KS2 Reasoning & Problem Solving Questions

MathsHUBS
White Rose

Information

This booklet contains over 40 reasoning and problem solving questions suitable for KS2 and KS3 classes. These are the questions that we have been putting out each day in March 2016 on Twitter in the run up to SATS.

The answers are provided with some simple notes at the back of the booklet and for some questions supplementary questions and variation has been provided.

We hope to release more questions like this over the course of next year including some open ended problems. Please keep a look out for our work. If you have not seen our schemes and assessments for primary then please take a look at our website www.whiterosemathshub.co.uk

As always we welcome any feedback on the work we are doing and the materials that we are releasing.

Thank you for taking an interest in our work.

The White Rose Maths Hub Team

Reasoning and Problem Solving Questions

Children's Reponses

Children's responses will tell you a lot about their depth of understanding of a given topic. For example

> **2** Here are two number cards.
>
> A B
>
> Here is some information about the cards.
>
> When you divide A by B you get 1.5
>
> The difference between A and B is 7
>
> Find the value of A and B.
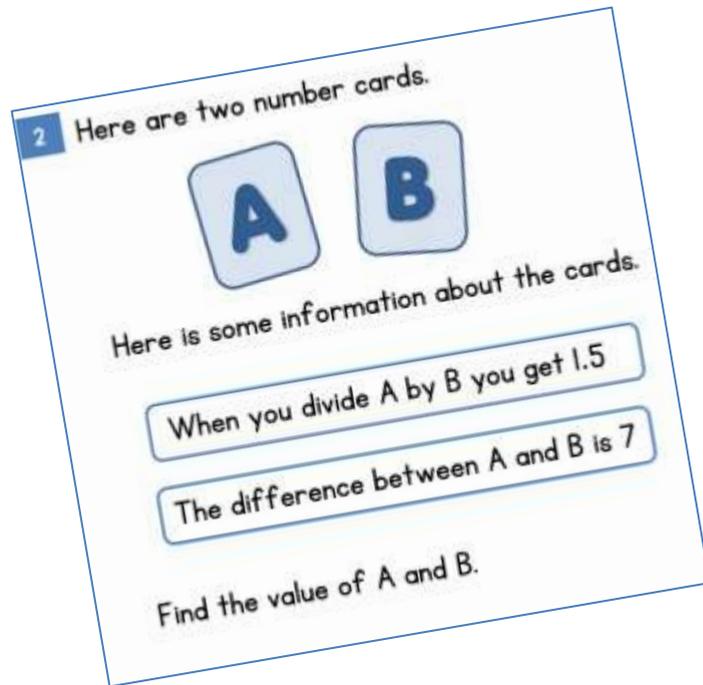
Some children may approach this using trial and error.

Some may say that 1.5 is equivalent to $\frac{3}{2}$ and then try and work out equivalent fractions e.g. $\frac{6}{4}, \frac{9}{6}$ and realise difference increases by 1 each time.

Some may try and form an equation.

Bar Modelling – Pictorial Methods

Many of the problem solving questions in this booklet can be solved using a bar modelling method. Encourage children to use diagrams to help them solve the problem.

Here is a problem where bar modelling would help.

> **3** Geoff is reading a book.
>
> On Monday he reads $\frac{1}{3}$ of th...
>
> On Tuesday he reads $\frac{3}{10}$ of...
>
> pages.
>
> He has 35 pages left t...
>
> How many pages are...

> Monday   25   50
>
> Tuesday
>
> 15   35
>
> $35 \div 7 = 5$
> $5 \times 3 = 15$
> $15 + 35 = 50$
> $50 \div 2 = 25$
>
> There are 75 pages in the book in total
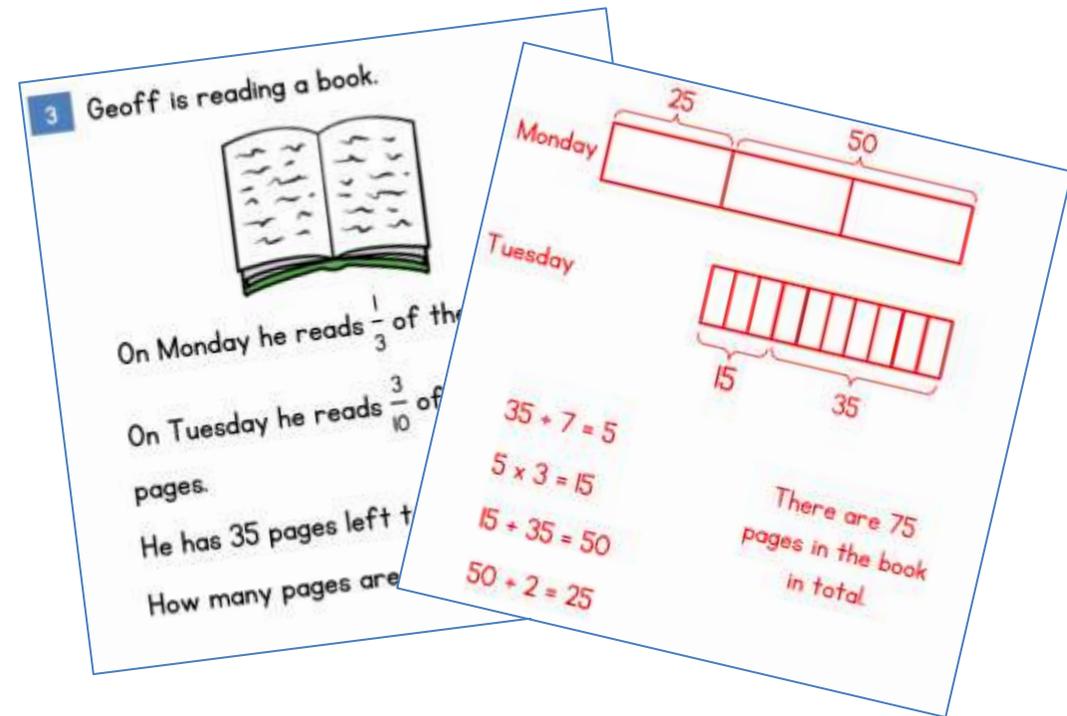
If you want to find out more about bar modelling please contact the Hub.

