6 Fractions as a multiplicative relationship

Multiplying integers by fractions

Any two numbers can be linked using a **multiplier**. A multiplier is a number that multiplies another number so that it increases or decreases in value. For example, in the multiplication statement 5 × 4 = 20, the multiplier 4 increases the value of 5 to 20.

When multiplying an integer by a fraction, write the integer as a fraction (with 1 as the denominator) in order to multiply the two values.

a) Work out $5 \times \frac{4}{5}$

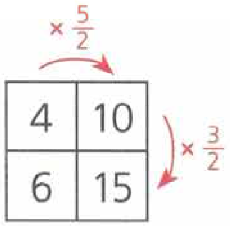
$$\frac{5}{1} \times \frac{4}{5} = \frac{5 \times 4}{1 \times 5}$$
$$= \frac{20}{5} = 4$$

b) Work out $\frac{3}{8} \times 6$

$$\frac{3}{8} \times \frac{6}{1} = \frac{3 \times 6}{8 \times 1}$$
$$= \frac{18}{8} = \frac{9}{4}$$

Finding and using a multiplier

Consider this ratio table:



4	10
6	15

Within the ratio table:

- 4 and 6 are linked by a multiplier of $\frac{3}{2}$
  $4 \times \frac{3}{2} = 6$
- 10 and 15 are linked by a multiplier of $\frac{3}{2}$
  $10 \times \frac{3}{2} = 15$
- 4 and 10 are linked by a multiplier of $\frac{5}{2}$
  $4 \times \frac{5}{2} = 10$
- 6 and 15 are linked by a multiplier of $\frac{5}{2}$
  $6 \times \frac{5}{2} = 15$

To find the multiplier, use **inverse operations**.

For example, 10 ÷ 4 can be written as $\frac{10}{4}$. When simplified, this is $\frac{5}{2}$

Inverse means opposite.

Find the missing number in the multiplier:

$5 \times \frac{\square}{5} = 12$

This calculation involves multiplication. To find the multiplier, use inverse operations. The inverse of multiplication is division, so divide 12 by 5.

12 ÷ 5 can be written as $\frac{12}{5}$

The missing number is 12.

Find the multiplier in this calculation:

$5 \times \frac{\square}{\square} = 14$

To find the multiplier, divide 14 by 5.

14 ÷ 5 can be written as $\frac{14}{5}$ so the multiplier is $\frac{14}{5}$

Find the missing number in the ratio table.

4	7
6	?

To find the missing number, work out the multiplier using the information given.

4 and 7 are linked by a multiplier of $\frac{7}{4}$

Therefore, $6 \times \frac{7}{4}$ = the missing number

$6 \times \frac{7}{4} = \frac{6}{1} \times \frac{7}{4} = \frac{42}{4}$

Simplifying: $\frac{42}{4} = \frac{21}{2}$ or 10.5

It is always good practice to simplify fractions but leave the numerator and the denominator as integers.

RETRIEVE

6 Fractions as a multiplicative relationship

Multiplying integers by fractions

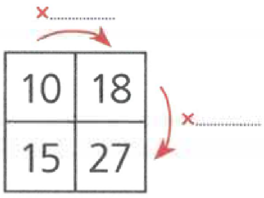
1 Work out:

a) $5 \times \frac{6}{5}$

b) $6 \times \frac{2}{3}$

Finding and using a multiplier

2 Work out the multipliers in the ratio table.



3 Find the missing multiplier.

$3 \times \frac{\square}{\square} = 25$

4 Find the missing number in each ratio table.

a)

4	5
6	

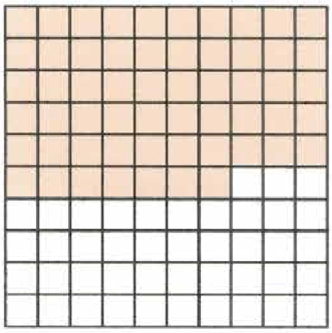
b)

12	
8	9

5 Percentages

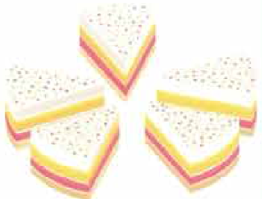
Fractions, decimals and percentages

Percent means '**out of 100**'. Percentages, fractions and decimals are all ways to represent part of a whole, so percentages can also be written as equivalent fractions and decimals.



57 out of 100 squares (57%) are shaded

Write the amount of cake that has been eaten as a fraction, a decimal and a percentage.



3 out of 8 slices have been eaten. That means $\frac{3}{8}$ of the cake has been eaten.

$\frac{3}{8} = 3 \div 8$ $\quad \begin{array}{r} 0\,.\,3\,7\,5 \\ 8\overline{)3\,.\,{}^{3}0\,{}^{6}0\,{}^{4}0} \end{array}$ $\quad \frac{3}{8} = 0.375$

0.375 × 100 = 37.5%

Conversion	Method
Decimal to percentage	Multiply by 100, e.g. 0.75 × 100 = 75%
Decimal to fraction	Use the smallest decimal place value as the denominator and digits as the numerator, e.g. $0.7\underset{\uparrow}{5} = \frac{75}{100} = \frac{3}{4}$ Hundredths place Divide by 25 to simplify $\frac{75}{100}$
Percentage to decimal	Divide by 100, e.g. 75% ÷ 100 = 0.75
Percentage to fraction	Use 100 as the denominator and the percentage as the numerator, e.g. 75% = $\frac{75}{100}$
Fraction to decimal	Divide the numerator by the denominator, e.g. $\frac{3}{4} = 3 \div 4$ $\quad \begin{array}{r} 0\,.\,7\,5 \\ 4\overline{)3\,.\,{}^{3}0\,{}^{2}0} \end{array}$ $\quad \frac{3}{4} = 0.75$
Fraction to percentage	Convert to a decimal then multiply by 100, e.g. $\frac{3}{4} = 0.75$ 0.75 × 100 = 75%

One number as a percentage of another number

To find what percent one number is of another, divide the first number by the second and multiply by 100.

7 out of 10 beads in a bag are red.

This is $\frac{7}{10}$ as a fraction. As a decimal, $\frac{7}{10} = 0.7$

0.7 × 100 = 70%, so 70% of the beads are red.

To find what percent 18 is of 12, divide 18 ÷ 12 = 1.5, then 1.5 × 100 = 150%. 18 is 150% of 12.

A shirt that originally cost £20 is reduced by £3 in a sale. By what percentage has the price decreased?

Find what percent £3 is of £20.

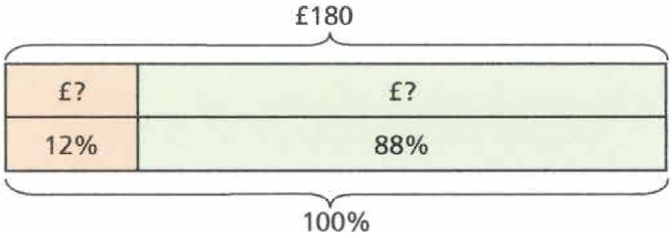
$\frac{3}{20} = 3 \div 20 = 0.15$, then 0.15 × 100 = 15%

The price of the shirt has decreased by 15%.

Finding percentages of a number or an amount

To find a percentage of an amount, convert the percentage to a decimal or fraction and multiply by the amount.

This bar model shows finding 12% of £180.



