



# Basic Number



Everyone uses numbers on a daily basis often without really thinking about them. Shopping, cooking, working out bills, paying for transport and measuring all rely on a good understanding of numbers and calculation skills.

**By the end of this topic you will have learned to:**

- Order positive and negative integers
- Use the symbols  $=$ ,  $\neq$ ,  $<$ ,  $>$ ,  $\leq$ ,  $\geq$
- Apply the four operations, including formal written methods, to integers - both positive and negative
- Understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)
- Recognise and use relationships between operations including inverse operations (e.g. cancellation to simplify calculations and expressions)
- Estimate answers
- Check calculations using approximation and estimation, answers obtained using technology



## WORDS

Positive,  
negative, symbol,  
operations,  
inverse  
operations,  
formal, simplify,  
expression,  
estimate,  
approximation,  
calculation,  
cancellation,  
estimation,  
integer

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## Pre-test Basic Number

### Question 1

Three numbers add up to 60

The first number is a square number.

The second number is a cube number.

The third number is less than 10

What could the numbers be?

### Question 2

Write 64 as

- (a) a square of an integer.
- (b) the cube of an integer.

### Question 3

Which of the numbers 1, 6, 11, 12, 18, and 24 are factors of 24?



# Factors and Multiples



Counting in multiples saves quite a bit of time. If you know that each shelf has 15 boxes and each box contains 5 reams of paper, then you know straight away that you have 75 reams on each shelf without having to count each ream.

**By the end of this topic you will have learned to:**

- Use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation, and the unique factorisation theorem
- Apply systematic listing strategies and the use of the product rule for counting



## WORDS

Factor, multiple, prime number, common factor, common multiple, highest common factor, lowest common multiple, factorisation, listing, factor tree.

Mastery Indicators

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Pre-test Factors and Multiples

**Question 1**

Write 60 as the product of its prime factors.

Give your answer in index form.

**Question 2**

- (a) Write 1764 as a product of prime factors.
- (b) Use your answer to part (a) to work out  $\sqrt{1764}$

**Question 3**

A drinks machine sells Tea (T), Coffee (C) and Soup (S).  
Gareth buys 2 drinks at random.

- (a) List all the possible pairs of drinks he could buy.
- (b) Use your list to find the probability that both drinks are the same.



# Angles



Many people rely on an understanding of angles and spatial relationships in their daily work. These include designers, architects, opticians and tree surgeons.

**By the end of this topic you will have learned to:**

- Use conventional terms and notations:
  - points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries.
- Use the standard conventions for labelling and referring to the sides and angles of triangles.
- Draw diagrams from written descriptions
- Apply the properties of:
  - angles at a point
  - angles at a point on a straight line
  - vertically opposite angles.
- Understand and use alternate and corresponding angle lines.



## WORDS

Point, line, vertex, vertices, edge, plane, parallel, perpendicular, polygon, regular, reflection, rotation, angle, right angle, triangle, diagram, straight line, vertically opposite, alternate angle, vertically opposite.

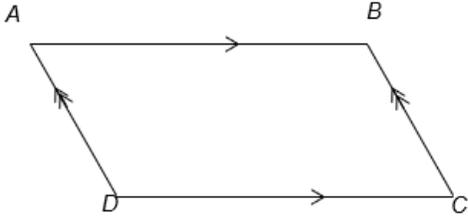
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## Pre-test Angles and Bearings

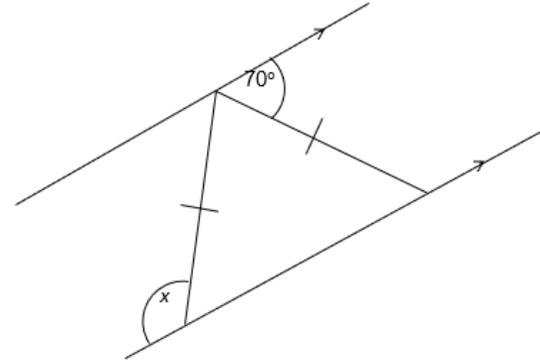
### Question 1

In parallelogram  $ABCD$ ,



- (a) Draw a line through  $B$  perpendicular to  $DC$ .
- (b) Draw a line through the midpoint of  $AB$  parallel to  $CB$ .

### Question 2



Not drawn accurately

Work out the size of angle  $x$ .

You must explain any properties that you have used to obtain your answer.

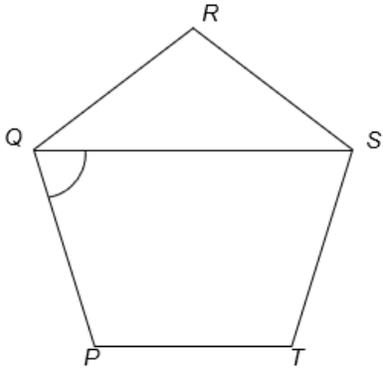
### Question 3

The pentagon  $PQRST$  has sides of equal length.

The line  $QS$  is drawn.

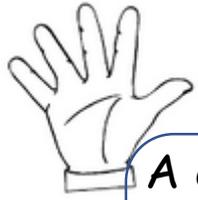
Not drawn accurately

Work out the size of angle  $PQS$ .



### Question 4

Use a scale of  $1:500\,000$  to decide how many kilometres are represented by 3 cm on the map.



# Scale diagrams and bearings

A cartographer uses accurate measurements to work out the scale when he draws maps. The people who use maps need to understand the scale so that they can make sense of map distances.

By the end of this topic you will have learned to:

- Use scale factors, scale diagrams and maps.
- Measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings.



## WORDS

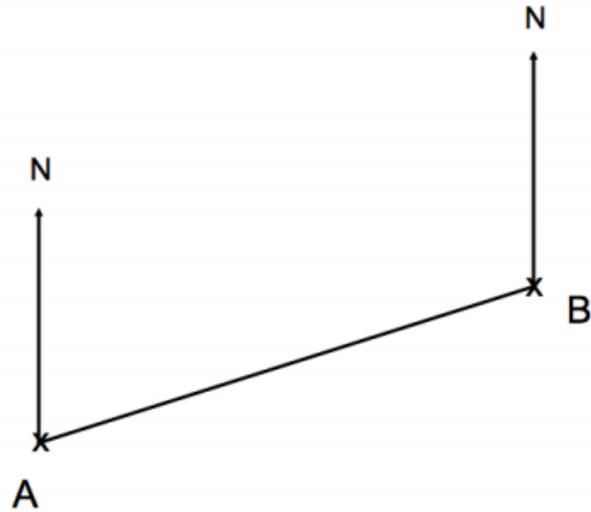
Scale,  
bearing,  
diagram, map,  
measure, line,  
segment,  
angle, drawing.

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Topic test

## Pre-test scales and bearings

The diagram shows the position of two houses, A and B, on a map.



Measure the bearing of B from A.

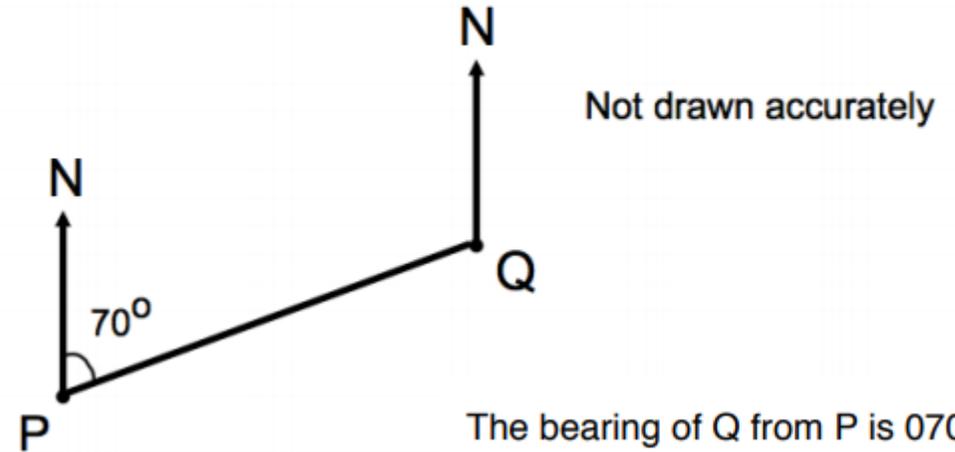
A map has a scale of 1:4000

On the map, the distance between two houses is 9cm.

