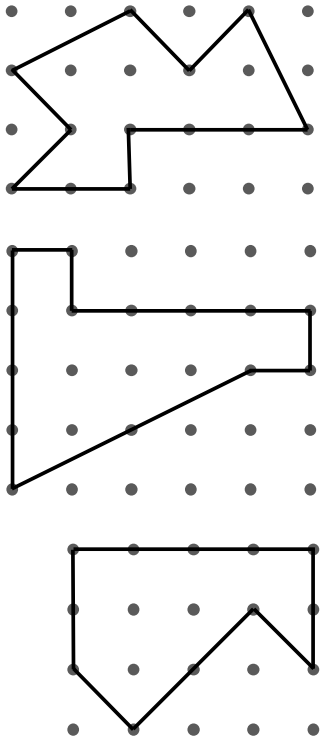
matchboxes



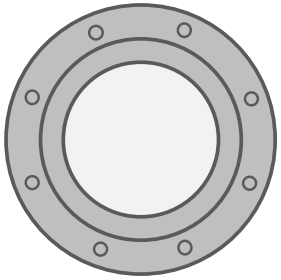
- Venus matches come in packs of so many boxes to a carton. Each matchbox measures 4cm x 3cm x 2cm and each carton measures 12 cm x 6cm x 4 cm. How many matchboxes do you get in a carton ?
- The makers of Venus matches decide to start packing the boxes in cartons measuring 8cm x 6cm x 6cm. How does the surface area of the new carton compare with the surface area of the original carton ?

half-life

Split each of these shapes into two identical halves :



cabin fever



The luxury cabins on the steam yacht Caledonia have been numbered using solid brass numerals. Altogether 171 of these numerals have been used. How many cabins are there ?

(In other words, what does the numbering go up to ?)

important factors

- 10 has four factors : 1, 2, 5 and 10.
- 18 has six factors : 1, 2, 3, 6, 9 and 18.

Try to find :

a. Three different numbers under 50, each with eight factors.

b. A number under 50 which has nine factors.

c. A number under 50 which has ten factors.

adding in pairs

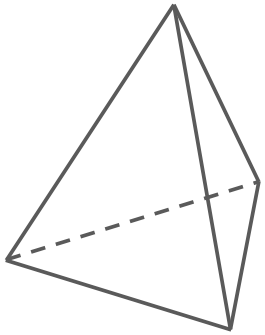
When you have three numbers and you add together different pairs, you get three different totals. For example, if your three numbers are 2, 7 and 10, your totals will be 9, 12 and 17. With four numbers added in pairs you get six different totals.

a. Find three numbers which give totals of 8, 11 and 13 when you add them together in pairs.

b. Find four numbers which give totals of 5, 6, 7, 9, 10 and 11 when added in pairs.

c. Find four numbers which give totals of 7, 7, 10, 14 and 14 when added in pairs.

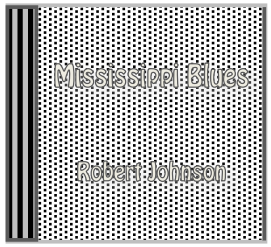
coloured faces



Here's a picture of a regular tetrahedron. It has four faces, each one of them an equilateral triangle.

Suppose you decide to colour one face blue, another face green, another face yellow and the last face red. How many different ways are there of doing this ? (Don't count two ways as different if you can get from one to the other just by turning your tetrahedron around.)

record spend



Mr G bought 9 new CDs for his record library. Altogether he spent £100. Some of the CDs he bought were double albums and the others were single albums. The single albums were all the same price as each other – and the double albums were all £5 more than the single albums.

How many of each type did Mr G buy, and what did he pay for them ?

quality products

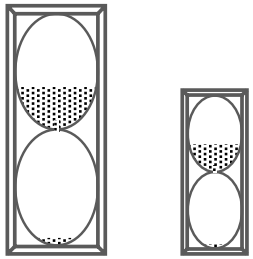
This question is all about 2-digit numbers. Let's take 21 for example : you'll notice that the number itself is 7 times the sum of its digits (2 + 1 = 3 and 7 x 3 = 21).

a. Apart from 21, John finds two other numbers where the number itself is 7 times the sum of the digits. What are John's two numbers ?

b. Kate says she's going to find a number which is 5 times the sum of its digits. John says it's not possible. Who is right ?

c. Ben looks for a number which is 9 times the sum of its digits but he doesn't find one. Is there such a number ?

before clocks

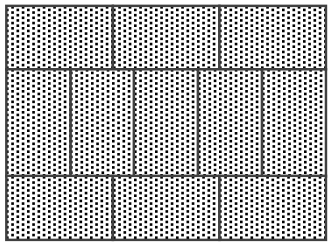


Jack has two egg-timers in his kitchen. One of them measures 7 minutes and the other measures 11 minutes.

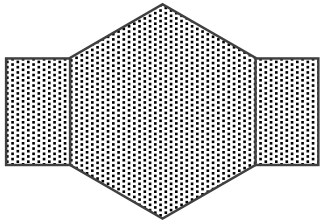
a. Try to work out how Jack, using just these two timers, can measure out a time of 4 minutes.

b. Now work out how Jack can measure out 8 minutes, again using just these two timers.

out on the tiles

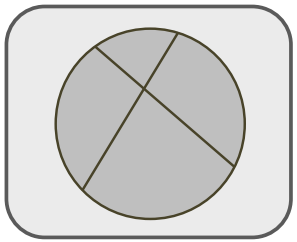


- The perimeter of this shape (made from 11 identical tiles) is 104 cm. What do the individual tiles measure ?