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# What fraction is shaded?

1 Here are 3 identical rectangles.

Part of each shape has been shaded.

What fraction of the middle shape is shaded?

$$\frac{3}{5}$$

$$\frac{1}{4}$$

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2 Here are 3 identical rectangles.

Part of each shape has been shaded.

What fraction of the middle shape is shaded?

$$\frac{11}{15}$$

$$\frac{7}{10}$$

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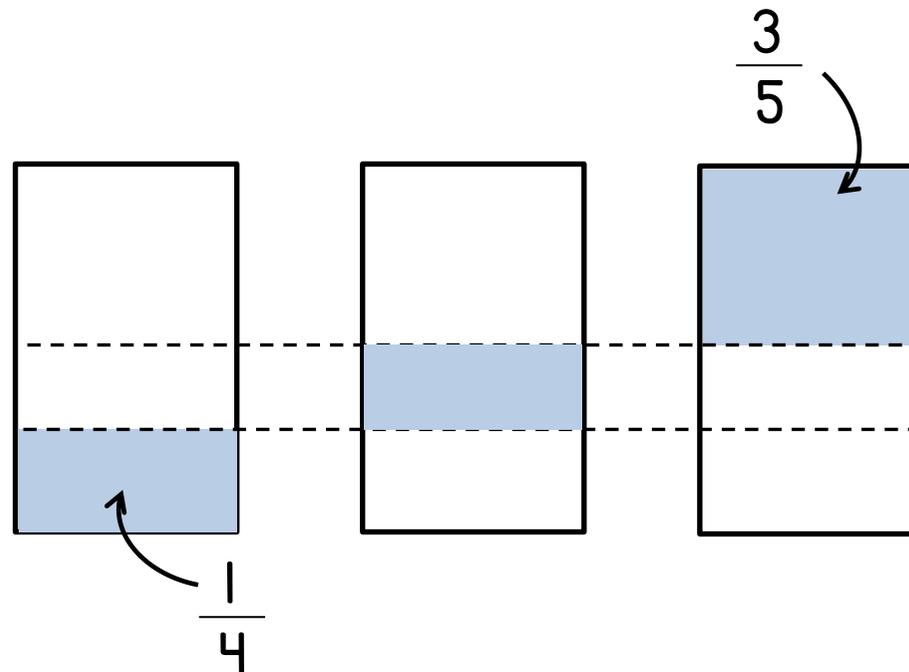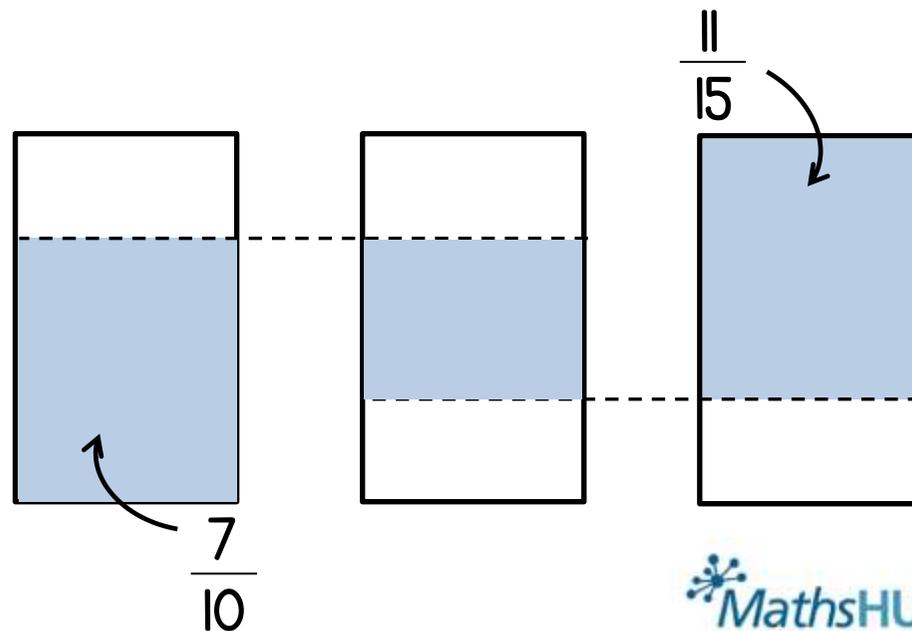
Presents and Lollies

1 Mrs Jones has £20 to spend on presents.

She buys 4 mugs and 3 teddy bears.

What is the greatest number of key-rings she can buy?

95p

£1.80

£2.45

2 Lollies are sold in two sizes, small and large.

Sanjay buys two small lollies for 92p

Jenny buys 5 small lollies and 3 large lollies and pays with a £10 note.

Jenny receives £4.16 change.

How much does one large lolly cost?

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Perimeter Problems

1 Here is a square.

Inside the square is an equilateral triangle.

The perimeter of the triangle is 54cm.

Find the perimeter of the square.
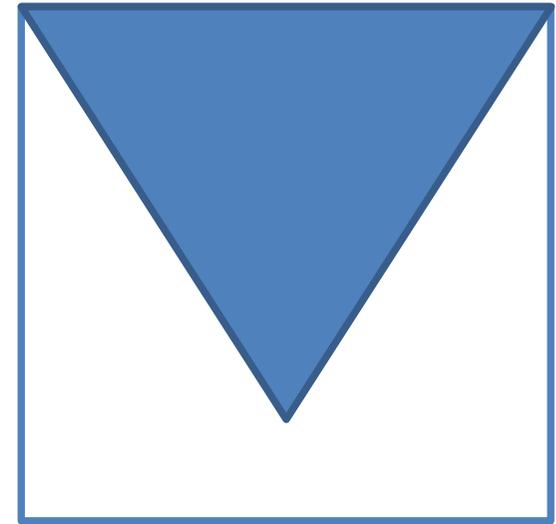
2 The perimeter of the rectangle is 33 metres.