What is the actual distance between the houses?

Give your answer in metres.

The diagram shows the position of two airplanes, P and Q.



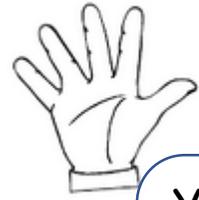
The bearing of Q from P is  $070^\circ$ .

Calculate the bearing of P from Q.

A map has a scale of 1cm represents 50 metres.

(a) Put a circle around the ratio which is equivalent to this.

1:50      1:500      1:5000      1:50000      1:500000      1:5000000



# Basic Algebra review

You are unlikely to think about algebra when you watch cartoons or play video games, but animators use complex algebra to program the characters and make objects move.



**By the end of this topic you will have learned to:**

- Use and interpret algebraic notation
- coefficients written as fractions rather than decimals
- brackets
- Use conventional notation for priority of operations, including brackets, powers, roots and reciprocals
- understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors
- Simplify and manipulate algebraic expressions by:
  - collecting like terms
  - multiplying a single term over a bracket
  - taking out common factors



## WORDS

Algebra,  
brackets,  
coefficient,  
fraction, decimal,  
power, root,  
reciprocal,  
equation, formula,  
identity,  
inequality, term,  
factor, like term,  
single term,  
common factor,  
simplify

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## Pre-test Basic Algebra

### Question 1

Neil buys  $y$  packets of sweets costing 45p per packet.

He pays  $T$  pence altogether.

Write a formula for the total cost of the sweets.

### Question 2

Expand and simplify  $3(a - 4) + 2(2a + 5)$

### Question 3

Expand and simplify  $(3a - 2b)(2a + b)$

### Question 4

Factorise  $6w - 8y$

### Question 5

Simplify  $x^2 \times x^4$

Simplify  $x^{16} \div x^4$

### Question 6

A rectangle has base  $(2x + 1)$  cm and width  $(3x - 2)$  cm

(a) Explain why the value of  $x$  **cannot** be  $\frac{2}{3}$

(b) Work out the area of the rectangle when  $x = 7$

### Question 7

Factorise  $x^2 - 7x + 10$

### Question 8

Two angles have a difference of  $30^\circ$

Together they form a straight line.

The smaller angle is  $x^\circ$

(a) Write down an expression for the larger angle, in terms of  $x$ .

(b) Work out the value of  $x$ .



# Basic fractions

Nurses and other medical support staff work with fractions, decimals, percentages and ratios every day. They calculate medicine doses, convert between different systems of measurement and set the patients' drips to supply the correct amount of fluid per hour.



**By the end of this topic you will have learned to:**

- Order positive and negative fractions
- Apply the four operations, including formal written methods, to simple fractions (proper and improper) and mixed numbers - both positive and negative
- Calculate exactly with fractions



## WORDS

Fractions,  
positive, negative,  
simple, improper,  
proper, mixed  
number, add,  
subtract, multiply,  
divide, reciprocal.

Mastery  
Indicators

Pretest  
Progress check  
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## Pre-test Fractions

1 Which fraction does not belong in each set?

a  $\frac{3}{15}, \frac{1}{5}, \frac{6}{30}, \frac{5}{35}, \frac{4}{20}$

b  $\frac{4}{7}, \frac{8}{14}, \frac{12}{21}, \frac{9}{16}, \frac{52}{91}$

c  $\frac{22}{10}, \frac{11}{4}, 2\frac{3}{4}, \frac{33}{12}, 2\frac{18}{24}$

2 Each calculation contains a mistake. Find the mistake and write the correct answer.

a  $\frac{2}{3} + \frac{3}{4} = \frac{5}{7}$

b  $\frac{4}{5} - \frac{9}{10} = \frac{1}{10}$

c  $\frac{2}{7} \times \frac{4}{5} = \frac{6}{35}$

d  $30 \div \frac{1}{2} = 15$

3 Which is greater in each pair?

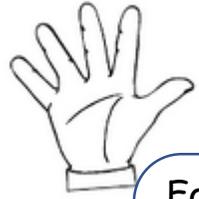
a  $\frac{5}{8}$  of 40 or  $\frac{3}{5}$  of 60

b  $\frac{3}{4}$  of 240 or  $\frac{7}{10}$  of 300

c  $\frac{1}{4}$  of  $\frac{1}{2}$  or  $\frac{1}{2}$  of  $\frac{3}{4}$

4 If you have read 45 pages of a 240 page book, what fraction of the book remains unread?

5 What fraction of 30 minutes is 45 seconds?



# Basic decimals

Food technologists analyse the contents of different raw and prepared foods to work out what they contain and how much there is of each ingredient. For example, how much water, protein and fat there is in a cut of meat. They use decimal fractions to give the quantities correct to tenths, hundredths or even smaller parts of a gram.



**By the end of this topic you will have learned to:**

- Order positive and negative decimals
- Apply the four operations, including formal written methods, to decimals - both positive and negative
- Understand and use place value (e.g. when calculating with decimals)
- Work interchangeably with terminating decimals and their corresponding fractions



## WORDS

Decimal, positive, negative, place value, tenth, hundredth, thousandth, terminating, recurring, fractions.

Mastery Indicators

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## Pre-test Decimals

- Write a decimal that is between:  
**a** 2.15 and 2.16    **b** 2.155 and 2.156    **c** 0.6753 and 0.6754
- Write the red digit in each number as a fraction with a denominator of 10, 100 or 1000.  
**a** 3.0**9**87    **b** 12.34**2**    **c** 0.**8**865
- Which number has the greater value in each pair?  
**a** 3.14 or  $3\frac{1}{4}$     **b** 0.78 or  $\frac{8}{9}$     **c**  $\frac{10}{11}$  or 0.99
- Choose the correct answer for each calculation.

| Calculation               | Possible answers |                |                |
|---------------------------|------------------|----------------|----------------|
| <b>a</b> $24 - 2.35$      | <b>A</b> 2.165   | <b>B</b> 216.5 | <b>C</b> 21.65 |
| <b>b</b> $19.5 - 3.45$    | <b>A</b> 16.5    | <b>B</b> 1.605 | <b>C</b> 16.05 |
| <b>c</b> $2.25 \times 3$  | <b>A</b> 675     | <b>B</b> 67.5  | <b>C</b> 6.75  |
| <b>d</b> $18.32 \times 4$ | <b>A</b> 732.8   | <b>B</b> 73.28 | <b>C</b> 7.328 |
| <b>e</b> $7.488 \div 6$   | <b>A</b> 1.248   | <b>B</b> 12.48 | <b>C</b> 124.8 |
| <b>f</b> $58.35 \div 3$   | <b>A</b> 0.1945  | <b>B</b> 1.945 | <b>C</b> 19.45 |

# Year 9 Mastery



## Coordinates and linear graphs

When designing a new building, an architect uses graphs to help identify and describe the structural properties the building needs to have.



**By the end of this topic you will have learned to:**

- Work with co-ordinates in all four quadrants
- Solve geometrical problems on co-ordinate axes
- Plot graphs of equations that correspond to straight line graphs in the co-ordinate plane
- Identify and interpret gradients and intercepts of linear functions graphically and algebraically.



### KEY WORDS

Co-ordinate,  
quadrant, axes,  
y-axis, x-axis,  
graph, equation,  
straight line,  
linear line,  
positive,  
negative.