To find 12% of £180, convert 12% to a decimal or fraction, then multiply by 180. 12% of £180 = £21.60

To find 10% of a number, × by 0.1, or ÷ by 10.

To find 5% of a number, halve 10% of the number.

To find 1% of a number, × by 0.01, or ÷ by 100.

Find 17% of 160.

17% of 160 = 10% of 160 + 5% of 160 + 2% of 160

10% of 160 = 160 ÷ 10 = 16

5% of 160 = 16 ÷ 2 = 8

2% of 160 = 1.6 × 2 = 3.2

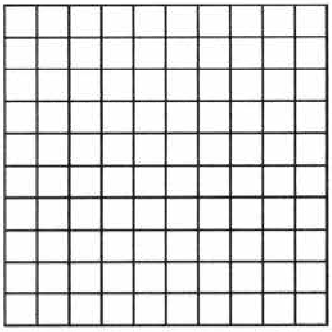
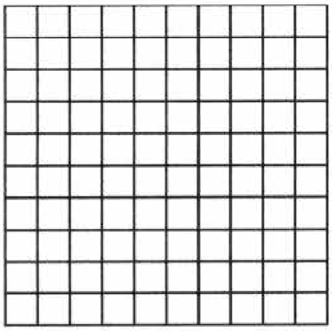
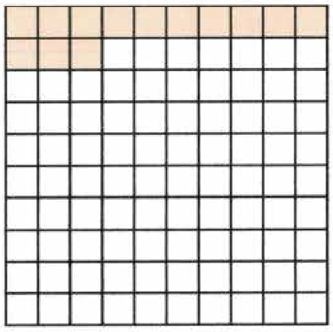
So 17% of 160 = 16 + 8 + 3.2 = 27.2

RETRIEVE

5 Percentages

Fractions, decimals and percentages

1 Complete the table.

Fraction	$\frac{19}{50}$		
Decimal		0.74	
Percentage			
Diagram			

One number as a percentage of another number

2 Find the percent by which each of these items is discounted. Give your answers to the nearest percent.

a) A shirt is originally £18 and is decreased by £2.

b) A pair of trousers is originally £38 and is decreased by £5.

Finding percentages of a number or an amount

3 A theme park offers a discount of 8% for tickets bought online.
A family of 1 adult and 3 children plan to go to the theme park.

How much will they save by buying their tickets online?

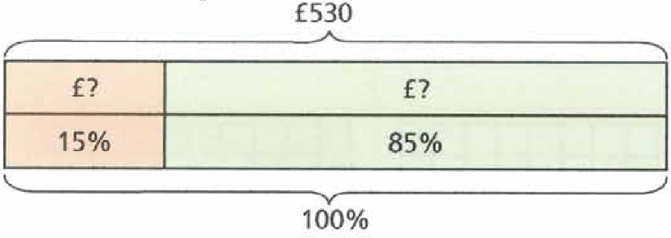
ORGANISE

5 Percentage changes

Percentage decrease

Prices may be reduced by a certain percentage; this is an example of **percentage decrease**.

This bar model represents a £530 TV decreased in price by 15%. £530 is 100% of the original cost. The price is reduced by 15%, so the sale price is 85% of the original.



To find the new price, either find 15% of the original price and subtract it from the original price, or find 85% of the original price.

To find the new price, use one of these methods:

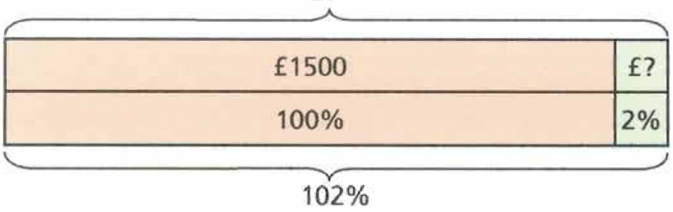
Convert 15% to a decimal: 15% = 15 ÷ 100 = 0.15 Find the amount of the decrease: £530 × 0.15 = £79.50 Find the new price: £530 – £79.50 = £450.50	Find the percentage the sale price is of the original price: 100% – 15% = 85% Convert 85% to a decimal: 85% = 85 ÷ 100 = 0.85 Find the new price: £530 × 0.85 = £450.50

To find the new value after a percentage decrease, multiply the original value by the percent remaining after the decrease (100% – percentage decrease).

Percentage increase

Prices may rise by a certain percentage; this is called **percentage increase**. Interest in a bank account is also an example of percentage increase. The bank pays interest based on a percentage of the balance. When this interest is paid at the end of the year, it is called **simple interest**.

This bar model shows the interest earned on a £1500 bank account. The new balance is 2% more than at the start. So the new balance is 102% of the starting balance.



To find the new balance, use one of these methods:

Convert 2% to a decimal: 2% = 2 ÷ 100 = 0.02 Find the amount of interest earned: £1500 × 0.02 = £30 Add to the original balance to find the new balance: £1500 + £30 = £1530	Find the percentage the new balance is of the original balance: 100% + 2% = 102% Convert 102% to a decimal: 102% = 102 ÷ 100 = 1.02 Find the new balance: £1500 × 1.02 = £1530

To find the new value after a percentage increase, multiply the original value by (100% + the percentage increase).

Finding the percentage change

The percentage by which a value has increased or decreased is the **percentage change**. It is the same as asking what percentage one number is of another.

$$\%\ \text{change} = \frac{\text{amount of increase or decrease}}{\text{original value}} \times 100$$

The price of a video game has been reduced by £5. The original price was £40.

$$\%\ \text{change} = \frac{\text{amount of increase or decrease}}{\text{original value}} \times 100$$

$$\%\ \text{decrease} = \frac{5}{40} \times 100 = 12.5\%$$

The price has decreased by 12.5%

Find the percentage increase in the amount of shampoo in the bottle.

Amount of increase:

420 ml – 400 ml = 20 ml

$$\%\ \text{change} = \frac{\text{amount of increase or decrease}}{\text{original value}} \times 100$$

$$\%\ \text{increase} = \frac{20}{400} \times 100 = 5\%$$

The amount of shampoo has increased by 5%

RETRIEVE

5 Percentage changes

Percentage decrease

1 A furniture shop is having a sale. The original prices are shown.

Calculate the new price of each item.

a)

b)

Percentage increase

2 A manufacturer is increasing the amounts in its food packages.

a) Increase the amount of cereal by 8%

b) Increase the amount of porridge by 20%

Finding the percentage change

3 An electronics store is having a sale on TVs.

Calculate the percentage change of each of these discounts given the original prices indicated. Give your answers to the nearest percent.

a) A TV originally costs £2500 and is being discounted by £300.

b) A TV originally costs £1700 and is now £1350.

ORGANISE

2

Introducing probability

Vocabulary of probability

Probability is a measure of how likely something is to happen. It is the likelihood of a particular **event** resulting from an **experiment** or **trial**.

Probability is a measure of the chance of something happening. It can be expressed in words or numbers.

