Numeracy across the curriculum

What is mathematics?
Mathematics is all around us. It is beautiful and relevant.
The consistency and intrinsic truth of mathematics reflect the nature of God.
Mathematics teaches a depth and rigour of thinking and communicating that is not found in any other discipline, and is essential for all aspects of life.
Through mathematics we learn to appreciate structure and pattern, to connect the unconnected and to solve and explain challenging problems.

What is numeracy?
A 'number sense' giving the ability to cope with the mathematical demands of further education, employment and adult life, which includes:

- The ability to carry out basic calculations efficiently and accurately, either mentally or with pencil and paper as appropriate.
- The ability to apply knowledge of number to both familiar and new circumstances and to use it in the solution of problems, including those involving percentages, ratio and proportion.
- The ability to understand and use units of measurement of length, mass, capacity and time.
- The ability to understand and use information presented in graphs, tables and charts.

Aims of the policy

- Maintain high standards of numeracy across the school
- Make use of opportunities to include numeracy in the teaching of all subjects
- Help students to retain and transfer knowledge between subjects

WAVES tool for staff planning:

Q: Find 28% of £355
A: 355 × 0.28 = 99.4 = **£99.40**
↖
Write this down even if you typed it into a calculator!

Working out

Working out for calculations should **always** be shown.

Approach

Many subject areas share common mathematical methods.
Common approaches at All Saints are described in the attachment.

Vocabulary

Mathematical vocabulary is precise and rigorously defined. It should be used carefully to avoid misinterpretation and confusion with the same or similar words used elsewhere.

Estimation

Errors are commonly made when students fail to check the 'reasonableness' of their answer in the context of the question. For example, calculating 170m for the height of an adult and writing it down with no consideration that they have used the wrong unit.

Scientific calculator

This is a requirement for both tiers of GCSE mathematics and students are expected to have their own calculator in school. They can be bought from school.

Vocabulary and language

	Mathematics interpretation	**Other interpretation**
Evaluate	Work out the numerical value	Consider evidence for and against
Compare	Use <, = or > to compare two values	Describe similarities and differences
Simplify	Collect terms or cancel down	Explain using less complex language
Translate	Move a shape laterally with no rotation or reflection	Write in a different language
Show that…	Use mathematical arguments and working out to prove the validity of a mathematical statement	

Similar	Two or more shapes with the same angles and sides in proportion	Having some properties in common
Product	The result of a multiplication	An item

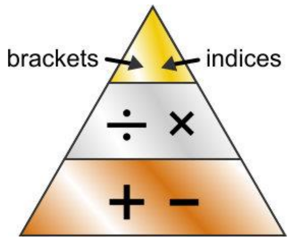
Correct use of the 'equals' symbol

It is ***incorrect*** to write 3 + 2 = 5 × 10 = 50

'=' means '**is equal to**' and 3 + 2 is definitely not equal to 5 × 10

Instead, write as one full calculation: (3 + 2) × 10 = 50

Order of operations



3 + 2 × 10 = 50 is ***incorrect***.

3 + 2 × 10 = 23 is ***correct***.

Multiplication (and division) take precedence over addition (and subtraction).

Brackets must be used to prioritise calculations if necessary.

Language

The digit **0** is read 'zero' not 'oh'.

'**705**' is 'seven hundred and five' not 'seven oh five'

Averages

The (arithmetic) **mean** of a discrete set of values is equal to the sum of the values divided by the count of the values. In maths, we also use **median** and **mode** as different types of 'average' or 'measures of central tendency'.

Using a scientific calculator

Knowledge of the 'S↔D' button to convert between Rational/Exact/Surd and Decimal forms.

Standard form

Use of calculator in standard form calculations: preferable to ignore the 'x10^n' button and just type in the expressions using the usual power button.

Note that answers will not necessarily be given in standard form (by which we mean $A\times10^n$ where $1\le A<10$) but can be converted to powers which are multiples of 3 by using the 'ENG' button.