Mastery  
Indicators

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## Pre-test Coordinates and Linear Graphs

### Question 1

$A$  is the point  $(2, 3)$

$B$  is the point  $(-5, 2)$

$B$  is the midpoint of  $AC$ .

Work out the coordinates of  $C$ .

### Question 2

Draw the graph of  $x + 2y = 10$

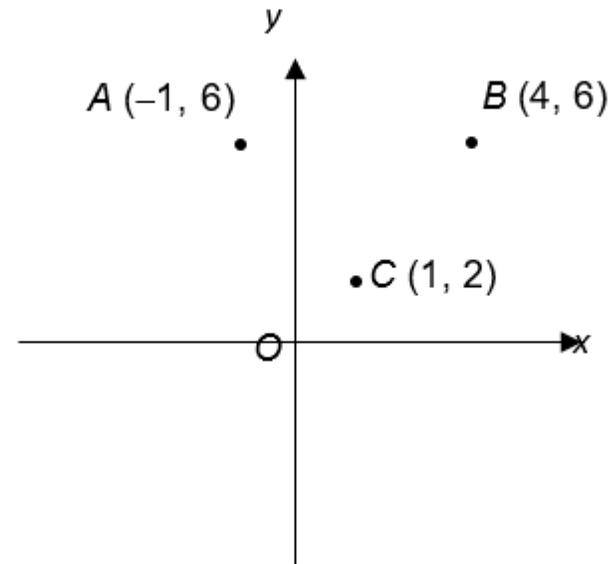
### Question 3

$A$  has coordinates  $(3, -5)$ .  $B$  has coordinates  $(6, 7)$ .

Work out the equation of the straight line  $AB$ .

### Question 4

$ABCD$  is a parallelogram.



Not drawn accurately

Work out the coordinates of  $D$ .

Work out the coordinates of the centre of the parallelogram.



# Rounding

A consumer rounds off the prices to the nearest pound and keeps a mental running total of the costs of things he puts in his trolley so that he knows that he is not overspending.



By the end of this topic you will have learned to:

- Round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures)
- Use inequality notation to specify simple error intervals due to truncation or rounding
- Apply and interpret limits of accuracy including upper and lower bounds



## WORDS

Rounding, decimal places, significant figures, inequality, error intervals, truncation, interpret, accuracy, lower and upper bounds.

Mastery Indicators

Pretest  
Progress check  
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## Pre-test Rounding

The mass of a coin is 8 grams to the nearest gram.  
Complete the error interval for the mass of the coin

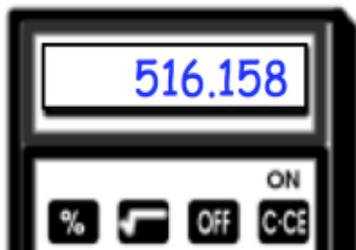
A chocolate bar contains 0.4715g of salt.  
Round this to two decimal places.

..... g  $\leq$  mass < ..... g

Tom has been asked to round the number on the calculator to 2 significant figures.

Tom says the answer is 516.16

Can you explain Tom's mistake?



A parcel has a mass of 28.6 g

This mass has been truncated to 1 decimal place.

Use inequalities to write down the error interval due to truncation.

# Year 9 Mastery



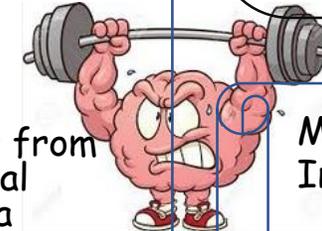
## Collecting and representing data

We live in a very information-rich world. Knowing how to construct accurate graphs and how to interpret the graphs we see is important. Many graphs in print and other media are carefully designed to influence what we think by displaying the data in particular ways.



### By the end of this topic you will have learned to:

- Interpret and construct tables, charts and diagrams including, for categorical data:
  - frequency tables
  - bar charts
  - pie charts
  - pictograms
  - vertical line charts for ungrouped discrete numerical data
  - tables and line graphs for time series data
  - know their appropriate use
- Interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate graphical representation involving discrete, continuous and grouped data
- Construct and interpret diagrams for grouped discrete and continuous data, i.e. histograms and cumulative frequency graphs, and know their appropriate use.



### WORDS

Collecting, data, representing, frequency table, bar chart, pie chart, pictogram, line chart, discrete, line graph, series, interpret, analyse, continuous, grouped data.

Mastery Indicators

Pretest  
Progress check  
Topic test

## Pre-test Collecting and representing Data

### Question 1

5% of a flock of sheep are black and the rest are white.

$\frac{1}{4}$  of the black sheep and  $\frac{1}{2}$  of the white sheep have been sheared.

Complete the two-way table.

|             | Sheared sheep | Unsheared sheep |
|-------------|---------------|-----------------|
| Black sheep | 4             |                 |
| White sheep |               |                 |

### Question 2

The table shows the number of shoppers the weekend before a sale and the weekend of the sale.

|                     | Saturday | Sunday |
|---------------------|----------|--------|
| Weekend before sale | 675      | 389    |
| Weekend of sale     | 741      | 419    |

Does the data provide evidence to support a claim of a 10% increase in shoppers during the sale?

### Question 3

The table shows the time taken for 100 runners to finish a fun run.

| Time, $t$ (minutes) | Frequency |
|---------------------|-----------|
| $10 < t \leq 20$    | 8         |
| $20 < t \leq 30$    | 26        |
| $30 < t \leq 40$    | 51        |
| $40 < t \leq 50$    | 15        |

Draw a cumulative frequency diagram for the data.

### Question 4

The table shows the heights of 100 five-year-old boys.

| Height, $h$ (cm)   | Frequency |
|--------------------|-----------|
| $80 \leq h < 90$   | 8         |
| $90 \leq h < 100$  | 31        |
| $100 \leq h < 110$ | 58        |
| $110 \leq h < 120$ | 3         |

- (a) Calculate an estimate of the mean height of these boys.
- (b) Give a reason why your answer to part (a) is an estimate.



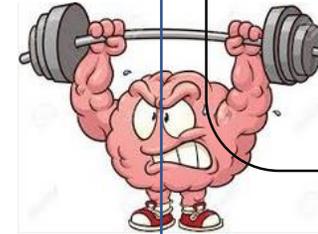
# Sequences

Finding a pattern and working out how the parts of the pattern fit together is important in scientific discovery. Scientists use sequences to model and solve real-life problems such as estimating how quickly diseases spread.



**By the end of this topic you will have learned to:**

- Generate terms of a sequence from either a term-to-term or a position-to-term rule
- Recognise and use:
  - sequences of triangular, square and cube numbers
  - simple arithmetic progression
  - Fibonacci type sequences
  - quadratic sequences
  - and simple geometric progressions ( $r^n$  where  $n$  is an integer and  $r$  is a rational number  $> 0$ )
- Other sequences
- Deduce expressions to calculate the  $n$ th term of a linear and quadratic sequence



## WORDS

Term, nth term, sequence, triangle number, square number, cube number, arithmetic sequence, quadratic sequence, Fibonacci sequence, geometric sequence, integer, rational number, linear sequence.

Mastery Indicators

Pretest  
Progress check  
Topic test

## Pre-test Sequences

### Question 1

The  $n$ th term of a sequence is  $\frac{7 - n}{n^2 + 1}$

- (a) Which term in the sequence is the first one with a negative value?
- (b) Work out the value of this term.

### Question 2

Write down the first three terms of a sequence where the  $n$ th term is given by  $n^2 + 4$

### Question 3

Write down the next **two** terms in the following quadratic sequence.

7    10    15    22    .....

### Question 4

An arithmetic progression starts  $3 + 2a$ ,  $3 + 4a$ ,  $3 + 6a$  .....

If the fifth term is 73, work out the value of  $a$ .

### Question 5

A Fibonacci - type sequence is made by adding the first term to double the second term.

The first four terms are    1    2    5    12

Work out the 7th term.