Term	Example (based on rolling dice)
Experiment or **trial** is the procedure you are doing.	Rolling a six-sided dice
The **sample space** is the set of all outcomes (or results) that could occur.	All the numbers you could roll: 1, 2, 3, 4, 5, 6
An **outcome** is the result of a trial.	The specific number that you roll, e.g. a 3.
An **event** is something that can happen in the trial. It is a particular result from a trial and is a subset of the possible outcomes (which can be one outcome or many).	In the event of rolling a 2, the set of outcomes is 2. In the event of rolling an even number, the set of outcomes is 2, 4 and 6.
Mutually exclusive events cannot occur at the same time.	When rolling one dice, you will only roll an even number or an odd number, not both at once.
Independent events are when the probability of the second event does not change based on the first event.	Imagine rolling a dice two times. Whatever you roll on the first roll will not affect what you roll on the second.
Equally likely means the outcomes have the same chance of happening. In this case, the experiment or trial is said to be **fair** (**unbiased**).	The chances of rolling 1, 2, 3, 4, 5 and 6 are the same.
A trial or experiment is **biased** when the outcomes are not equally likely.	A dice that has been weighted so that it is more likely to land on a 6.

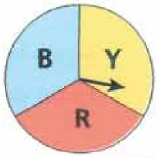
Expressing probability in words

Probability can be expressed using words such as **certain**, **likely**, **even chance**, **unlikely**, and **impossible**. Something that is certain will definitely happen. Something that is impossible cannot occur.

Even chance (also called 'evens' or '50/50') means that something has a 50% chance of happening. Note that this is only possible if there are exactly two outcomes that are equally likely. It is not the same as 'equally likely outcomes' when there are more than two outcomes.

The chance of each outcome on a fair coin is $\frac{1}{2}$. This is an 'even chance'.

The chance of spinning each colour is $\frac{1}{3}$. They are equally likely outcomes but not an 'even chance'.

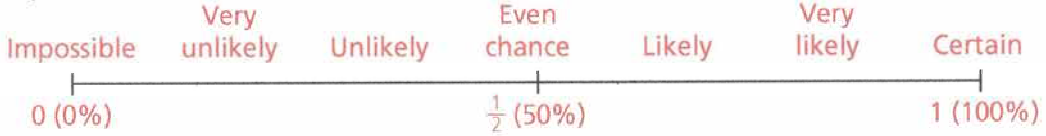


Probability scale

Probability can be measured in numbers using decimals, fractions or percentages on a scale from 0 (impossible) to 1 (certain).

In words	Probability	Example
Certain	1 (or 100%)	New Year's Day will be on 1st January
Likely	Between 0.5 and 1 (50% and 100%)	Pulling out a yellow ball from a bag of 8 yellow balls and 2 green balls
Even chance	0.5 (or $\frac{1}{2}$ or 50%)	Getting a Heads when flipping a fair coin
Unlikely	Between 0 and 0.5 (0% and 50%)	Pulling out a green ball from a bag of 8 yellow balls and 2 green balls
Impossible	0 (or 0%)	Rolling a 7 on a dice numbered 1 to 6

The probability scale can be shown on a number line:

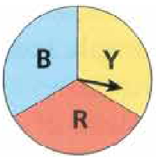


RETRIEVE

2 Introducing probability

Vocabulary of probability

① Imagine spinning a fair, three-coloured spinner and measuring the probability of spinning red or blue. Draw lines to join the terms to the correct example.



Terms	**Example**
Event	Spinning the spinner
Outcome	Each section is equal
Sample space	Spinning yellow
Trial	Spinning red or blue
Unbiased	Red, yellow and blue

Expressing probability in words

② State whether each event is **impossible**, **unlikely**, **even chance**, **likely** or **certain**.

a) Picking a red card from a standard, fair deck of cards. ....

b) Rolling a 1 on a fair, 10-sided dice. ....

c) The next month will have at least 15 days. ....

d) It will rain meatballs. ....

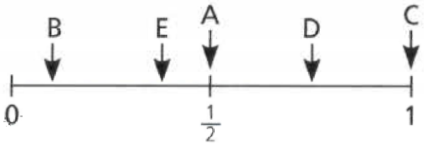
③ Claire says that there is an even chance of rolling a 6 on a fair, six-sided dice because each outcome is equally likely. Is she correct? Explain your answer.

....

....

Probability scale

④ This probability scale shows the probabilities of five events (A, B, C, D and E).



a) Is event B or E more likely to happen? ....

b) Which events are less likely to occur than D? ....

c) Write down whether each event is: **impossible**, **unlikely**, **evens**, **likely** or **certain**. You may need to use the same word for more than one event and all words may not be used.

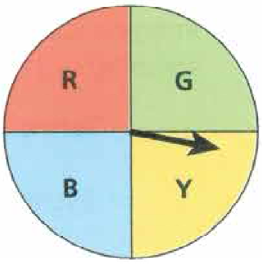
A .... B .... C .... D .... E ....

ORGANISE

2 Probability of single events

Calculating theoretical probability

To calculate probability, you need to know all the possible outcomes (also called the **sample space**). The sample space is a set, so set notation S = { } is often used. Outcomes are often written with corresponding letters rather than in words, e.g. B instead of 'blue'. Write the outcomes in an ordered list so that none are missed.



The sample space of flipping a coin is Heads or Tails. This is written S = {H, T}

The sample space of this spinner is Red, Green, Blue, Yellow, or S = {R, G, B, Y}

To calculate probability numerically:

$$\textbf{P(event)} = \frac{\textbf{number of ways the outcome can occur}}{\textbf{total number of possible outcomes}}$$

Find the probability of rolling a number greater than 4 on a fair, six-sided dice.

The sample space is S = {1, 2, 3, 4, 5, 6}. There are six possible outcomes.

The event is rolling a number greater than 4. This can only happen two ways (by rolling a 5 or a 6).

So, $\text{P(a number greater than 4)} = \frac{\text{number of ways to roll a number greater than 4}}{\text{total number of ways to roll the dice}} = \frac{2}{6} \left(= \frac{1}{3}\right)$

Probabilities sum to 1

When events are mutually exclusive, they cannot happen at the same time. So the probabilities of all events in a trial of mutually exclusive events will always sum to 1 (or 100%).

Imagine a bag containing 8 yellow marbles (Y) and 2 green marbles (G). One marble is chosen at random.

$$P(Y) = \frac{\text{number of yellow marbles}}{\text{total number of marbles}} = \frac{8}{10}$$

$$P(G) = \frac{\text{number of green marbles}}{\text{total number of marbles}} = \frac{2}{10}$$

As fractions, $\frac{8}{10} + \frac{2}{10} = \frac{8+2}{10} = \frac{10}{10} = 1$

As percentages, 80% + 20% = 100%

The total number of marbles will always be the sum of the yellow and green marbles, so the sum of the probabilities will always be a fraction that simplifies to $\frac{1}{1} = 1$.

This fact also means that:
P(event) = 1 – P(event not happening)

You could calculate P(G) by knowing P(Y) and by knowing that all the marbles are green or yellow.

$P(G) = 1 - P(Y) = 1 - \frac{8}{10} = \frac{2}{10}$

Probabilities of mutually exclusive events in a trial will always sum to 1.

Experimental probability

Theoretical probability measures what should happen if everything in the trial is fair.

Experimental probability records the actual results of a trial and reports them as a **relative frequency**.

$$\textbf{Relative frequency} = \frac{\textbf{number of times event occurred}}{\textbf{total number of trials}}$$

The theoretical probability of getting Tails when flipping a coin is 50%. However, if you were to conduct a trial by physically flipping a coin many times, you may find a slightly different chance. Experimental probability will be very close to theoretical probability if a fair trial is repeated enough times.

Before beginning a trial, you can work out the theoretical probability and calculate the **expected results**.