Proportion and Ratio

[Science, Geography, DT, Art]

Proportion is a theme intrinsically present in all kinds of everyday numerical relationships.

A **proportion table** shows the relationship between variables clearly, and allows for a **unitary method** to be used.

E.g. Using the conversion 5 miles = 8km, work out 6.4 miles in km.

	miles	km.	
	5	8	
÷5			÷5
	1 →	1.6	
×6.4			×6.4
	6.4	<u>10.24</u>	

→

The **rate multiplier (conversion rate** or **constant of proportionality**) can be seen here to be 1.6

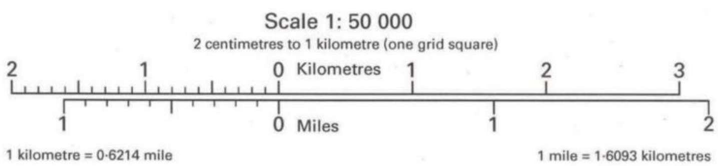
A **double number line (DNL)** can be constructed to help visualise the proportional relationship

miles	km.
0	0
5	8
10	16
15	24
20	32
25	40
30	48

E.g. A map has a scale of 1:25000

On the map the distance between two points is 3.7cm. What is the real life distance in km?

	map	actual.	
	1cm	25000cm	
×3.7			×3.7
	3.7cm	92500cm	
			convert units (÷100)
		925m	
			convert units (÷1000)
		<u>0.925km</u>	



This map scale is a horizontal DNL for miles and km

This method would work in exactly the same way starting with a ratio of 1cm : 4km instead of 1:25000

E.g. My average speed is 48mph.

Work out the distance I could travel in three hours and 25 minutes.

Note: 48mph means 48 miles travelled in 60 minutes

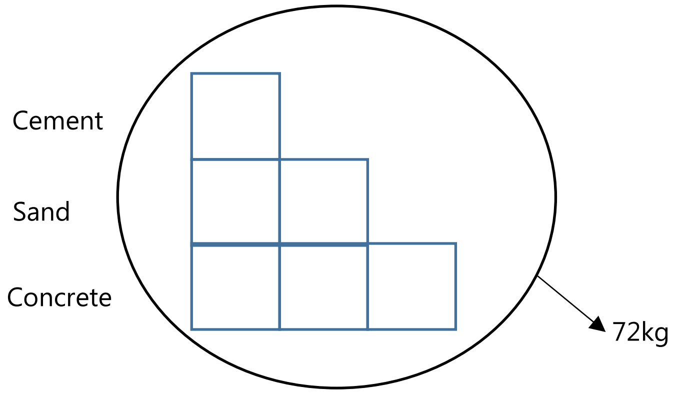
Note: three hours and 25 minutes is 3×60+25 = 205 minutes

	distance	time.	
	48	60	
÷60			÷60
	0.8	1	
×205			×205
	<u>164</u>	205	

This method works for any compound measure (e.g. density: mass and volume are proportional). Formulas can also be used (and formula triangles as an *aide memoir)*, however the proportional method is versatile when considering more complex numbers and units.

When performing calculations with ratios, a bar-model method is used to illustrate the ratio – this often makes the ratio much easier to understand.

E.g. The ratio of concrete is 1 part cement to 2 parts sand and 3 parts gravel.
How much of each element will be needed for 72kg of concrete?

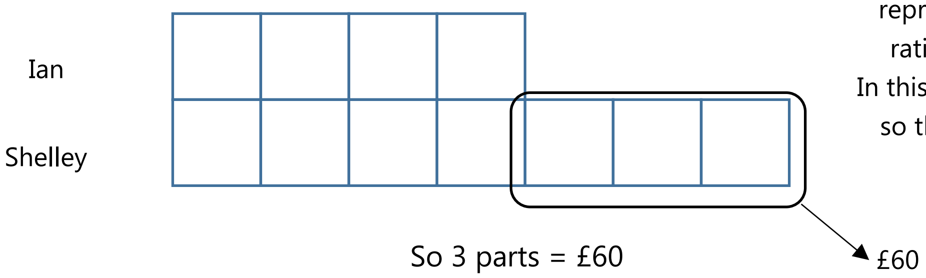


Each row of the bar model represents one element of the ratio.
Each box represents 1 part of the ratio.
In this case we want 72kg of concrete so the whole diagram represents 72kg.