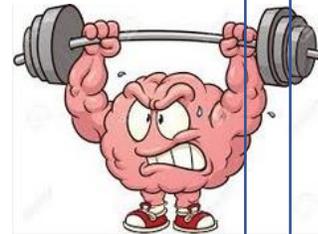
# Basic Percentages

Statistics in the media are often reported as percentages. This makes it easier to understand, but percentages can also be misleading - 60% sounds like a lot, but it could just mean 3 out of 5 people interviewed.



**By the end of this topic you will have learned to:**

- Define percentage as 'number of parts per hundred'
- Interpret percentages and percentage changes as a fraction or a decimal and interpret these multiplicatively
- Express one quantity as a percentage of another
- Compare two quantities using percentages
- Work with percentages greater than 100%
- Interpret fractions and percentages as operators



## WORDS

Percentage,  
percentage  
change,  
fraction,  
decimal,  
quantity,  
interpret,  
operator,  
multiplier.

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## Pre-test Percentages

- 1 Write each percentage as a fraction.  
a 34%                      b 115%
- 2 Write each set of numbers in order from smallest to biggest.  
a 12%, 0.125,  $\frac{7}{50}$ ,  $\frac{5}{12}$ , 19%  
b  $2\frac{3}{4}$ , 200%, 2.5%, 12.5%, 1.08, 1.25
- 3 What is 19 out of 25 marks as a percentage?
- 4 What is 50% of 128?
- 5 In a population of 12 500 000 people of working age, 3 400 000 are unemployed.  
  
What is the unemployment rate as a percentage?
- 6 Express 25p as a percentage of £7.50
- 7 Increase £20 by 9.5%.
- 8 Pete wants to buy a second-hand car marked at £2800.  
  
The dealer offers him a 7.5% discount if he pays cash. What will the cash price be?
- 9 Mandy bought a book in a 25% off sale for £2.55. What was the original price of the book?

# Year 9 Mastery



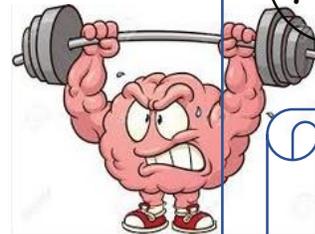
## Perimeter and area

Working out the amount of fencing needed for a field, or the number of tiles needed to edge a swimming pool, or the number of perimeter cameras needed to secure an area all require the calculations of a perimeter.



By the end of this topic you will have learned to:

- Identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres
- Calculate the perimeter of a 2D shape and composite shapes
- Calculate the area of composite shapes
- Know and apply formulae to calculate area of:
  - triangles
  - parallelograms
  - Trapezia
- Find the surface area of pyramids and composite solids.



### WORDS

Faces, surfaces, edges, vertices, vertex, cube, cuboid, prism, cylinder, pyramid, cone, sphere, perimeter, area, composite shape, triangle, parallelogram, trapezium, formula.

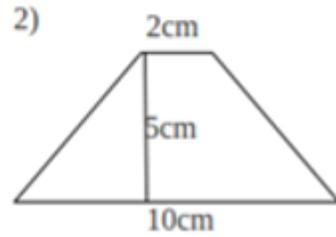
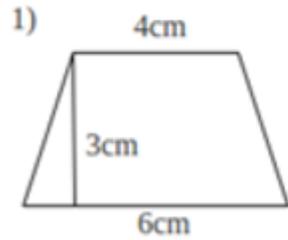
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## Pre-test Area and Perimeter

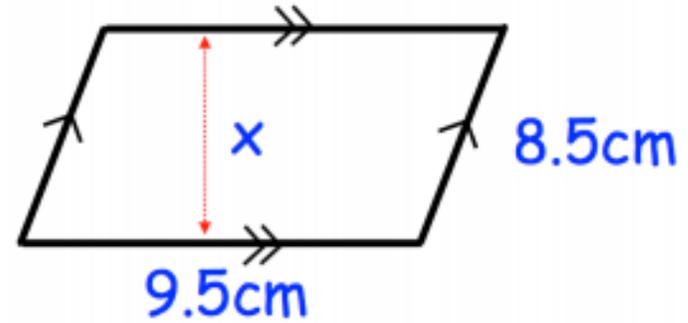
Question 1.

Work out the area of these trapezia:

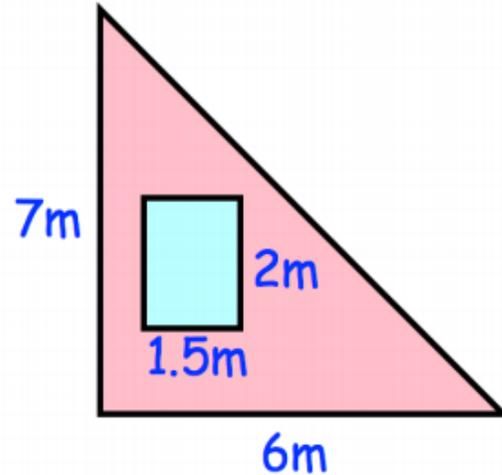


Calculate the length of the missing sides.

$$\text{Area} = 71.25\text{cm}^2$$



Question 2: Shown is a triangular brick wall with a rectangular window. Find the area of the wall that is brick.





## Real Life Graphs

All sorts of information can be obtained from graphs in real-life contexts. The shape of a graph, its gradient and the area underneath it can tell us about speed, time, acceleration, prices, earnings, break-even points or the value of one currency against another, among other things.



**By the end of this topic you will have learned to:**

- Plot and interpret graphs (including reciprocal graphs and exponential graphs) and graphs of non-standard functions in real context, to find approximate solutions to problems such as simple kinematics problems involving distance, speed and acceleration.
- Interpret the gradient of a straight line as a rate of change.



### WORDS

Plot, interpret, reciprocal, exponential, graph, function, distance, speed, acceleration, kinematics, gradient, straight line, rate of change.

Mastery Indicators

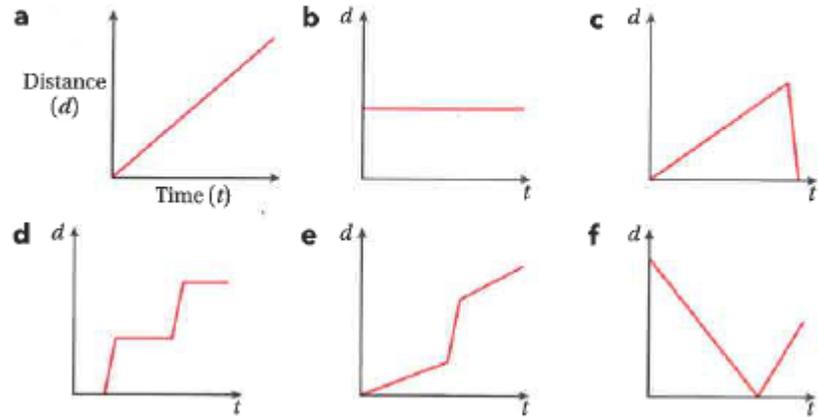
Pretest

Progress check

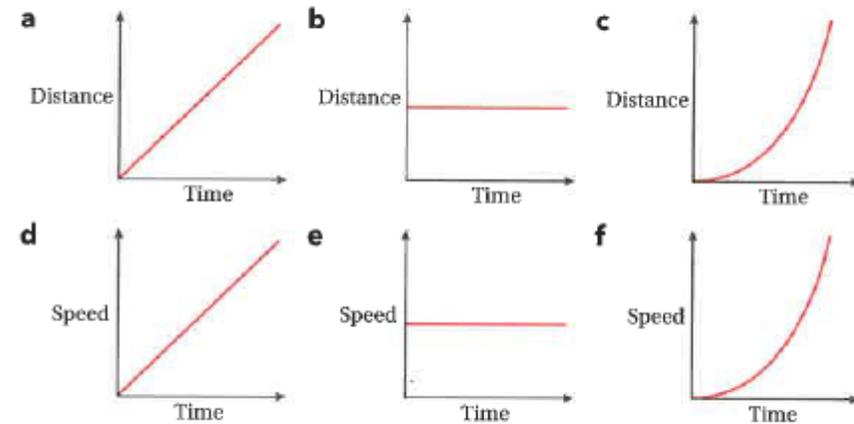
Topic test

## Pre-test Real life graphs

- 1 Describe what is happening in each of the distance–time graphs below. Suggest a possible real-life situation that would result in each graph.