This can be written as:
Expected result = P(event) × number of trials

If you flipped a coin 100 times, you would expect it to land on Tails 50 times.

Expected Tails = $\frac{1}{2} \times 100 = 50$

Suppose a coin is flipped 100 times and comes up Tails 52 times and Heads 48 times.

$$\text{Relative frequency (T)} = \frac{\text{number of times Tails occurred}}{\text{total number of trials}}$$
$$= \frac{52}{100} \left(= \frac{13}{25} \text{ or } 0.52\right)$$

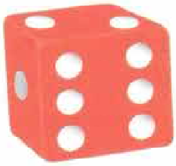
RETRIEVE

2 Probability of single events

Calculating theoretical probability

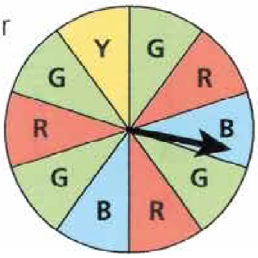
1 List the sample space for each trial.

a) Rolling a six-sided dice



b) Choosing a letter out of a hat from the word

c) Spinning this spinner



2 Use your answers to question 1 to calculate the probability of:

a) rolling a number less than or equal to 4

b) choosing the letter M from the word MATHEMATICS

c) the spinner landing on green

Probabilities sum to 1

3 A weather forecast says the probability of rain tomorrow is 52%.

Find the probability that it will **not** rain.

Experimental probability

4 A dice is to be rolled 24 times.

a) What is the probability of rolling a 6 on a fair dice?

b) What is the expected number of times a 6 will be rolled?

c) Here are the results of the trial:

2 1 6 5 2 5 4 1 2 4 1 1 2 1 3 6 5 4 2 3 4 1 5 3

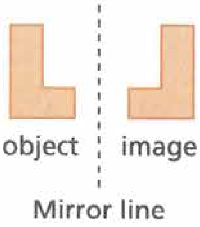
What is the relative frequency of rolling a 6?

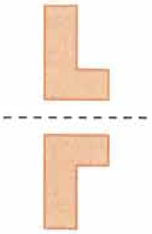
ORGANISE

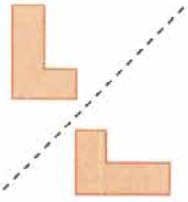
8 Reflection

Reflecting shapes

A reflection makes a mirror image of a shape.

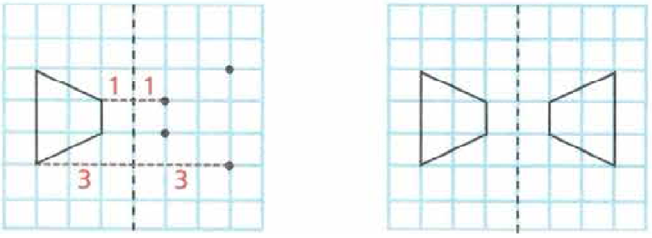






The reflected shape is called the **image**. It is the same size as the original shape, facing in the opposite direction. The image is the same distance from the mirror line as the object.

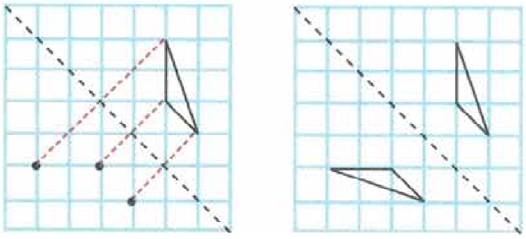
Trapezium reflected in a vertical mirror line



Draw the reflection of each vertex the same distance from the mirror line, on the other side.

Join the vertices with straight lines.

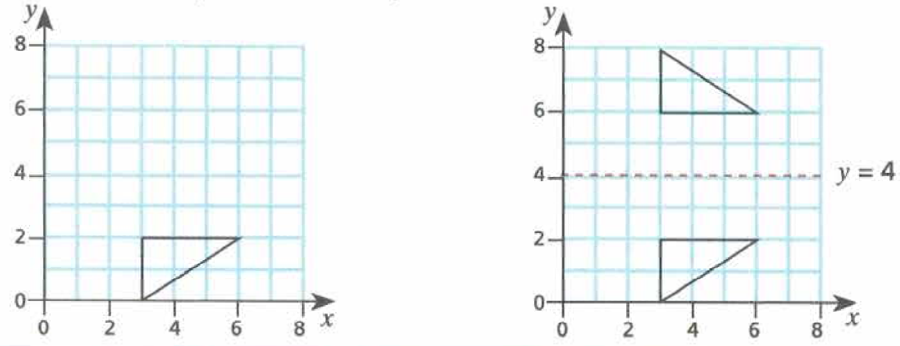
Triangle reflected in a diagonal mirror line



If it makes it easier, you can rotate the diagram so the mirror line is vertical.

Reflecting shapes on a coordinate grid

Reflect this shape in the line $y = 4$



See page 30 for help with drawing lines on a grid.

Draw in the mirror line, $y = 4$

Draw the reflection in the mirror line.

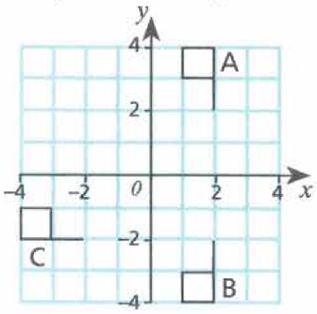
Describing reflections

To describe a reflection, you need to state the equation of the mirror line.

Describe the reflection that takes:

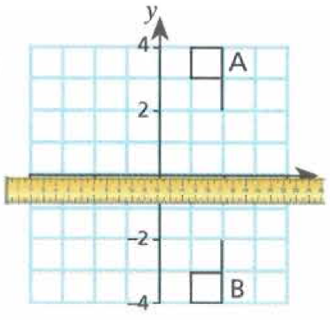
a) shape A to shape B

b) shape A to shape C



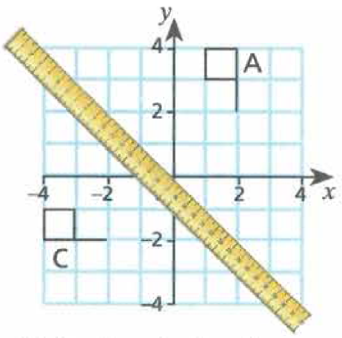
Use a ruler to help find the mirror line, halfway between the object and the image.

a)



Reflection in the x-axis.

b)



Reflection in the line $y = -x$

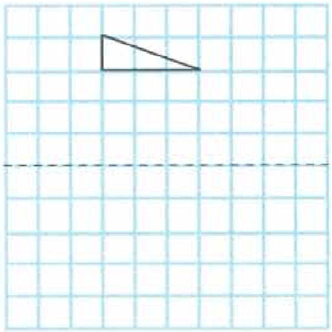
RETRIEVE

8 Reflection

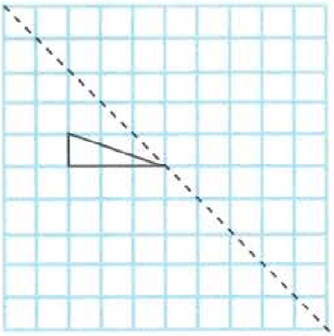
Reflecting shapes

1 Reflect the shape in each mirror line.

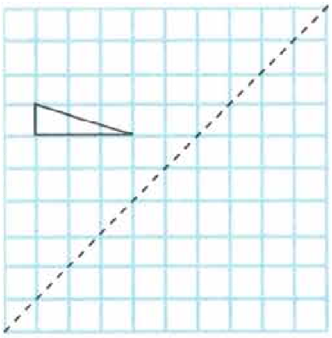
a)



b)



c)