Find the length of the rectangle.

3.6m

length

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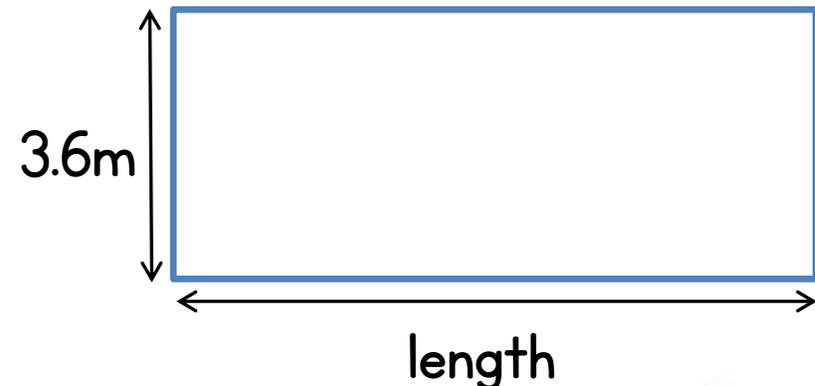
Fractions Friday

1 Choose one of these symbols

$$<, > \text{ or } =$$

to make the number sentences correct.

$$\frac{1}{5} \bigcirc \frac{1}{7} \qquad \frac{3}{5} \bigcirc \frac{4}{7}$$

You may use the fraction strips below to help you.
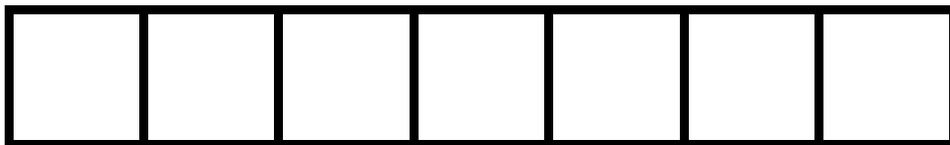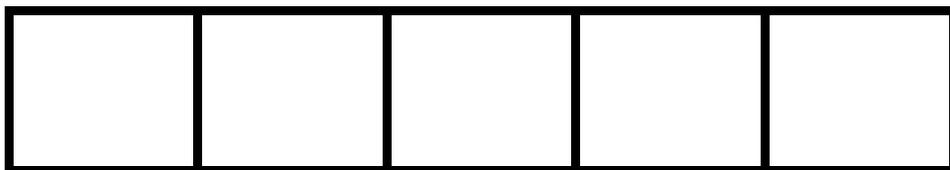
2 A square is divided into smaller squares.

What fraction is shaded?
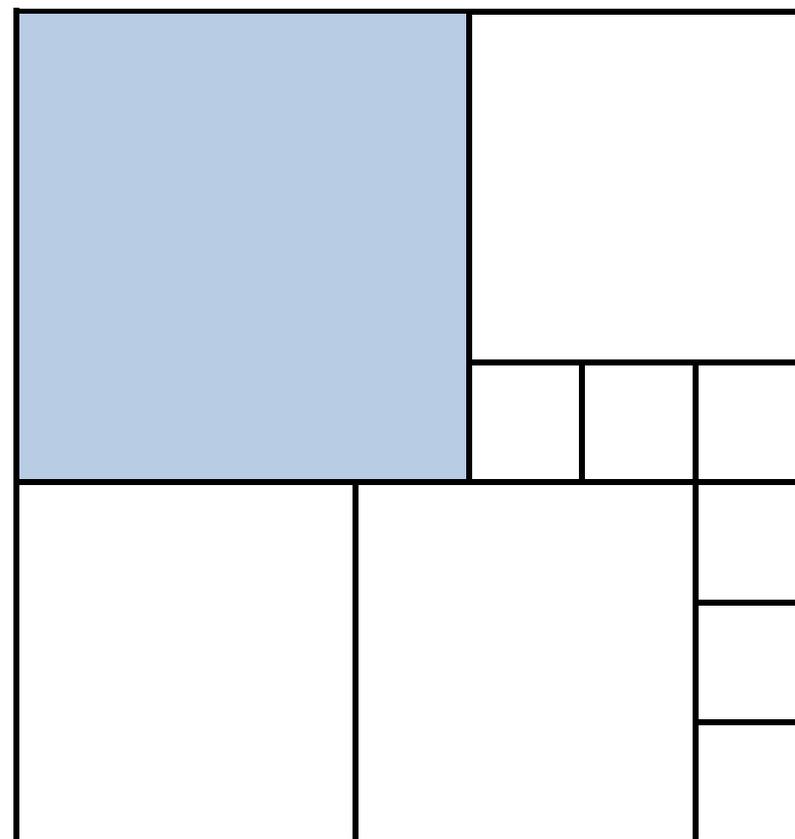
Ratio Problems

1 Des has two bags of sweets.

Each bag contains only lime and strawberry sweets.

There are 20 sweets in each bag.

- In the first bag there is 1 lime sweet for every 3 strawberry.
- In the second bag there are 2 lime sweets for every 3 strawberry.

How many more lime sweets are there in the second bag?

---

2 A tower is made of red and green cubes.

For every 1 red cube there are 2 green cubes.

Each cube has a height of 2.5cm

The tower is 30cm tall.

How many green cubes are in the tower?