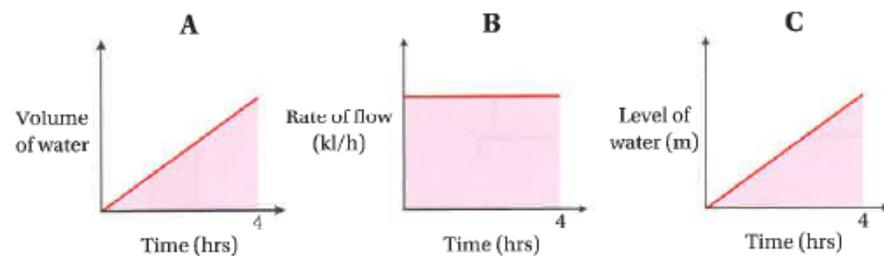


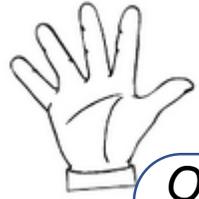
- 2 Consider the following graphs depicting the journey of a car. Match them up to the situations being described below. Justify your choices.



- A The car is travelling at a constant speed.  
 B The car is accelerating at a constant rate.  
 C The car's acceleration is increasing.  
 D The car is stationary.

- 3 The shaded part of one of these graphs represents the amount of water in a swimming pool after 4 hours. Which graph is it? Explain your answer.





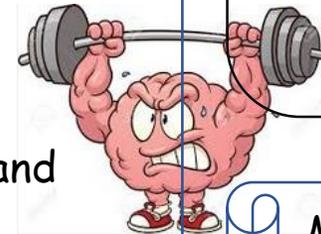
## Circumference and area

Ordering the right quantity of turf for a sports field, preparing detailed floor plans and determining how much fertiliser is needed to treat a field crop all require knowledge and calculation of areas.



**By the end of this topic you will have learned to:**

- Identify and apply circle definitions and properties, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
- Know the formulae
  - circumference of a circle =  $2\pi r = \pi d$
  - area of a circle =  $\pi r^2$
- Calculate: perimeters of 2D shapes, including circles and composite shapes
- Calculate areas of circles and composite shapes
- Calculate surface area of spheres, cones and composite solids
- Calculate arc lengths, angles and areas of sectors of circles



### WORDS

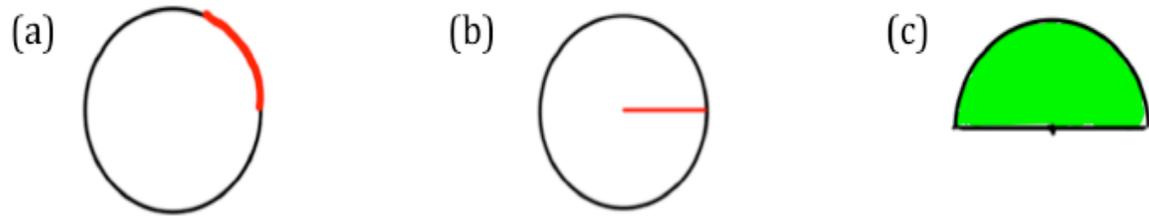
Circle,  
circumference,  
centre, radius,  
diameter, chord,  
arc, tangent,  
sector, segment,  
pi, perimeter,  
composite shape

Mastery  
Indicators

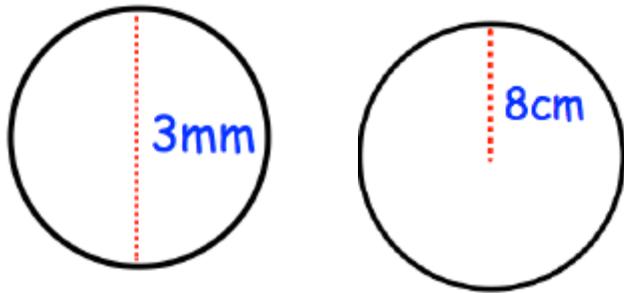
Pretest  
Progress check  
Topic test

**Pre-test Circumference and Area**

Question 1: Name the parts of the circle shown in each diagram



Question 2: Calculate the circumference of the following circles. Give your answers to 1 decimal place.



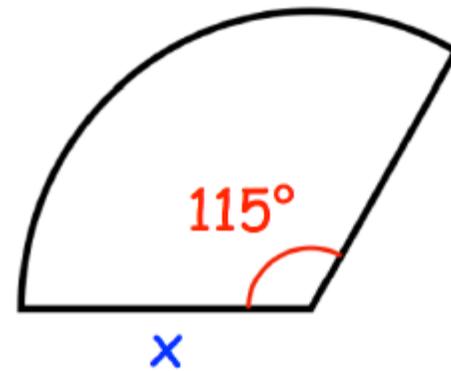
Question 3: Work out the area of the following circles. Give your answers to 1 decimal place.

A circle with radius 9cm

A circle with diameter 5 yards

Question 4: The areas of these sectors have been given. Calculate x.

Area =  $20\text{cm}^2$





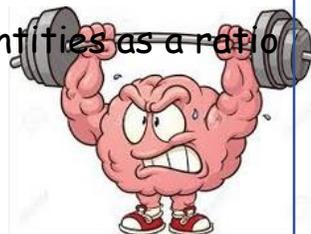
# Ratio and Proportion

Converting between different currencies, working out which packet of crisps is the best value for money, mixing large quantities of cement and scaling up a recipe to cater for more people all involve reasoning using ratios



**By the end of this topic you will have learned to:**

- Identify and work with fractions in ratio problems
- Express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1
- Use ratio notation, including reduction to simplest form
- Divide a given quantity into two parts in a given part:part or part:whole ratio
- Express the division of a quantity into two parts as a ratio
- Apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing and concentrations)
- Express a multiplicative relationship between two quantities as a ratio or a fraction
- Understand and use proportion as equality of ratios
- Relate ratios to fractions and to linear functions



## WORDS

Ratio, proportion, quantity, fraction, simplest form, conversion, comparison, scaling.

Mastery Indicators

Pretest  
Progress check  
Topic test

## Pre-test Ratio and Proportion

- 1 Write the ratio 12 : 21 in its simplest form.
  - 2 In a class of 14 girls and 16 boys what is the ratio of boys to girls?
  - 3 Every 80 minutes of television broadcasted includes a quarter of an hour of advertising. What is the ratio of adverts to programme broadcast?
- 
- 4 Ten people have enough food for a 6-day camping trip.
    - a How long would the food last if there were only five people?
    - b Two more people join the group unexpectedly.  
How long would the food last if there were 12 people?



# Equations

Although the computer does the actual calculations, an accountant has to insert different equations to tell it what operations to perform and in which order to perform them.



By the end of this topic you will have learned to:

- Substitute numerical values into formulae and expressions, including scientific formulae
- Solve linear equations in one unknown algebraically including those with the unknown on both sides of the equation



## WORDS

Equation,  
substitution,  
formula,  
expression, linear  
equation,  
variable,  
coefficient.

Mastery  
Indicators

Pretest  
Progress check  
Topic test

## Pre-test Equations

Match each equation to its solution.

Equations

**a**  $x + 7 = 19$

**b**  $x - 6 = 11$

**c**  $2x + 5 = 7$

**d**  $8x = -24$

**e**  $2 - 3x = 8$

Solutions

**A**  $x = 1$

**B**  $x = 17$

**C**  $x = -2$

**D**  $x = 12$

**E**  $x = -3$

**f** How can you check whether a solution is correct?

The cost of hiring a car for a number of days is calculated using the formula

$$\text{Hire Cost} = 30 \times \text{Number of Days} + 50$$



(a) Calculate the cost of hiring a car for 4 days.