So 72kg needs to be shared equally amongst 6 parts (6 boxes)
1 part = 72 ÷ 6 = 12kg.
So each box represents 12kg.
Cement = 1 box = 12kg
Sand = 2 boxes = 2 x 12 = 24kg
Concrete = 3 boxes = 3 x 12 = 36kg.

E.g. Ian and Shelley share money in the ratio 4 : 7. Shelley gets £60 more than Ian.
How much do they each get?

This time the quantity isn't representative of the whole ratio…



Again, each row of the bar model represents one element of the ratio and each box one part.
In this case Shelley gets £60 more so the extra boxes Shelley has equate to £60

So 3 parts = £60
1 part = £20
Ian = 4 parts = 4 x £20 = £80
Shelley = 7 parts = 7 x £20 = £140

Percentages

[Science, Geography, Business Studies]

We use **decimal multipliers** to calculate with percentages.

25% = 0.25 (note that finding 25% is equivalent to reducing by 75%)

108% = 1.08 (which is equivalent to increasing by 8%)

$$108\% = \frac{108}{100} = 1.08$$

Calculating a percentage of an amount [Y7]

Find 20% of $5600

0.2 × 5600

Find 8% of 35

0.08 × 35

Increasing or decreasing by a percentage [Y9]

Decrease £350 by 10%

350 × 0.9

Increase £15900 by 2.5%

15900 × 1.025

Finding the percentage change [Y9]

Bob's salary increases from £24900 to £25690.

Find the percentage increase.

$$24900 \xrightarrow{\text{multiplied by } k} 25690$$

$$24900 \times k = 25690$$

$$k = \frac{25690}{24900} = 1.03172\ldots$$

which is 103.172...%

equivalent to an increase of <u>3.2%</u>

(rounded to 1d.p.)

You can use the formula on the right to calculate percentage change. This is probably easier in itself, but does not promote the links to other percentage calculations that we need students to develop.

$$\frac{difference}{original} \times 100$$

Link to proportion

An alternative approach to the question above

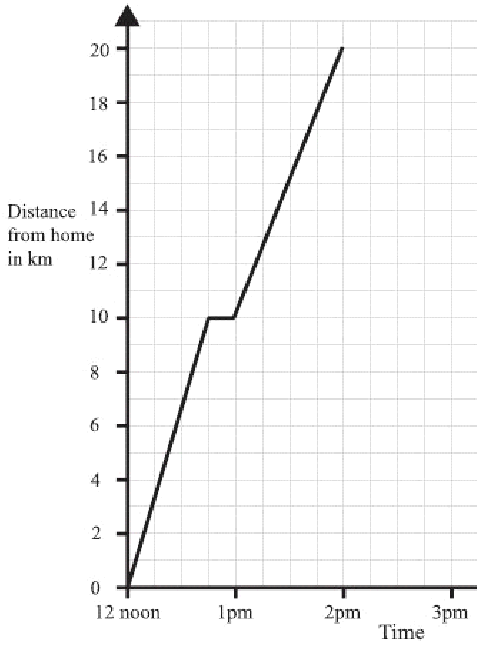
	%	amount.	
÷24900	100	24900	÷24900
		1	
×25690	<u>103.172...</u>	25690	×25690

Graphs and charts

[Science, Geography, Business Studies]

Graphs showing algebraic or proportional relationships [Y10]

These types of graph are fundamentally different from those used to display data and those with an element of randomness. These are vitally important in mathematics. See later section.