2.5cm
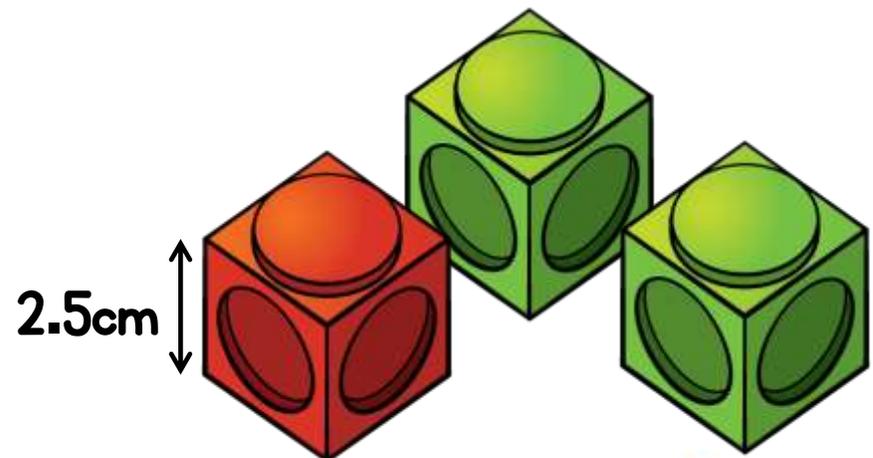
Number Problems

1 Three numbers are marked on a number line.

A   C   B

0
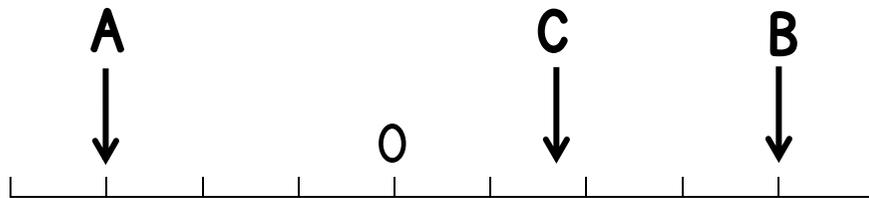
- The difference between A and B is 28
- The difference between A and C is 19
- D is 10 less than C

What is the value of D?

Can you mark D on the number line?

2 Louise is thinking of a number.
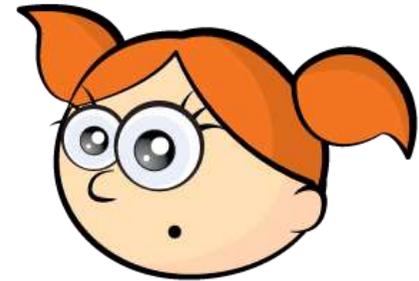
It is less than 50

It is a 2-digit number.

3 is a factor of this number.

The sum of its digits is one third of the number.

What number is Louise thinking of?

Co-ordinate Problems
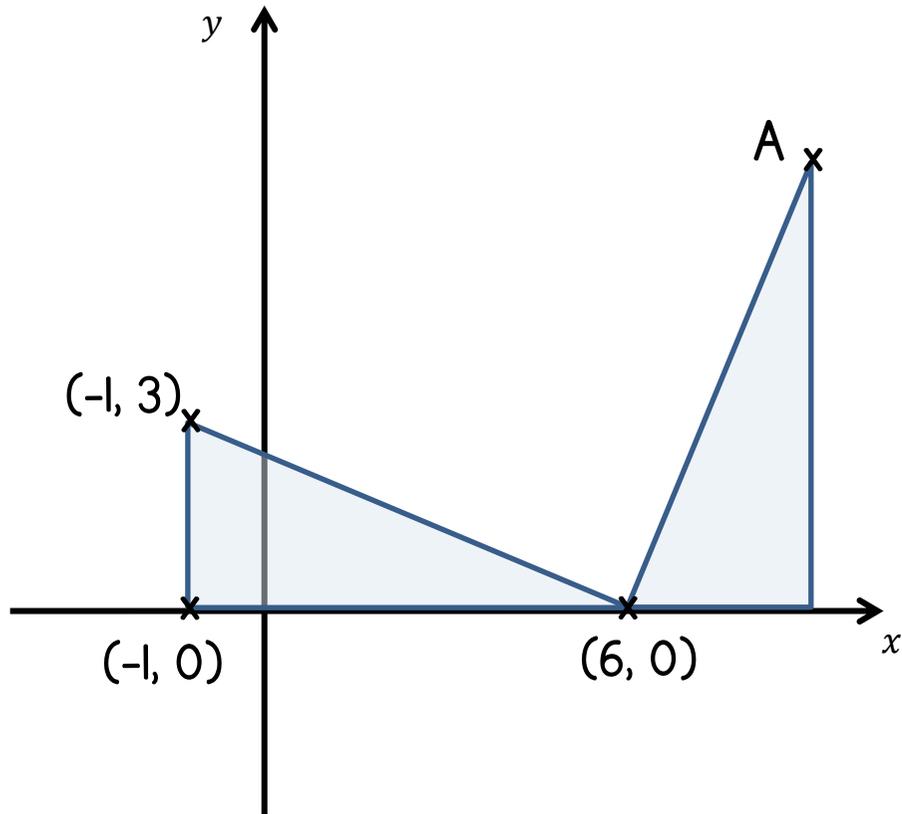
The diagram shows two identical triangles.

The co-ordinates of three points are shown.

Find the co-ordinates of point A.
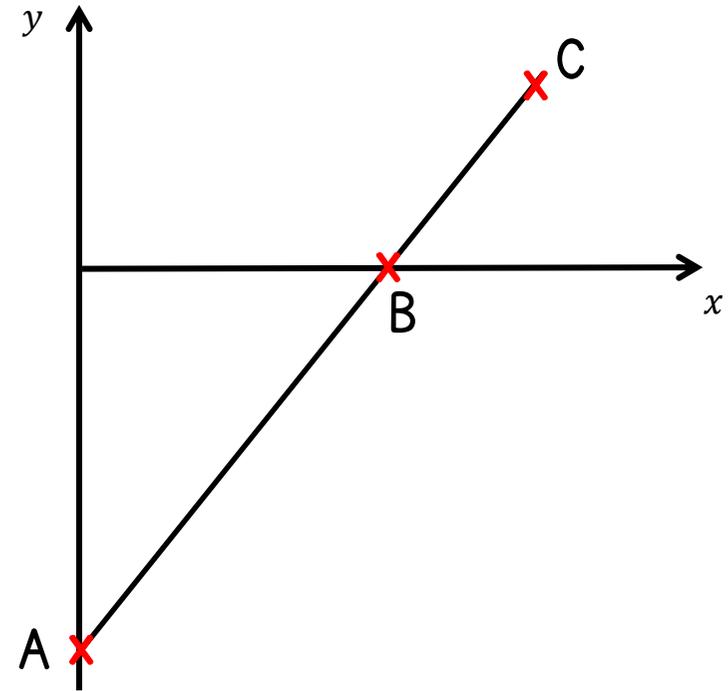
A is the point $(0, -10)$

B is point $(8, 0)$

The distance from A to B is two - thirds of the distance from A to C

Find the co-ordinates of C.