- What's the perimeter of this shape (made from two of the same tiles as above plus a regular hexagon) ?

pizza portions



If you take a pizza and make 1 straight cut across it, you'll get 2 pieces. If you make 2 straight cuts, you'll get 4 pieces.

a. If you take a pizza and make 3 straight cuts across it, what's the largest number of pieces you can make ?

b. How many pieces could you make with 4 straight cuts ?

c. How many pieces do you think you could get with 5 straight cuts ? (Look for a pattern !)

missing numbers

Look for the pattern in each of these sequences and then work out what the missing numbers must be :

a. 3, 8, 23, 68, 203, □ , □ . . .

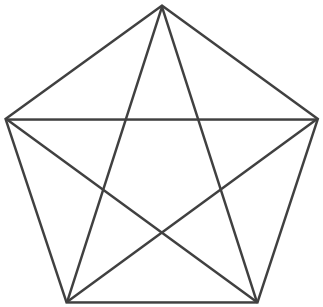
b. □, 3, 9, 12, □, 33, 54 . . .

c. 2, 3, □, 7, □, 13, 17, 19 . . .

d. 4, 5, 7, 11, 19, 36, □ , □ . . .

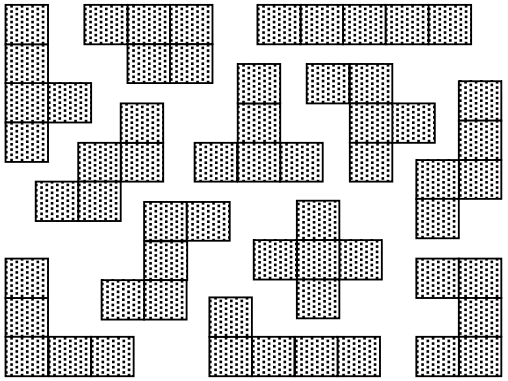
think isosceles !

For this question you'll need to make a few copies of this diagram, which shows a regular pentagon with its five diagonals :



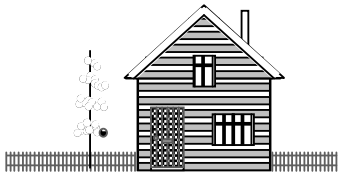
Now see how many different isosceles triangles you can find in the shape.

pentomino squares



– Here is the full set of pentomino pieces (all the pieces you can make from 5 squares joined edge to edge).
Draw a 5 x 5 grid on squared paper and try to fill it using five different pentomino pieces. Look for two different ways of doing this, using different pieces. (Don't get out a set of pentominoes, just work on paper !)

age-old problem

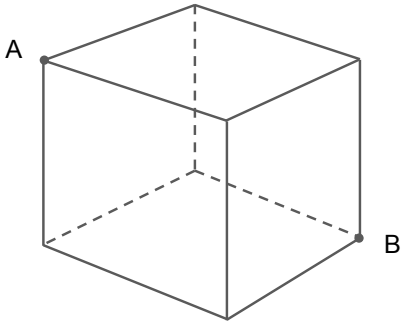


Four people live at Simon's house : Simon's mother, his father, his grandfather – and of course Simon himself. Here's some information about their ages :

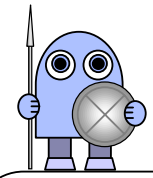
- The grandfather is 30 years older than the father.
- Simon's age plus his father's age comes to 48.
- The mother is 6 times as old as Simon.
- If you add together the mother's age and Simon's age, you get the father's age.

First of all work out the ages of all four residents. Then work this out : how long will it be before Simon's age is a quarter of his father's age?

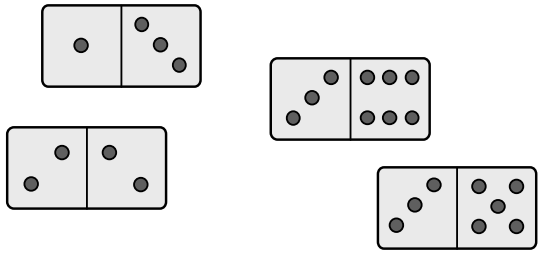
cube routes



- Lewis the ladybird is at point A on this 10 cm cube. What's his shortest distance to point B if he's only allowed to travel along the edges ? How many different ways are there of doing this ?
- What's the longest route Lewis could find from A to B if he travels along the edges and doesn't go through any point twice ?

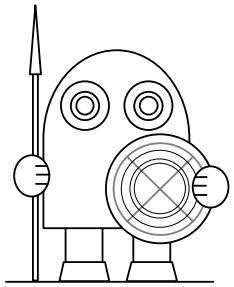


domino mystery



John got out a set of dominoes from the cupboard and arranged them on his desk. He found that instead of the usual 28 dominoes there were only 25. He counted up the number of spots on the dominoes he had and found that it came to 135. So which three dominoes were missing ?

four winds maths



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