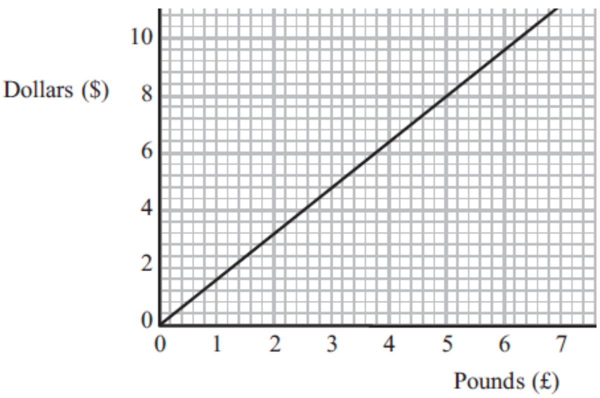


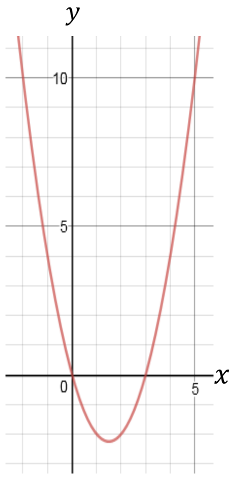
Examples:

Plot the graph of $y = x^2 - 3x$

Conversion graphs (e.g. £/$)

Distance-time graphs

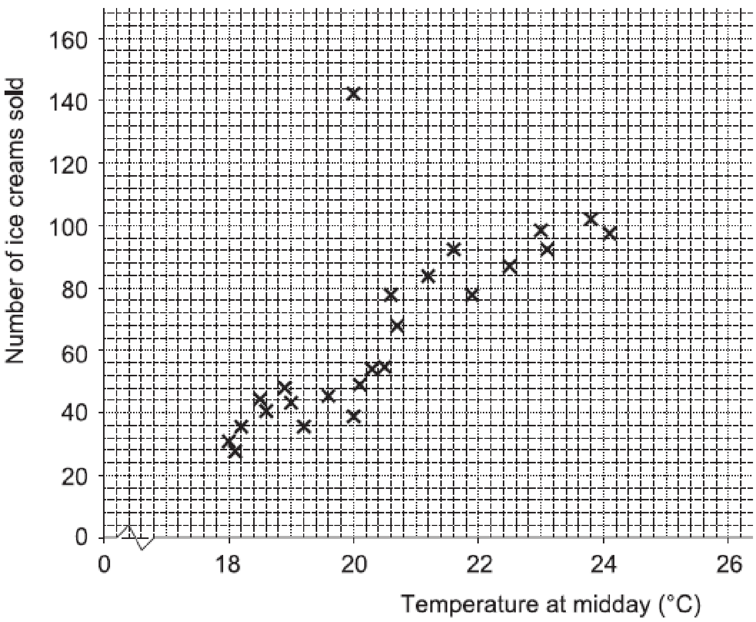




Scatter graphs [Y9]

We would expect students to describe the **correlation** and use a line of best fit drawn by eye to **interpolate or extrapolate**.

There can be a link from a scatter graph to an algebraic graph through the line of best fit. In science, experimental data would usually be expected to fit a rule, with experimental errors meaning it is not a perfect fit.