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Fraction of an Amount

1 Work out the missing values

$\frac{2}{5}$ of 30 = 3 × ☐

$\frac{7}{10}$ of 30 = $\frac{3}{4}$ of ☐

2 Here is a number card

A quarter of the card is 14

Find $\frac{2}{7}$ of the card.

3 Sarah has some cookies in a jar.

In January she eats $\frac{5}{8}$ of the cookies.

There are 12 cookies left in the jar.

How many were in the jar at the start?

Number Reasoning

1 Here is part of a multiplication grid.

×	4	5	6	7	8	9
4		20				
5	20					
6						
7						
8						
9	▓					

Shade in any other squares that have the same answer as the shaded square.

2
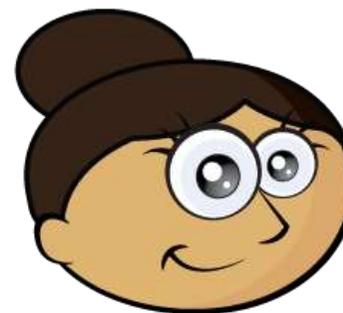
Sally multiplies a number by 100

Her answer has three digits.

The hundreds and ones digit are the same.

The sum of the digits is 10

What number could Sally have started with?

Are there any others?

Shape Problems

1 This shape is made of a regular pentagon and a square.
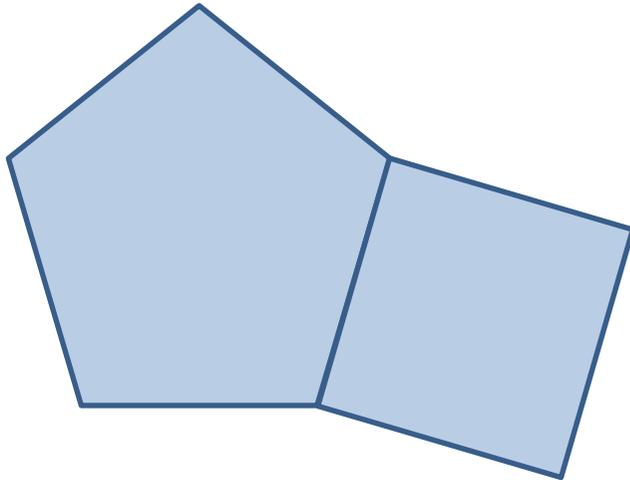
The area of the square is 81cm^2.

Find the perimeter of the shape.

2 This diagram is made up of two different sized rectangles.

60m
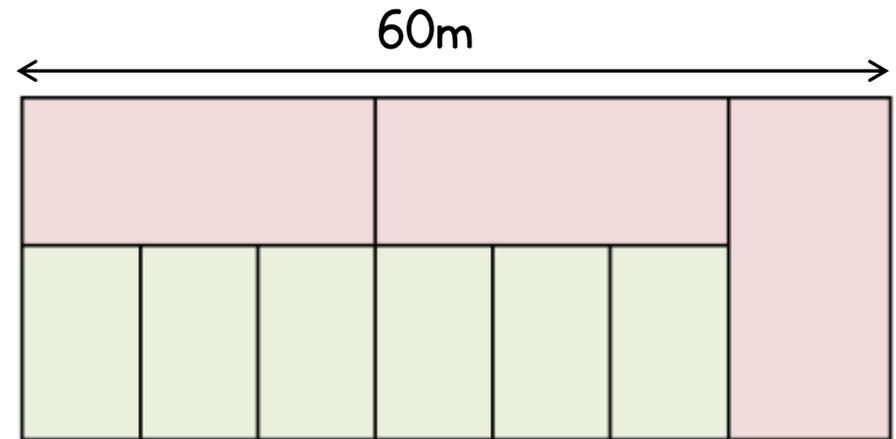
For each large rectangle the length is double the width.

The length of the diagram is 60m.

Find the area of one of the small rectangles.

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Fractions & Percentages

1

$\frac{1}{2}$ of $\boxed{A}$ = $\boxed{B}$

25% of $\boxed{B}$ = $\boxed{C}$

If $\boxed{A}$ is 36 find the value of $\boxed{C}$

2

25% of $\boxed{P}$ = $\boxed{Q}$

$\frac{1}{5}$ of $\boxed{Q}$ = $\boxed{R}$

10% of $\boxed{R}$ = 7

Calculate $\boxed{P}$ + $\boxed{R}$

**3** Geoff is reading a book.
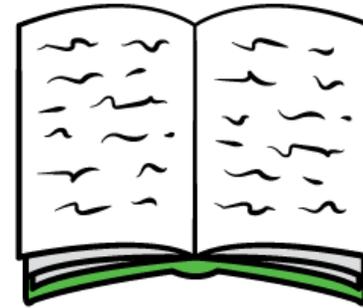
On Monday he reads $\frac{1}{3}$ of the book.

On Tuesday he reads $\frac{3}{10}$ of the remaining pages.

He has 35 pages left to read.

How many pages are in the book?