(b) Calculate the cost of hiring a car for 9 days.

(c) The hire cost is £110, how many days was the car hired for?

(d) The hire cost is £380, how many days was the car hired for?

When 16 is added to twice Jack's age, the answer is 44.

Write an equation and solve it to find Jack's age.



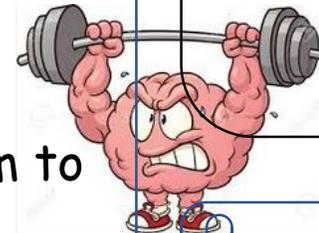
# Basic Probability

Software developers use probability when they build applications. Apps such as speech recognition, speech synthesis, key-word spotting and predictive text all rely on probability.



**By the end of this topic you will have learned to:**

- Record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees
- Apply the property that the probabilities of an exhaustive set of outcomes sum to one
- Apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one
- Construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities



## WORDS

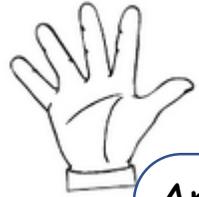
Probability,  
outcome,  
experiment,  
frequency tree,  
exhaustive,  
mutually  
exclusive,  
theoretical,  
equally likely.

Mastery  
Indicators

Pretest  
Progress check  
Topic test

## Pre-test Basic Probability

- 1** Maria rolls a normal six-sided dice 300 times.
  - a** Based on the theoretical probability of rolling a six, how many sixes would you expect her to roll?
  - b** In her experiment she obtains a six 113 times. What is the relative frequency of rolling a six?
  - c** If she rolled the same dice 650 times, how many sixes could she expect? Why?
  
- 2** Two normal six-sided dice are rolled and the sum of the numbers on their faces is recorded.
  - a** Calculate  $P(12)$ .
  - b** Which sum has the greatest probability? What is the probability of rolling this sum?
  - c** What is  $P(\text{Not even})$ ?
  - d** What is  $P(\text{Sum} < 5)$ ?



# Scatter graphs

Analysing large set of data enables financial and insurance companies to make predictions about what might happen in the future. Car insurance premiums are worked out according to typical or "average" behaviour of large groups of people.



**By the end of this topic you will have learned to:**

- Use and interpret scatter graphs of bivariate data
- Recognise correlation and know that it does not indicate causation
- Draw estimated lines of best fit
- Make predictions
- Interpolate and extrapolate apparent trends whilst knowing the dangers of doing so



## WORDS

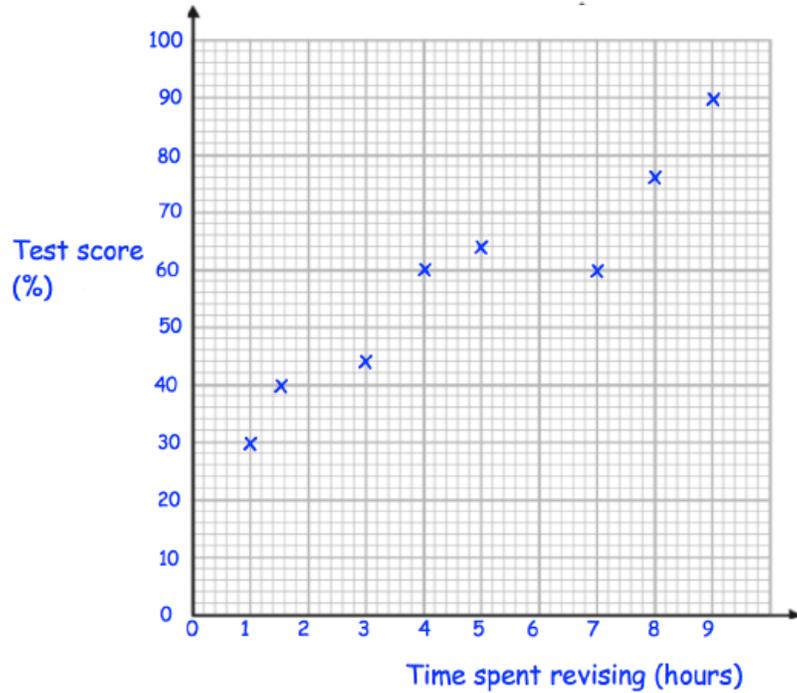
Scatter graph,  
correlation,  
negative,  
positive, line of  
best fit,  
prediction,  
interpolate,  
extrapolate.

Mastery  
Indicators

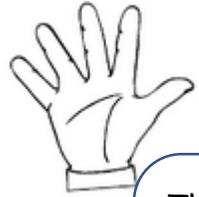
Pretest  
Progress check  
Topic test

# Pre-test Scatter Graphs

Question 1: The scatter graph below shows information about the number of hours spent revising for a test and the test result for a group of 8 students.



- Daisy spent 7 hours revising for the test. What is Daisy's test score?
- Harry's test score was 30%. How many hours did Harry spend revising?
- Draw a line of best fit.
- Another student spent 6 hours revising for the test. Find an estimate of their test score.
- Explain why it might not be sensible to use the scatter graph to estimate the score for a student that spent 15 hours revising.



# Standard Form

The study of stars, moons and planets involves huge numbers, Astronomers use standard form to make it easier to write or type very large quantities, to make them easier to compare and to allow them to calculate with and without calculators. The sun has a mass of  $1.988 \times 10^{30}$  kg. This is a number with 27 zeros and it would be clumsy and impractical to have to write it out each time you wanted to use it.



**By the end of this topic you will have learned to:**

- Understand and use place value (e.g. when working with very large or very small numbers)
- Calculate with and interpret standard form  $A \times 10^n$  where  $1 \leq A < 10$  and  $n$  is an integer



## WORDS

Place value,  
standard form,  
integer, index  
number, power,  
index law

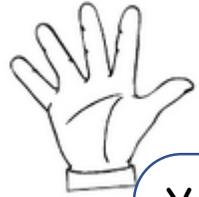
Mastery  
Indicators

Pretest  
Progress check  
Topic test

## Pre-test Standard Form

In questions 1 to 4, choose the correct answer.

- 1  $2.4 \times 10^7$  written in full.  
A 0.00000024      B 240000000      C 0.000000024  
D 24000000      E 2400000
- 2  $7 \times 10^{-3}$  written in full.  
A 0.0007      B 7000      C 0.007  
D 70000      E 0.00007
- 3 23500 written in standard form.  
A  $2.35 \times 10^{-4}$       B  $2.35 \times 10^4$       C  $235 \times 10^2$   
D  $23.5 \times 10^3$       E  $2.35 \times 10^{-2}$
- 4 0.0000231 written in standard form.  
A  $23.1 \times 10^{-5}$       B  $2.31 \times 10^5$       C  $2.31 \times 10^{-4}$   
D  $2.31 \times 10^4$       E  $2.31 \times 10^{-5}$
- 
- 5 Multiply  $2400000 \times 23000$  giving your answer in standard form.
- 6 Calculate  $\frac{4.6 \times 10^{-3}}{1.84 \times 10^4}$ .



# Transformations

You can see examples of reflections, rotations and translations all around you. Patterns in wallpaper and fabric are often translations, images reflected in the water are reflections and the blades of a wind turbine are a good example of rotation.



**By the end of this topic you will have learned to:**

- Identify, describe and construct congruent and similar shapes, on co-ordinate axes, by considering rotation, reflection, translation and enlargement (including fractional scale factors)
- Describe translations as 2D vectors
- Describe the changes and invariances achieved by combinations of rotations, reflections and translations (including using column vector notation for translations).