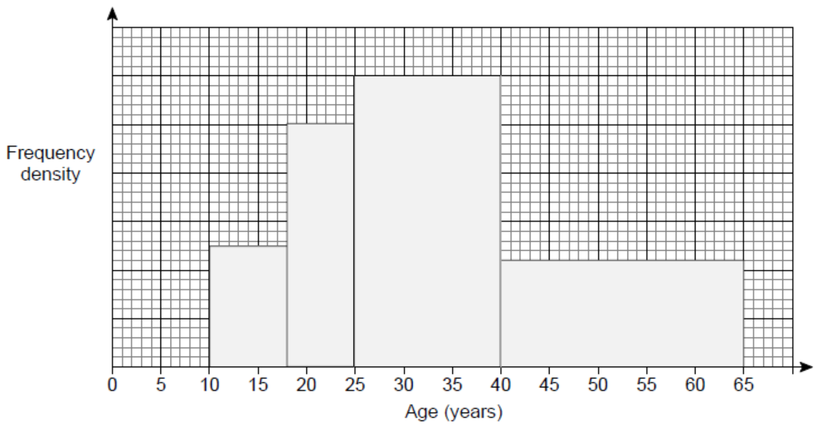


Histograms [Y11] (higher tier)

Frequency is proportional to **area**.

Hence y-axis is **frequency density**.

Bars can have unequal width.



Linear Graphs (y=mx+c)

[Science]

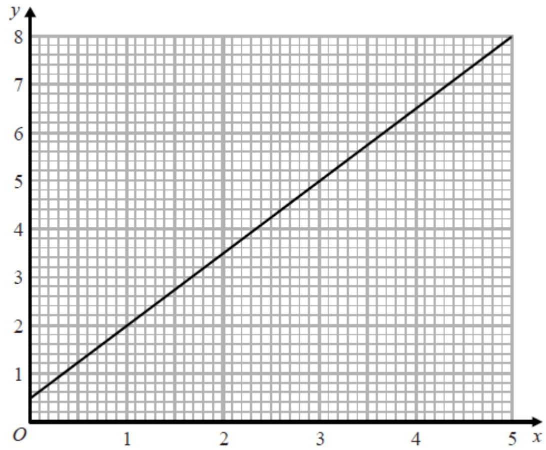
Gradient (slope) = $\frac{dy}{dx} = \frac{\Delta y}{\Delta x} = \frac{change\ in\ y}{change\ in\ x} = \frac{y_2 - y_1}{x_2 - x_1}$

Definition: rate of change of y (with respect to x).

In a proportional graph (of the form y=mx) the gradient is the rate multiplier between two variables

E.g. in the £ and $ graph on the previous page, the gradient $\frac{\Delta y}{\Delta x}$ is the number of $ per £1.

Maths GCSE problem:



Phone calls cost £y for x minutes.

The graph gives the values of y for values of x from 0 to 5

(a) (i) Give an interpretation of the intercept of the graph on the y-axis.

(ii) Give an interpretation of the gradient of the graph.

(b) Find the equation of the straight line in the form $y = mx + c$

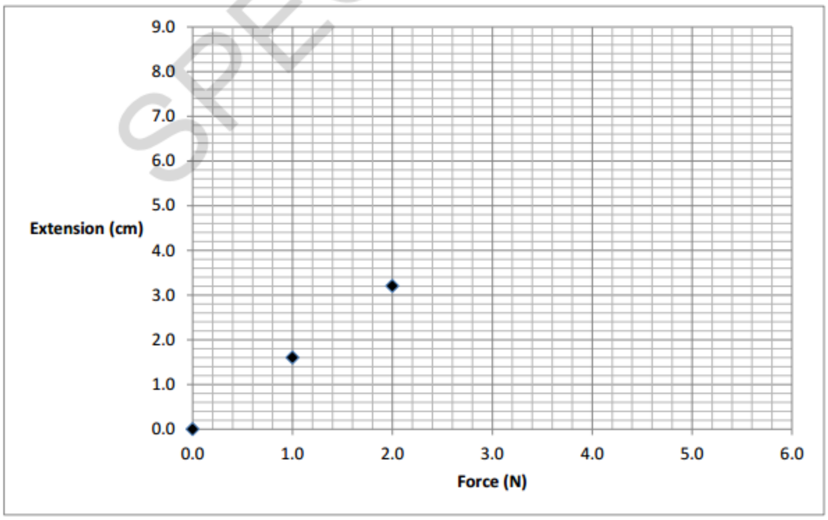
Science GCSE problem:

(b) They collect the following results.