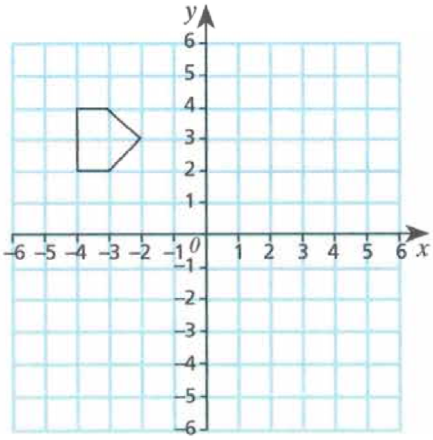
Reflecting shapes on a coordinate grid

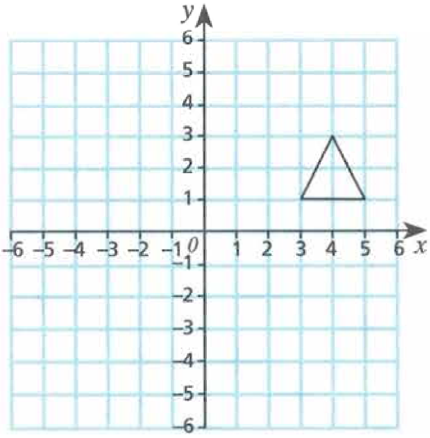
2 **a)** Reflect this shape in the x-axis.

b) Reflect this shape in the line $x = 1$

c) Reflect this shape in the y-axis.

d) Reflect this shape in the line $y = -x$





Describing reflections

3 Here are some reflected shapes on a coordinate grid.

Describe the reflection that takes:

a) shape A to shape B

....

b) shape C to shape D

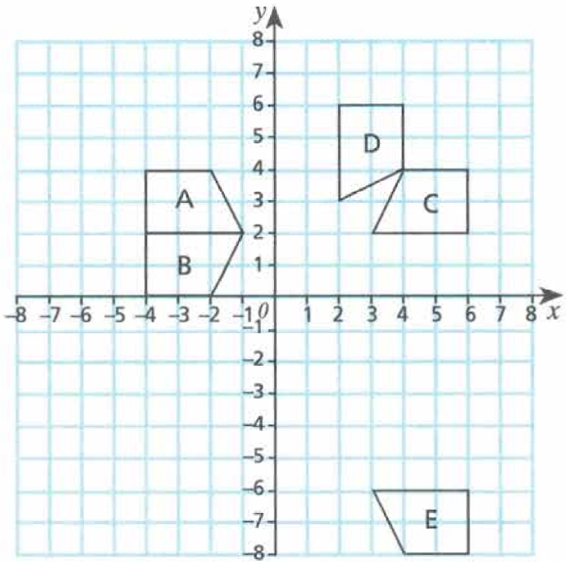
....

c) shape E to shape C

....

d) shape C to shape E

....



ORGANISE

8 Rotation

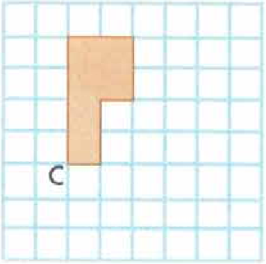
Rotating shapes

A rotation turns a shape around a point, called the **centre of rotation**.

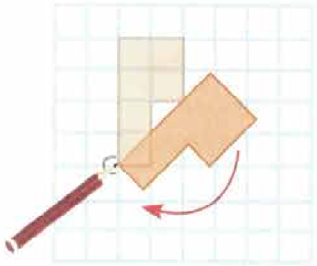
You can rotate through an angle clockwise ↻ or anti-clockwise ↺

The rotated shape is called the **image**. It is the same size as the original shape.

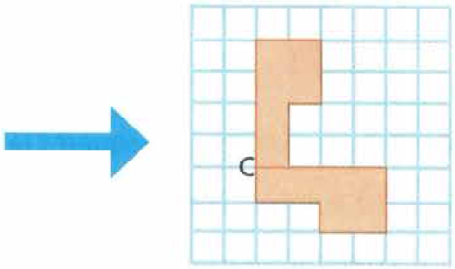
Rotate this shape 90° clockwise about point C.



Trace the shape. Put your pencil on the centre of rotation and rotate the tracing paper 90° clockwise.

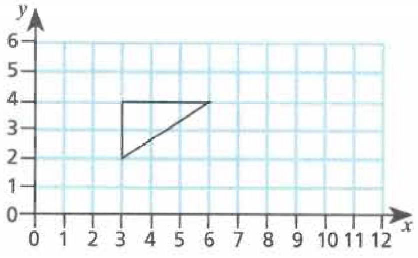


Draw the image in the correct position on the diagram.

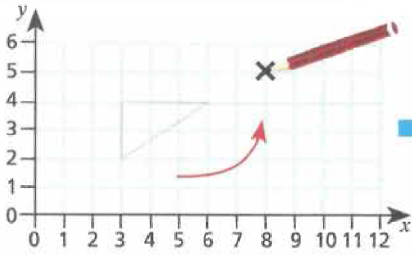


Rotating shapes on a coordinate grid

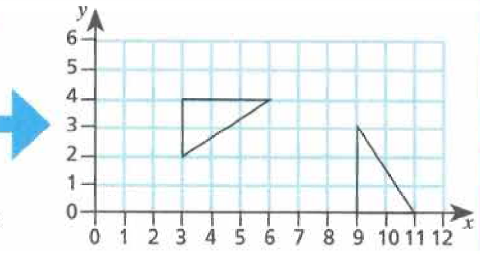
Rotate this triangle 90° anti-clockwise about centre of rotation (8, 5).



Mark the centre of rotation. Trace the shape. Put your pencil on the centre of rotation and rotate the tracing paper 90° anti-clockwise.



Draw the image in the correct position on the diagram.



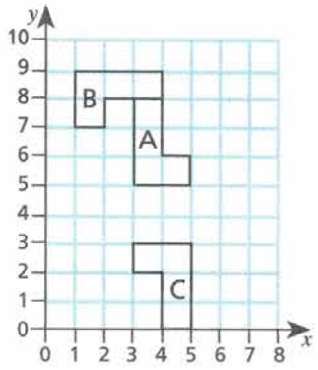
Describing rotations

To describe a rotation, you need to state the angle, the direction (clockwise or anti-clockwise) and the centre of the rotation.

Describe the rotation that takes:

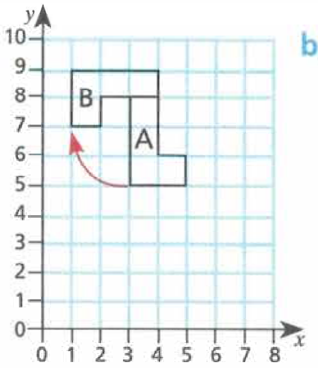
a) shape A to shape B

b) shape A to shape C



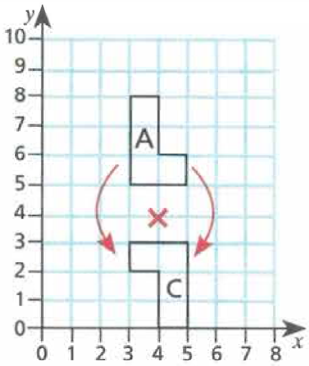
Find the angle and the direction of the rotation. To find the centre of rotation, trace the shape and try rotating it around different points until the image is in the correct place.

a)



Rotation 90° clockwise, centre (4, 8)

b)



Rotation 180°, centre (4, 4)

For a 180° rotation, you do not need to write the direction. 180° clockwise is the same as 180° anti-clockwise.