## WORDS

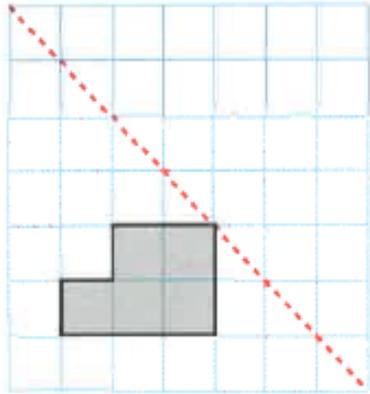
Transformation,  
describe,  
translation,  
reflection,  
rotation,  
enlargement,  
congruent,  
similar, scale  
factor, vector.

Mastery  
Indicators

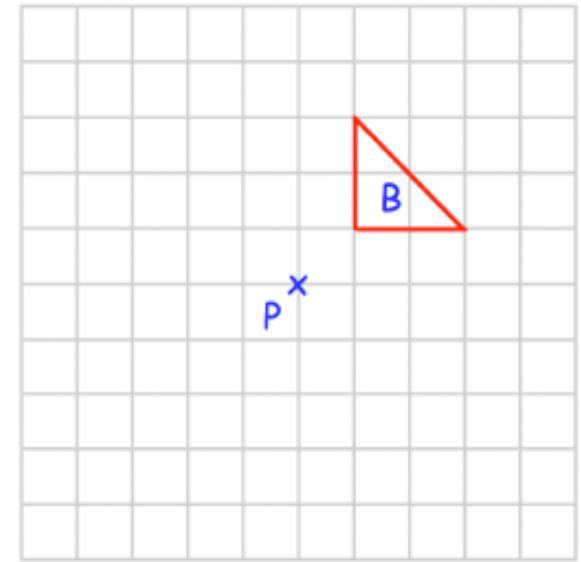
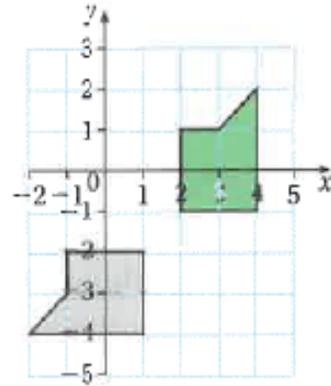
Pretest  
Progress check  
Topic test

# Pre-test Transformations

- 1 Reflect the given shape in the mirror line.

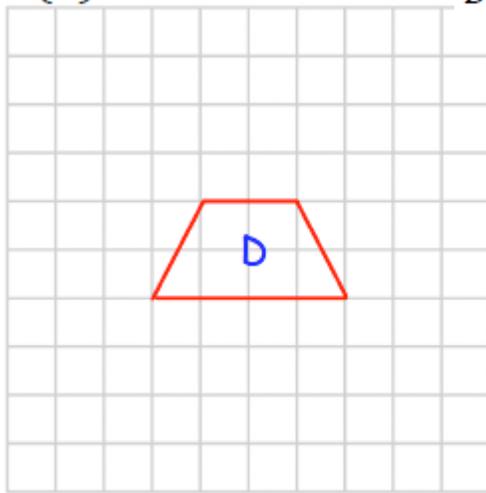


- 2 What is the equation of the mirror line?

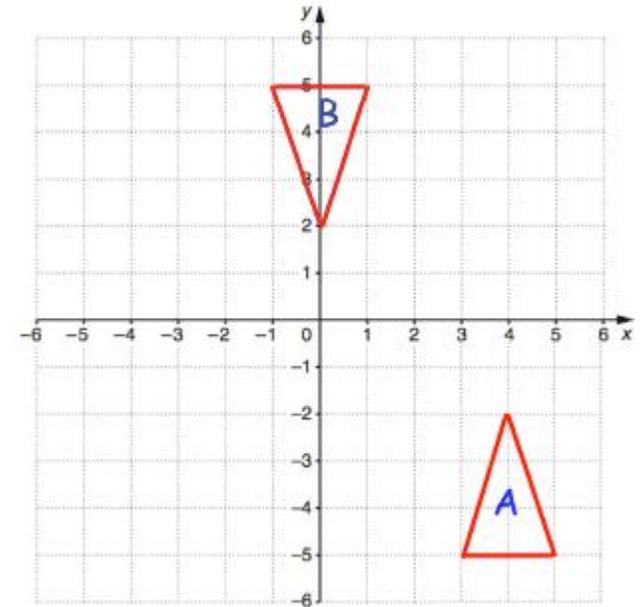
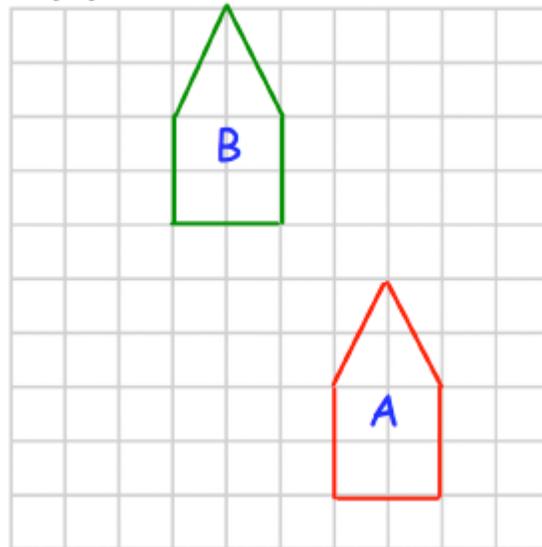


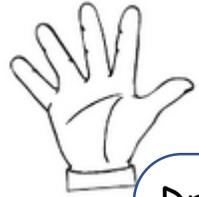
rotate  $90^\circ$  anticlockwise about P

Describe fully each translation that takes shape A to shape B



Translate D by  $\begin{pmatrix} -3 \\ 3 \end{pmatrix}$





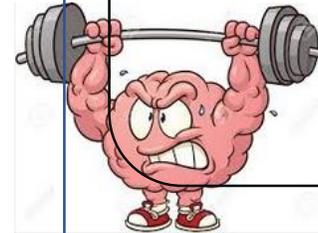
## Constructions and Loci

Draughts people and architects need to draw accurate scaled diagrams of the buildings and other structures they are working on. Although the drawings are complicated, they still use ordinary mathematical instruments like pencils, rulers and pairs of compasses to draw them.



**By the end of this topic you will have learned to:**

- standard ruler and compass constructions:
  - perpendicular bisector of a line segment
  - constructing a perpendicular to a given line from a given point
  - bisecting an angle
- Know that the perpendicular distance from a point to a line is the shortest distance to the line.
- Use them to construct given figures and solve loci problems.



### KEY WORDS

Ruler, compass, construction, perpendicular, bisector, line segment, angle, loci, locus.

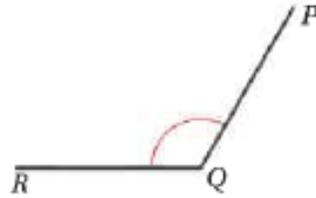
Mastery Indicators

Pretest  
Progress check  
Topic test

## Pre-test Construction and Loci

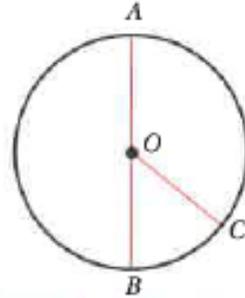
1 Which of the following statements are true of this angle?

- A It is an acute angle.
- B It measures  $120^\circ$ .
- C It is called  $QRP$ .
- D If you extend arm  $QR$ , the size of the angle will increase.



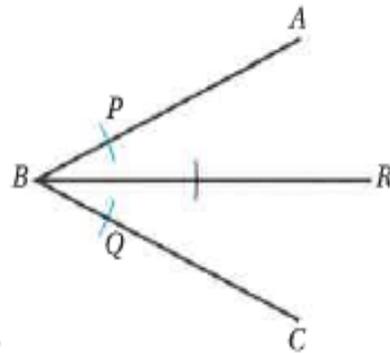
2 Which of the following statements are **not** true of this circle?