Force (N)	Extension (cm)
0.0	0.0
1.0	1.6
2.0	3.2
3.0	6.0
4.0	6.4
5.0	8.0

Circle the outlier in the results for extension. **[1]**

(c) They start to plot a graph of their results.

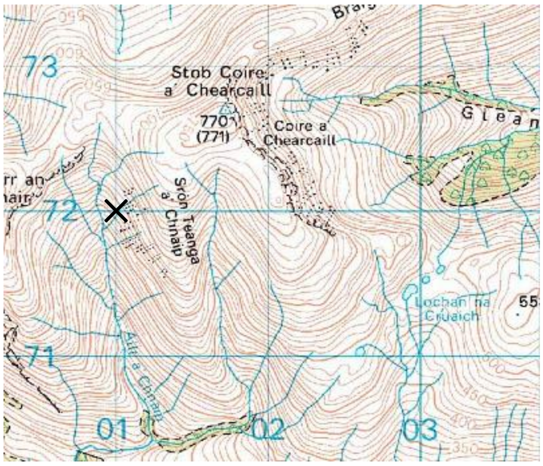


Plot the remaining points, **ignoring the outlier**, and draw a line of best fit. **[3]**

(d) Using the data, calculate the spring constant of the spring when the force is 4.0 N.

Force exerted = extension x spring constant

Coordinates and grid references



[Geography]
Grid reference 0172 refers to ***the whole grid square*** with the x at the bottom left.
E.g. the trig point has (4-figure) grid ref 0172.
(Eastings, Northings)

In mathematics the coordinate written (1, 72) refers only to ***the individual point*** marked x.
(x-coordinate, y-coordinate)

The coordinate of the trig point is approx. (1.7, 72.7)
The six figure grid reference is approx 017727

Using formulas

[Science]
From infant school, students learn about related calculations:
Given that 10 × 3 = 30, we know that 30 ÷ 10 = 3 and 30 ÷ 3 = 10

This *should* mean that manipulating D=MV is easy!
Science often remember formulas through a story. They use **a large number** of formulas – see formula sheet in appendix. Using the proportional approach is not always practical or intuitive.

Manipulate formulas and equations using a 'balance' method: do the same on both sides.

$$v = f\lambda$$

$\div f$ $\qquad$ $\div f$ $\qquad$ (show working out)

$$\frac{v}{f} = \lambda$$

Pie charts

[Geography, Business Studies]

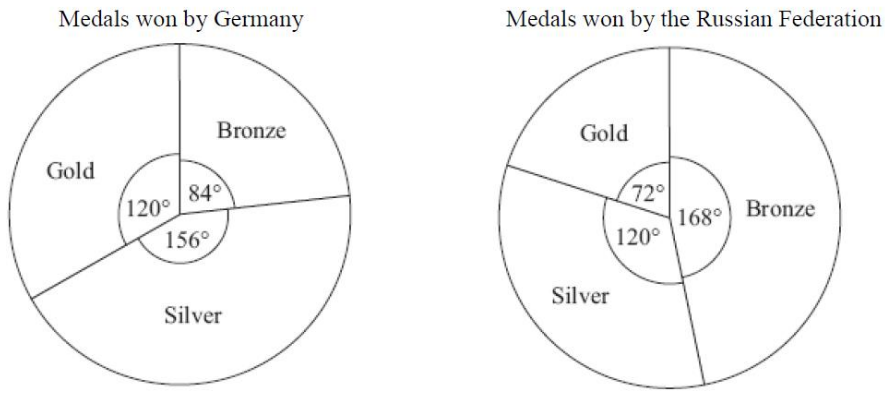
Constructing a pie chart [Y9] Use a proportion table and the unitary method, as shown in the proportion section, to calculate the correct angles needed.