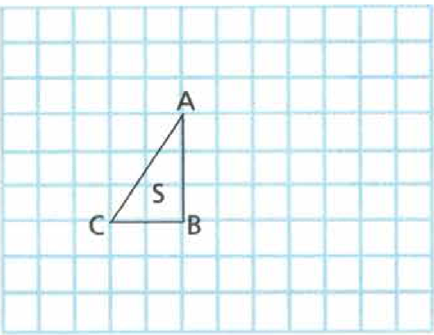
RETRIEVE

8 Rotation

Rotating shapes

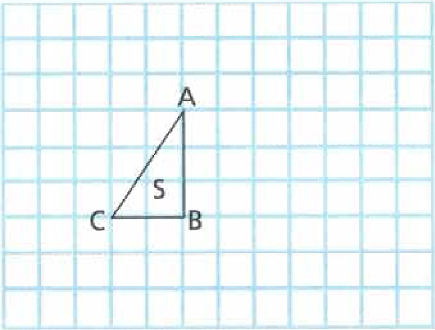
① **a)** Rotate shape S 90° clockwise about point A.

b) Rotate shape S 180° about point B.

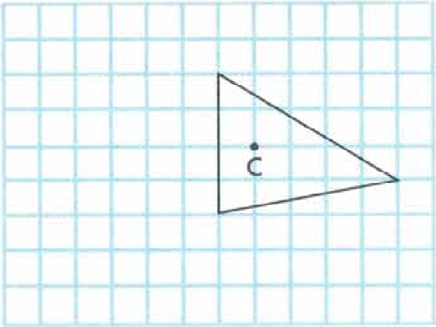


c) Rotate shape S 270° clockwise about point C.

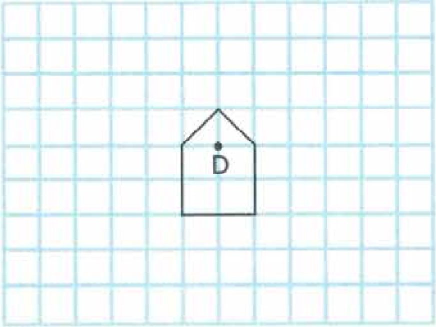
d) Rotate shape S 90° anti-clockwise about point B.



② **a)** Rotate this shape 180° about point C.



b) Rotate this shape 90° clockwise about point D.



Rotating shapes on a coordinate grid

③ Rotate this shape:

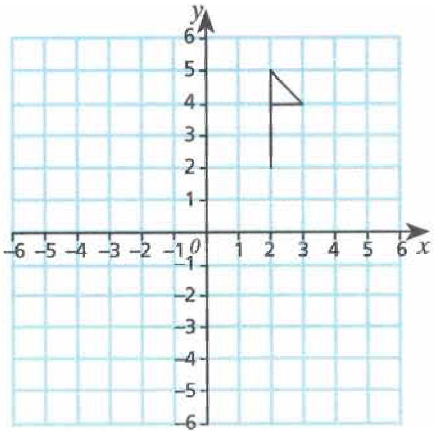
a) 90° anti-clockwise about centre of rotation (1, 1). Label the image A.

b) 90° clockwise about the origin. Label the image B.

The origin is (0, 0).

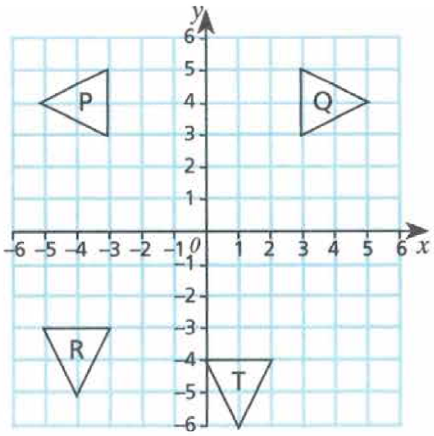
c) 270° anti-clockwise about centre of rotation (4, 3). Label the image C.

d) 180° about the origin. Label the image D.



Describing rotations

④



Describe the rotation that takes:

a) shape P to shape Q ....

b) shape P to shape R ....

c) shape R to shape P ....

d) shape P to shape T ....

ORGANISE

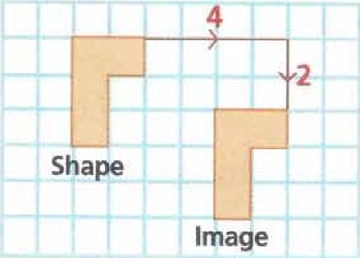
8 Translation

Translating shapes

A translation slides a shape across the grid.

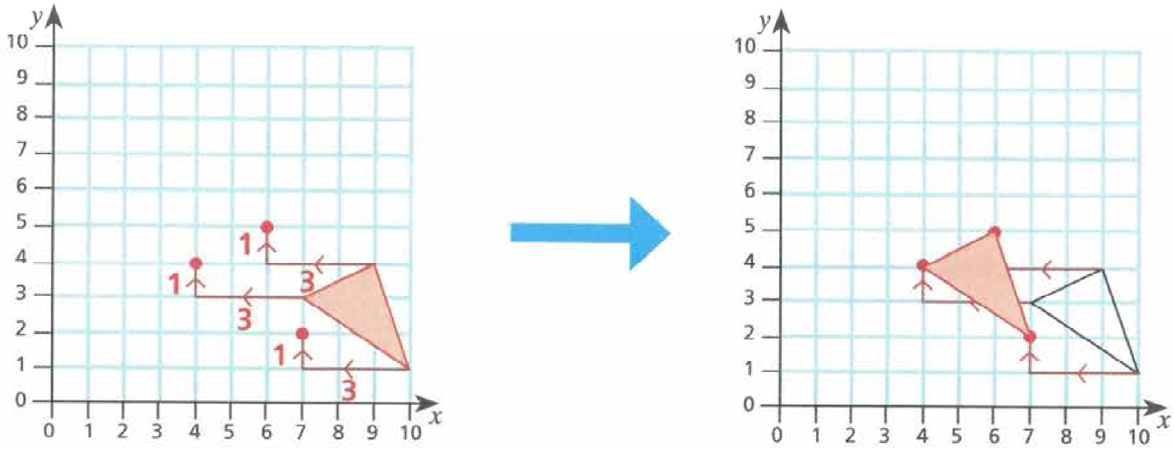
The translated shape is called the **image**. It is the **same size** as the original shape, facing in the **same direction**.

On the grid, the shape has been translated 4 squares right and 2 squares down.



To translate a shape, move each point on the shape the same distance left/right and up/down.

Translate triangle T 3 squares left and 1 square up.



Translate each vertex (corner) of the shape...

...and then join the dots.