- A It has a radius of 5 cm.
- B It has a diameter of 5 cm.
- C  $OC \perp AB$
- D  $OC = \frac{1}{2}(AB)$

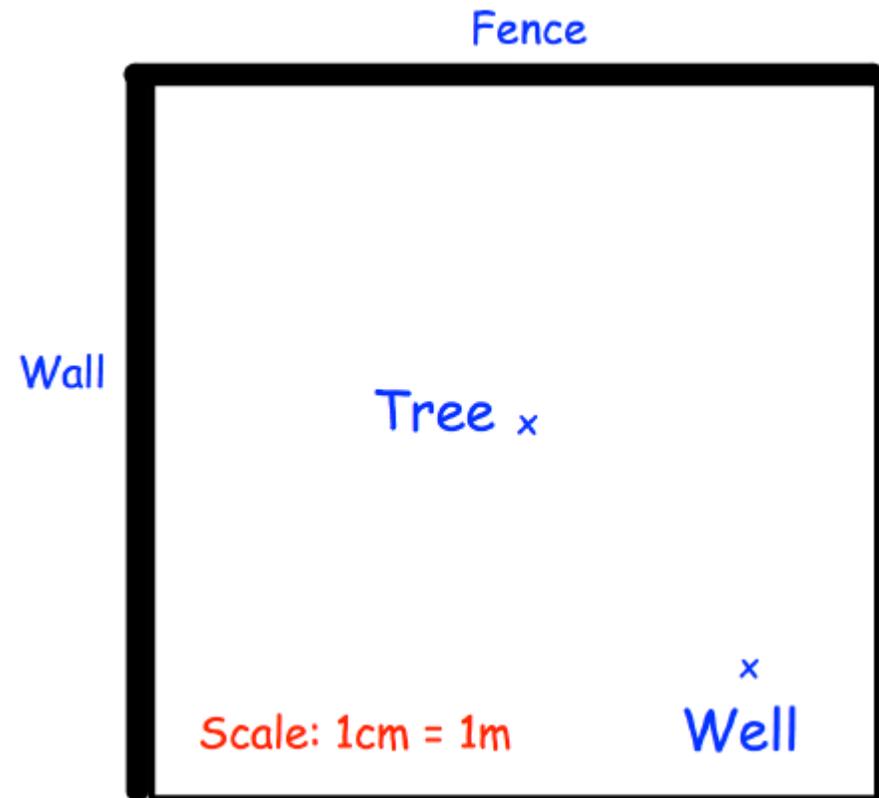


3 Niresh did the construction shown here.

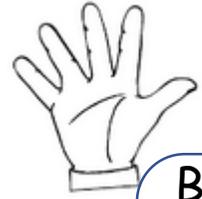
- a What do you call line  $BR$ ?
- b What did Niresh do to produce points  $P$  and  $Q$ ?
- c Given that angle  $ABC = 24^\circ$ , state the size of angle  $ABR$  without measuring it.



Show the possible positions of the bench:  
The bench is 2 metres away from the tree.



# Year 9 Mastery



## 2D representations of 3D shapes

Buildings, engine parts, vehicles and packaging are all carefully planned and designed before they are built or made. Most design work starts on paper or screen using two-dimensional images to represent the final three-dimensional objects.



By the end of this topic you will have learned to:

- Construct and interpret plans and elevations of 3D shapes



### WORDS

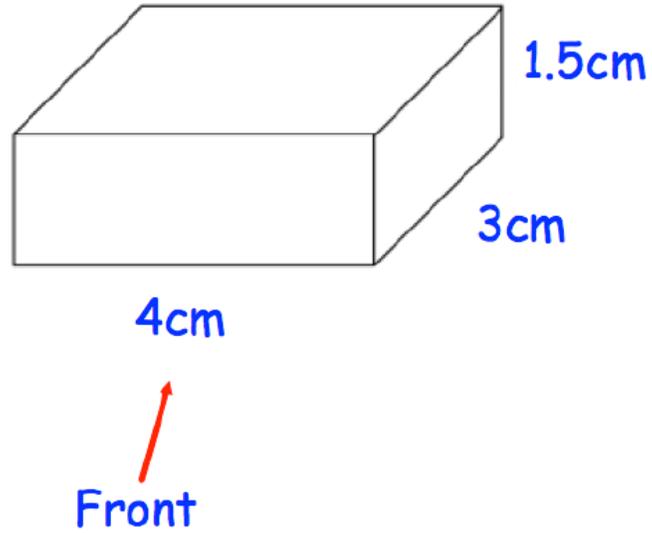
2D, 3D,  
construct,  
interpret, plan,  
side elevation,  
front elevation

Mastery  
Indicators

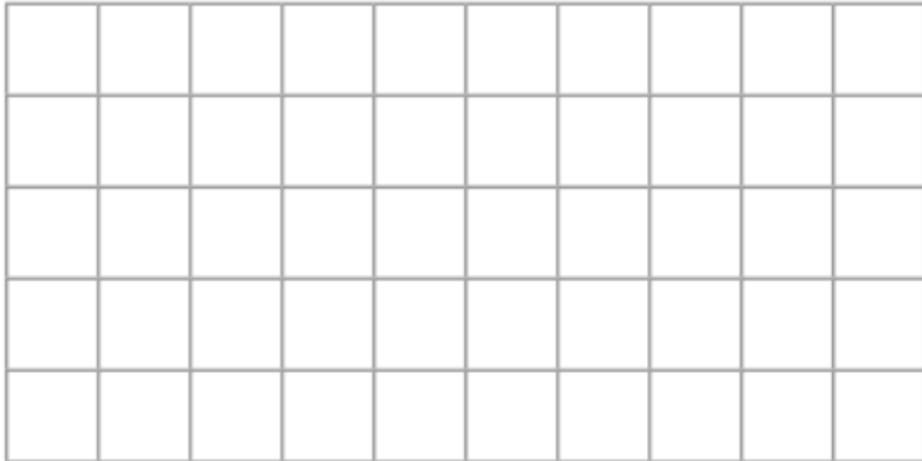
Pretest  
Progress check  
Topic test

## Pre-test 2D representations of 3D shapes

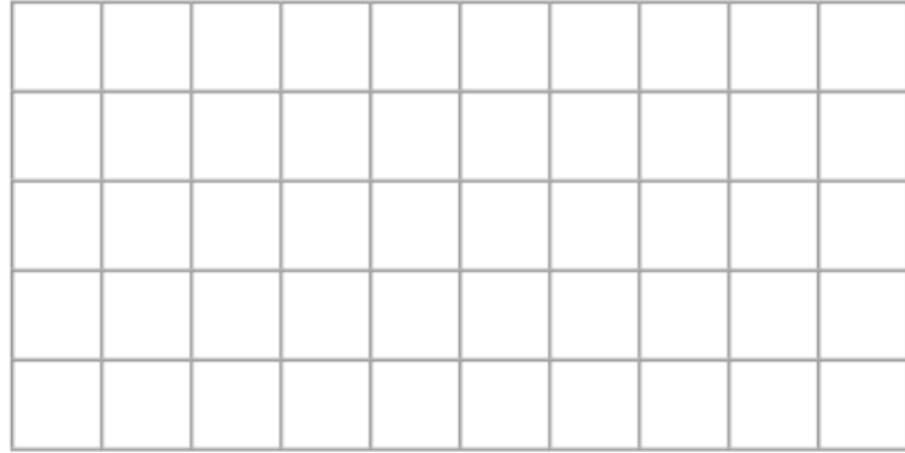
Shown below is a cuboid.



On the centimetre square grid, draw the front elevation.



On the centimetre square grid, draw the plan view.



The front elevation of a solid shape is a triangle.  
The side elevation of the solid shape is a triangle.  
The plan view of the solid shape is a circle.

Write down the name of the shape.