1

In the pyramid, the block layout shows:
- Top: 1
- Second row: $\frac{38}{100}$ and (blank)
- Third row: (blank), (blank), (blank)
- Bottom row: (blank), (blank), 0.25, $\frac{1}{10}$
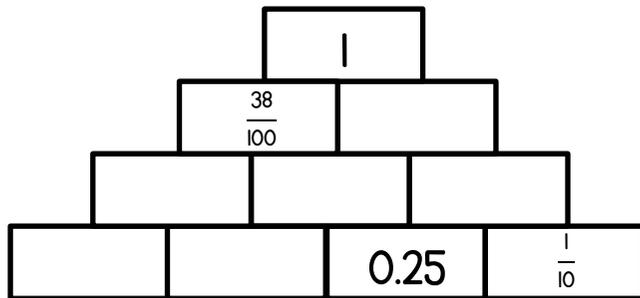
In the pyramid the two numbers below add to the make the number above.

Complete the number pyramid.

Can you write all of your answers as fractions in their simplest form?

2 A plank of wood is 4.6 metres long.

4.6m
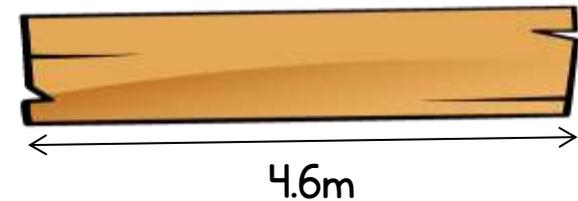
Three lengths of wood are cut from the plank.

$1\frac{1}{4}$ m   165cm   390mm

How much wood is left?

1 Class 6 are doing a survey.

They ask 20 people this question.

"How many pets do you own?"

The results are shown in this bar chart.
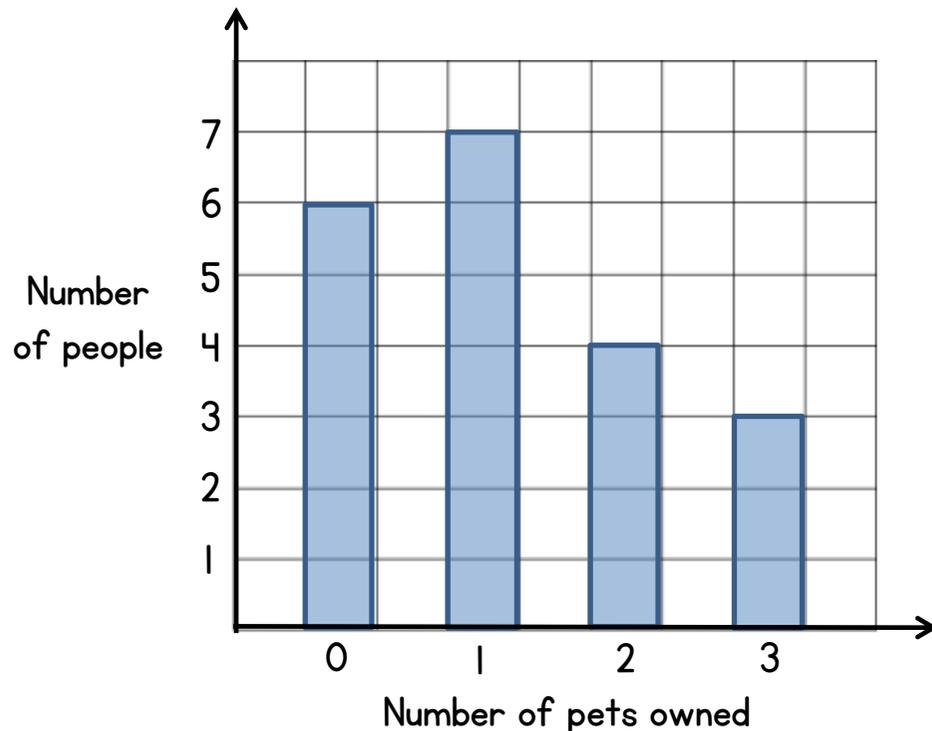
How many pets in total do these people own?

**2** Here are the heights of three horses.

160cm	$1\frac{1}{2}$ m	1.73m

What is the mean height?

Tino is another horse.
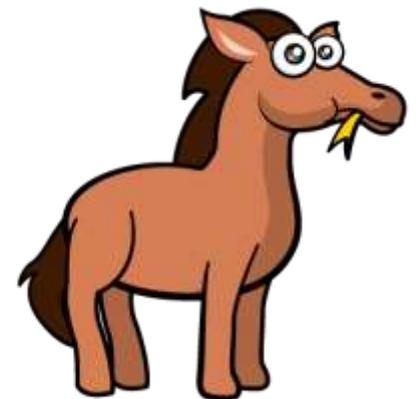
The mean height of all four horses is 1.62m

Find the height of Tino.

Two different problems

1 Filip buys 4 strawberry cupcakes and 1 chocolate cupcake.

Filip paid £3.70

A chocolate cupcake costs 25 pence more than a strawberry one.

How much does a chocolate cupcake cost?

2 A shape is made up of a square and rectangle.
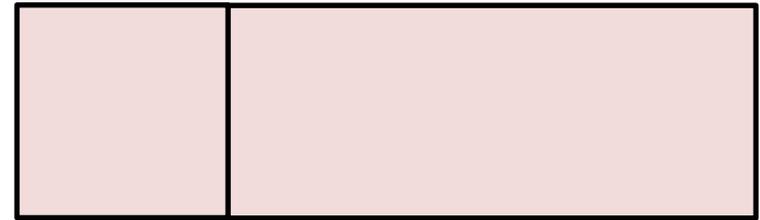
The perimeter of the shape is 70cm.

The area of the square is 121cm^2

What is the area of the rectangle?

Chocolate Orange

1 Two friends buy some chocolate bars.

Each bar cost £1.18

There is a special offer on.

> **Buy one bar, get a second half price**

They buy 5 bars and split the cost equally.

How much do they each pay?

2 A shop owner buys oranges in boxes of 5

She buys 8 boxes of oranges.