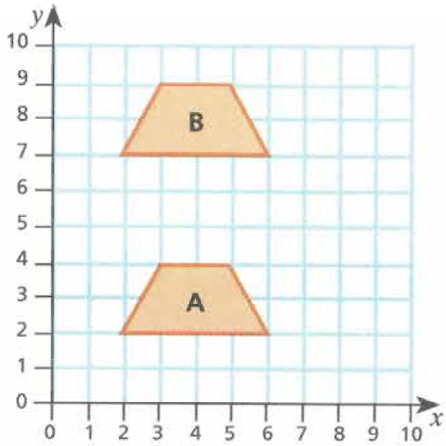
Describing translations

To describe a translation, write how many squares the shape moves left or right ↔ and ↕ up or down.

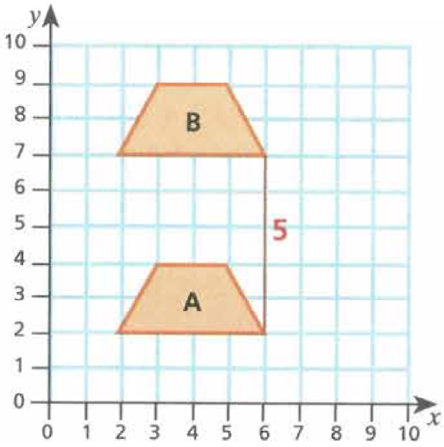
Describe the translation that takes:

a) shape A to shape B

b) shape B to shape A



Count the squares between matching vertices on the two shapes.



a) Translation 5 squares up

b) Translation 5 squares down

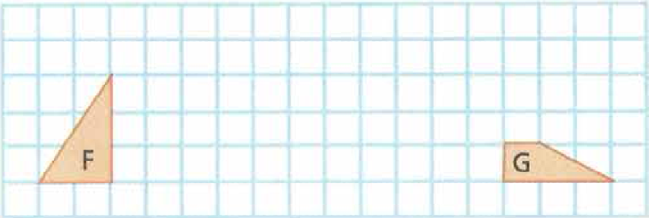
RETRIEVE

8 Translation

Translating shapes

1. **a)** Translate shape F 5 squares right.

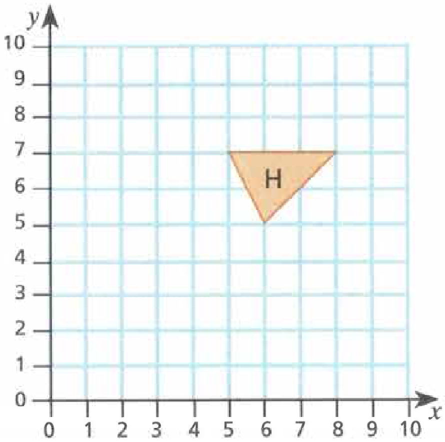
   b) Translate shape G 4 squares up.



2. **a)** Translate shape H 2 squares left and 3 squares down.

   b) The point (2, 7) is translated 2 squares left and 3 squares up.

   Write the new coordinates of the point after the translation.



Describing translations

3. Shapes J, K, L and M are shown on the grid.

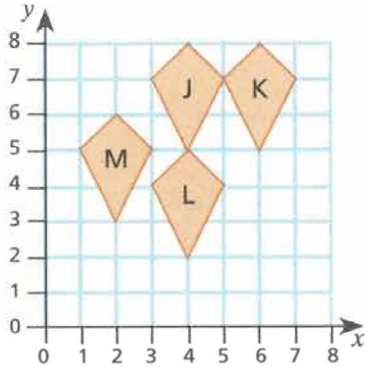
   Describe the translation that takes:

   a) shape J to shape K

   b) shape J to shape L

   c) shape L to shape J

   d) shape J to shape M



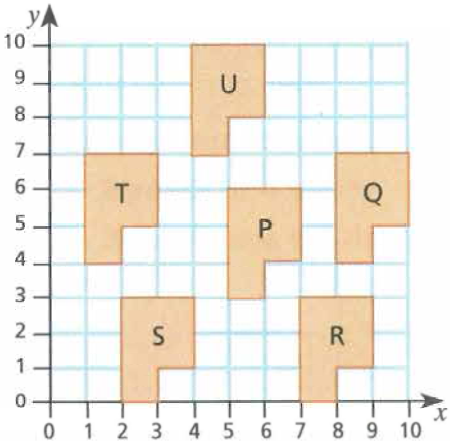
4. Shapes P, Q, R, S, T and U are shown on the grid.

   Write down the letter of the image of shape P after:

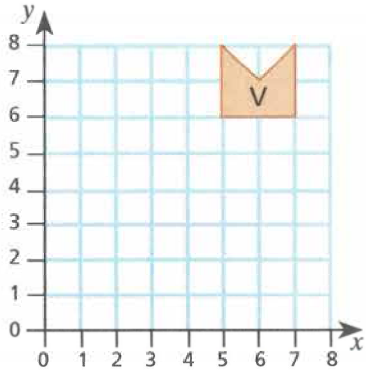
   a) a translation 4 squares left and 1 square up

   b) a translation 1 square left and 4 squares up

   c) a translation 2 squares right and 3 squares down



5. Shape V is shown on the grid.



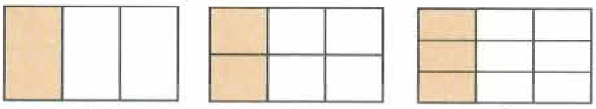
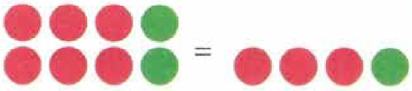
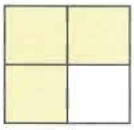
   a) Translate shape V 2 left and 4 down. Label the image W.

   b) Translate shape W 3 right. Label the image X.

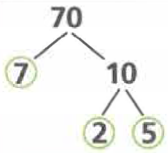
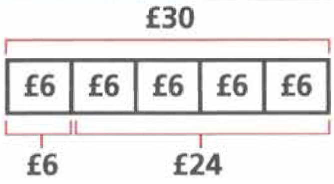
   c) Describe the single translation that takes shape X to shape V.

Key facts and vocabulary

Number

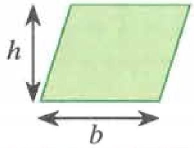
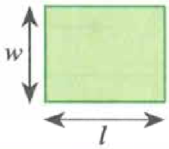
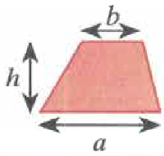
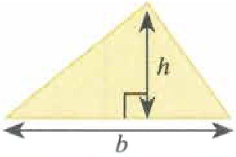
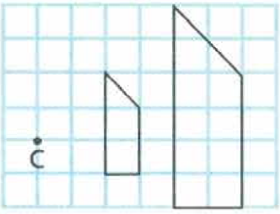
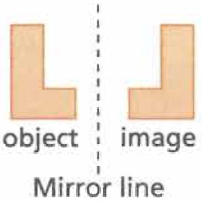
Adding and subtracting	Line up the digits by place value $\begin{array}{r} {}^{8}\cancel{9}\,.\,{}^{1}2\;4 \\ -\;2\,.\,3\; \\ \hline \mathbf{6\,.\,9\;4} \end{array}$ Convert fractions to equivalent fractions with the same denominator $\frac{5}{8} - \frac{3}{12} = \frac{15}{24} - \frac{6}{24} = \frac{9}{24} = \frac{3}{8}$
Dividing	Use place value to divide by 10, 100, 1000 320 ÷ 10 = 32 320 ÷ 100 = 3.2 320 ÷ 1000 = 0.32 In fractions, keep the first fraction the same, flip the second fraction, change ÷ to × $\frac{4}{9} \div \frac{3}{5} = \underset{\substack{\uparrow \\ K}}{\frac{4}{9}} \underset{\substack{\uparrow \\ C}}{\times} \underset{\substack{\uparrow \\ F}}{\frac{5}{3}} = \frac{20}{27}$
Equivalent	Represent the same amount or proportion  $\frac{1}{3} = \frac{2}{6} = \frac{3}{9}$  6 : 2 = 3 : 1
Factor	A number that divides exactly into another number
Fraction	 $3 \longleftarrow$ Numerator $4 \longleftarrow$ Denominator
Highest common factor (HCF)	The highest factor that two numbers share (have in common) **Factors of 12:** 1 2 3 4 6 12 **Factors of 18:** 1 2 3 6 9 18
Improper fraction	A fraction with a numerator greater than the denominator $\frac{13}{4}$
Integer	A whole number
Lowest common multiple (LCM)	The lowest multiple that two numbers share (have in common) **Multiples of 12:** 12 24 36 48 60 72 **Multiples of 18:** 18 36 54 72
Mixed number	Has a whole number part and a fraction part $3\frac{1}{4}$
Multiple	A number in a times table. Multiples of 4 are 4, 8, 12, 16, 20, …

Key facts and vocabulary

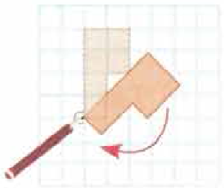
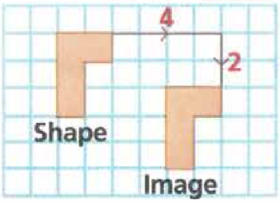
<table>
<tr><td>Multiplying</td><td>Use place value to multiply by 10, 100, 1000
$4.5 \times 10 = 45$ $4.5 \times 100 = 450$ $4.5 \times 1000 = 4500$
In fractions, multiply the numerators and multiply the denominators
$\frac{3}{5} \times \frac{4}{7} = \frac{12}{35}$</td></tr>
<tr><td>Negative numbers</td><td> </td></tr>
<tr><td>Order of operations</td><td>B I D M A S
( ) x^2 ÷ or × + or −</td></tr>
<tr><td>Place value</td><td>The value of each digit in a number
<table>
<tr><th>Ones</th><th>tenths</th><th>hundredths</th><th>thousandths</th></tr>
<tr><td>1 •</td><td>0.1 $\frac{1}{10}$</td><td>0.01 $\frac{1}{100}$</td><td>0.001 $\frac{1}{1000}$</td></tr>
<tr><td>7 •</td><td>3</td><td>6</td><td>4</td></tr>
</table>
$\frac{6}{100} = \frac{3}{50}$</td></tr>
<tr><td>Power</td><td>Repeated multiplication of a number by itself
Power (or index)
$8^5 = 8 \times 8 \times 8 \times 8 \times 8$
Base</td></tr>
<tr><td>Prime</td><td>Prime numbers have exactly two factors: 1 and itself; 1 is not a prime number</td></tr>
<tr><td>Prime factor decomposition</td><td>
$70 = 2 \times 5 \times 7$</td></tr>
<tr><td>Ratio</td><td>
black to yellow = 5 : 3

Sharing in the ratio of 1 : 4</td></tr>
<tr><td>Root</td><td>Inverse of a power
$3^2 = 9$, so $\sqrt{9} = 3$ Square root of 9 is 3.
$3^3 = 27$, so $\sqrt[3]{27} = 3$ Cube root of 27 is 3.</td></tr>
<tr><td>Rounding</td><td>3.235 = 3.2 (to 1 decimal place)
Less than 5 so round down
3.235 = 3.24 (to 2 decimal places)
5 or more so round up</td></tr>
<tr><td>Simplify</td><td>Simplify fractions and ratios by dividing both numbers by common factors
÷ 3
$\frac{9}{15} = \frac{3}{5}$
÷ 3
÷ 3 9 : 3 ÷ 3
3 : 1</td></tr>
</table>

Key facts and vocabulary

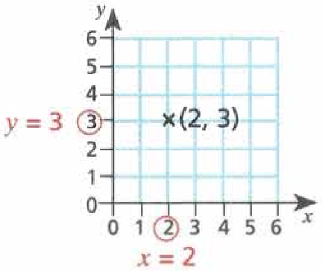
Geometry

Area	The space inside a 2D shape; measured in mm^2, cm^2, m^2, km^2
Area of parallelogram	Area of parallelogram = width × length = base × perpendicular height 
Area of rectangle or square	Area of rectangle or square = length × width 
Area of trapezium	Area of trapezium = $\frac{(a+b)}{2}h$ 
Area of triangle	Area of triangle = $\frac{1}{2}$ × base × perpendicular height 
Enlargement	Enlargement multiplies: • each length on the shape by the scale factor • the distance from the centre by the scale factor. To describe an enlargement: Enlargement scale factor ………………, centre ……………… number point 
Perimeter	The distance around the outside of a 2D shape; measured in mm, cm, m, km
Perpendicular	At right angles (90°) 
Polygon	A 2D shape with straight sides 
Reflection	Reflection makes a mirror image of a shape To describe a reflection: Reflection in the line ……………………… equation of mirror line 
Regular polygon	A polygon with all sides equal and all angles equal 

Key facts and vocabulary

Rotation	Rotation turns a shape around a point, called the centre of rotation. Use tracing paper. To describe a rotation: Rotation ....° clockwise/anti-clockwise, centre .... angle direction point 
Translation	Translation slides a shape across a grid. Translation 4 squares right, 2 down. To describe a translation: Translation .... squares right/left, ... up/down number direction number direction 

Algebra

Coordinates	Coordinates tell you the position of a point on a grid (2, 3) *x*-coordinate *y*-coordinate 
Distributive law	The number outside the bracket multiplies every number inside the bracket $3(10 + 2) = 30 + 6 = 36$ $7 \times 24 = 7(20 + 4) = 140 + 28 = 168$
Dividing terms	Write as a fraction Simplify the fraction $12ab \div 2a = \frac{12ab}{2a} = 6b$
Equation of a line	Tells you the relationship between the coordinates of the points on the line For example, the line $y = x$ goes through the points (–2, –2) (–1, –1) (0, 0) (1, 1) (2, 2)
Evaluate	Work out the value of For example: Evaluate n^2 when $n = 3$. $3^2 = 9$ Substitute 3 for *n*.
Multiplying terms	Numbers then letters, no multiplication sign, letters in alphabetical order $y \times 4 = 4y$ $4y \times 2t = 8ty$
Powers (indices)	Repeated multiplication of a term $a \times a = a^2$ $b \times b \times b = b^3$
Simplify by collecting like terms	Like terms have the same letters to the same power Collecting like terms means adding/subtracting any like terms $5a + 2b - a + 4b = 4a + 6b$
Substitute	Replace a letter in algebra with a number For example: Work out the value of $2y$ when $y = 3$. $2y = 2 \times 3 = 6$ Replace *y* with 3.
Term	A letter, a number, or letter(s) and numbers multiplied together a $3b$ 2 $6ab$