The cost of each box is £2.40
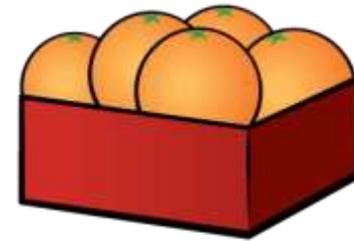
The owner sells the oranges separately.
She sells them for 70 pence each.

By the end of the week she sells $\frac{9}{10}$ of the oranges.

How much profit has she made?

Number problems

1 Laura buys:

- 3kg of potatoes

- and 2.5kg of carrots.

78p per kg

£1.46 per kg
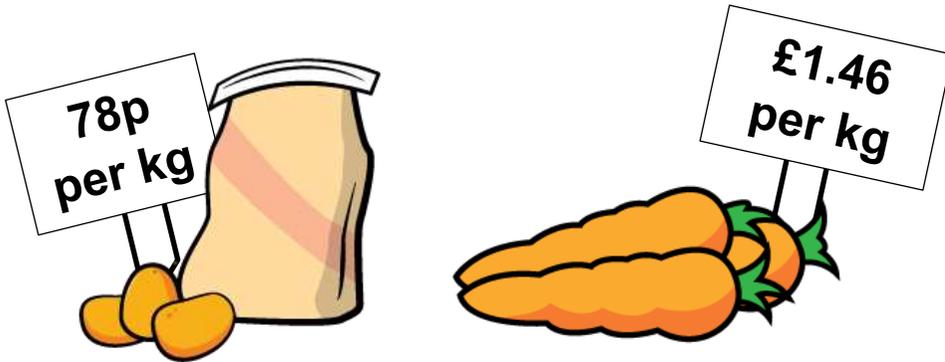
She pays with a £20 note.

How much change does she get?

2 Here are two number cards.
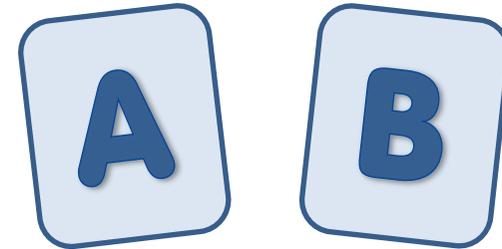
A **B**

Here is some information about the cards.

When you divide A by B you get 1.5

The difference between A and B is 7

Find the value of A and B.

Three Quick Questions

1 A 5p coin has a thickness of 1.6mm

Jake makes a tower of 5p coins worth 90p.

What is the height of the coins in cm?

2 Jamie has a number.

> If I divide my number by 5 I get 12
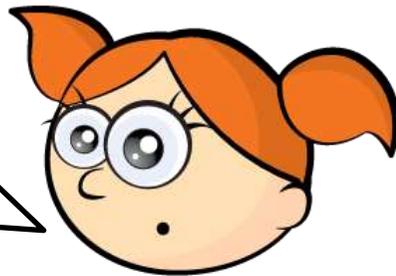
What answer does Jamie get if she divides the same number by 15?

Explain your answer.

3 Here is a rule for generating a sequence.

> Multiply the previous term by 3 and subtract 4

The second term of the sequence is 5

Find the difference between the first and fourth terms of the sequence.

Weighty Problems

1 A football and toy train together weigh 360g.

Three footballs and two toy trains weigh 810g.

Find the weight of a toy train.

2 The mass of a box of chocolates is 290g.

The box contains 7 identical chocolates.

Manish eats 3 chocolates

The mass of the box is now 194g

Find the weight of the empty box.

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Fraction Problems

The symbol ⭐ means

Double the first number and then subtract the second number

e.g. 5 ⭐ $2 = 8$

Find the missing values

$\frac{2}{5}$ ⭐ $\frac{3}{10}$ = □

2 ⭐ □ $= 2\frac{1}{4}$

$\left(\frac{3}{4}\right.$ ⭐ $\left.\frac{1}{2}\right)$ ⭐ $3\frac{2}{5}$ = □

Maz and Fred each make a tower using red and yellow cubes.
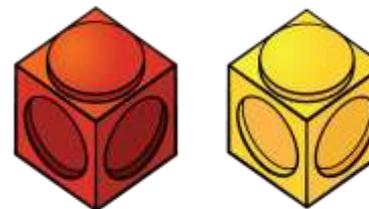
Their towers are the same height.

- $\frac{3}{8}$ of Maz's tower are red cubes
- $\frac{5}{6}$ of Fred's tower are red cubes

Maz uses 9 red cubes.

How many red cubes does Fred use?

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Egg Problems

1 One egg and one slice of toast costs £1.94
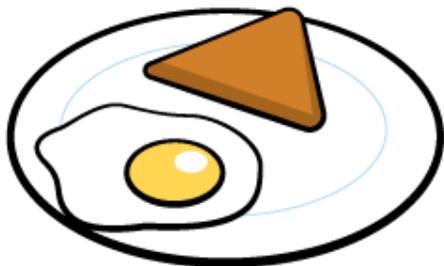
Three eggs and two slices of toast costs £5
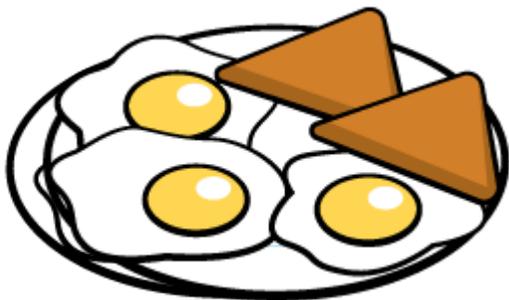
How much does one slice of toast cost?

2 These three chicks lay some eggs.

Kelsey   Beth   Caroline

Beth lays twice as many as Kelsey.

Caroline lays 4 more than Beth.

They lay 44 eggs in total.

How many eggs does Caroline lay?

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Shopping

1 Beans can be bought in single tins or as a multipack of 4 tins.

57p

BEANS

BEANS BEANS
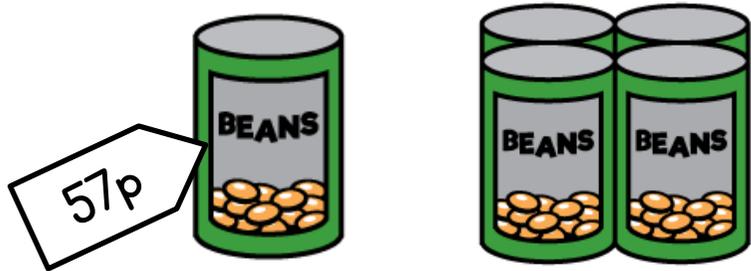
Ben buys 10 single tins.

John buys 2 multipacks and 2 single tins.

I paid £1.24 less than Ben.
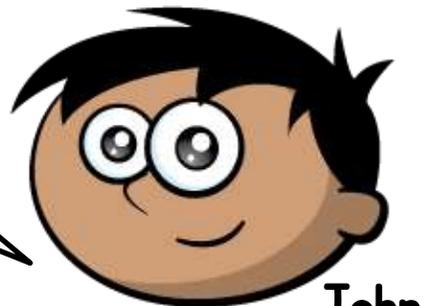
John

How much does a multipack of beans cost?

2 Cola is sold in bottles and cans.

COLA 330ml 48p

1.25 litres £1.59

Yasmin buys 5 cans and 3 bottles.

She sells the cola in glasses.

100ml glass of cola only 25p

She sells all of the cola.

How much profit does she make?

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Reasoning and Problem Solving Questions

KS2

Sheet	Answer	Notes
What fraction is shaded?	$\dfrac{3}{20}$	
	$\dfrac{13}{30}$	
Presents and lollies	5 keyrings	How much change would she get?
	£1.18	
Perimeter problems	72 cm	Find the area of the square.
	12.9 m	Find the area of the rectangle.
Fractions Friday	>, >	Can they write their own problems to challenge each other?
	$\dfrac{16}{49}$	Shade in more squares so that $\frac{5}{7}$ is shaded.
Ratio problems	3 more lime sweets	First bag has 5 lime sweets Second bag has 8 lime sweets How many strawberry sweets are there in total?
	There are 8 green cubes	There are 12 cubes in the tower.
Number problems	D = −3	

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	27	**Encourage students to make up their own number problems.**
Co-ordinate problems	**(9,7)**	
	(12,5)	
Fraction of an amount	**4** **28**	
	16	
	32 cookies	
Number reasoning		**Shade in all the square numbers.** **What fraction of the numbers are greater than 50?**
	4.24 is one possibility	**Various answers**

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Shape problems	63 cm	
	96 m²	**Large rectangle:** Length = 24 m Width = 12 m **Small rectangle:** Length = 12 m Width = 8 m
Fractions & percentages	C = 4.5	B = 18 What happens if the value of A is changed? What is the value of A if B = 36?
	1470	R = 70 Q = 350 P = 1400
	75 pages	A bar model diagram may help students answer this question.
Wednesday workout	 **In its simplest form.**	Students may find it easier to work in hundredths to begin with.
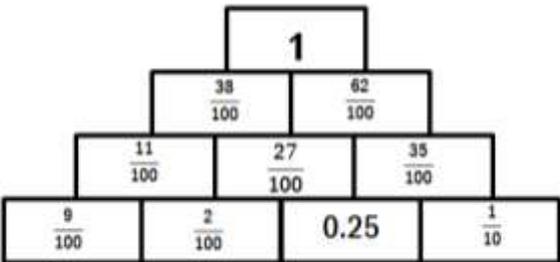
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Pyramid of fractions:

Top: 1

Second row: $\dfrac{19}{50}$, $\dfrac{31}{50}$

Third row: $\dfrac{11}{100}$, $\dfrac{27}{100}$, $\dfrac{7}{20}$

Bottom row: $\dfrac{9}{100}$, $\dfrac{1}{50}$, $\dfrac{1}{4}$, $\dfrac{1}{10}$

	1.31 m left or equivalent	
Statistics problems	24 pets	Students may struggle to realise that they need to multiply the height of the bar by the number of pets.
	1.61 m 1.65 m	
Two different problems	94 pence	Strawberry cupcake = 69 pence
	13 x 11 = 143 cm^2	Some students may have worked out the area of the large rectangle which is 24 x 11 = 264 cm^2
Chocolate orange	£2.36	How much more would they each have to pay if they bought 6 bars? How much would they save by buying the 6 bars together?

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Number problems	£6 profit	She has 40 oranges in total She sells 36 oranges She makes £25.20 They cost her £19.20
	£14.01 change	Potatoes cost £2.34 Carrots cost £3.65
	A = 21 B = 14	Encourage students to find the fractional equivalent of 1.5 and then use equivalent fractions.
Three quick questions	2.88 cm	
	4	With explanation. Is there a connection between Jamie's number and the answers?
	26	1st term = 3 2nd term = 5 3rd term = 11 4th term = 29 Does the difference increase if the 2nd term is 8? What is the difference if the 2nd term is -10
Weighty problems	Train = 270 g	Football = 90 g
	66 g	Each chocolate = 32 g

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Fraction problems	$\frac{1}{2}$ or equivalent $1\frac{3}{4}$ or equivalent $-1\frac{2}{5}$ or equivalent	Students could make up their own problems and their own special symbols.
	20 red cubes	
Egg problems	82 pence	Egg = £1.12 Toast = 82 pence
	20 eggs	Students may find it helpful to draw a bar model for this question.
Shopping	£1.66 for a multipack	Ben pays £5.70 John pays £4.46 Students should show all their working out.
	£6.33 profit	Total ml of cola = 5400 Total cost = £7.17 She can make 54 glasses of cola She gets £13.50 for the 54 glasses. If she wants to make £10 profit, how much would she have to charge per glass of cola?