	Frequency		Angle
Red	**15**		
Green	**18**		
Blue	**11**		
Total	44	1	360

÷44 ×360

Apply the same calculations (÷44, ×360) to each of the frequencies.
This proportion table is 'horizontal' rather than 'vertical' as in the previous examples.
It could be rotated to match up.

Interpreting a pie chart The pie charts show some information about the numbers of medals won by Germany and by the Russian Federation in the 2010 Winter Olympics.



The information above **does not** show that Germany won more gold medals than the Russian Federation. It only shows that the **proportion** of gold medals won by Germany was greater.

Proportion of gold medals won by Germany is $\frac{120}{360}$ = 33.33% of their medal total.
Proportion of gold medals won by Russian Federation is $\frac{72}{360}$ = 20% of their medal total.

Written arithmetic (non-calculator methods)

Each approach has a standard algorithm (method) but also has models that support the understanding of the concept.

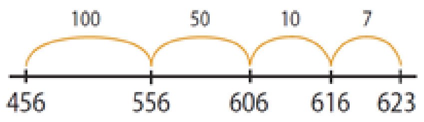
For **addition, subtraction and multiplication** the standard algorithm is the **column method**.
When modelling, for consistency, put the carries on the 'doorstep' as indicated in the examples.
Work from right to left.
For **division** the standard algorithm is **long division** with a 'bus stop'.

In primary school, students' understanding of all four operations is carefully built up from Early Years onwards, with the use of place value manipulatives and visual models to help.

7.1 Working with integers

Addition: number line model

456 + 167



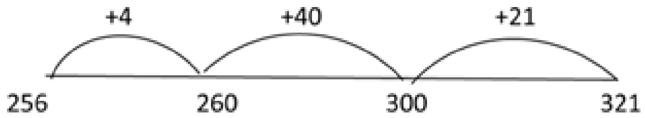
Addition and subtraction: column method

```
  456,789
+ 167,189
---------
  623,978
```

```
   11    16
 5 ⁄7 1⁄3 8 ⁄6 18
  623,978
- 456,789
---------
  167,189
```

Subtraction: counting on number line model

321 – 256



Add the 'hops': 40 + 21 + 4 = 65

Subtraction: expanded column method

942—214

Expanded method

```
       30  12
  900  40  2
- 200  10  4
-------------
  700  20  8
```

Compact Method

```
   3 12
   942
-  214
------
   728
```

Multiplication: area model

94 × 36

	90	4
30	2700	120
6	540	24

```
  24
 540
 120
2700
----
3384
```

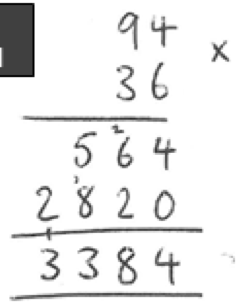
add the areas: 3384

Multiplication: expanded method

```
   94
 × 36
-----
   24    6 × 4
  540    6 × 9 tens
  120    3 tens × 4
 2700    3 tens × 9 tens
-----
 3384
```

thinking:

Multiplication: standard method



Division

360 ÷ 8

```
    0 4 5
8 | 3 ³6 ⁴0
```

Division: with partial products

966 ÷ 7

```
     138
 7 ) 966
   -  7
   ----
      26
   -  21
   ----
       56
   -   56
   ----
        0
```

Base ten place value

Billions			Millions			Thousands			Ones		
Hundred billions	Ten billions	billions	Hundred millions	Ten millions	millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones

Important vocabulary

Integer	A whole number
Factor	Divides **into** an integer. The factors of 8 are 1, 2, 4 and 8
Multiples	The 'times table' of a number. The multiples of 8 are 8, 16, 24, 32…
Square number	The product of a number with itself. The square of 6 is 36.
Prime number	Has **exactly** two factors. 17 is prime (its factors are 1 and 17)

Divisibility tests

Divisor	Test
2	Even number (ends in 0,2,4,6,8)
3	Add the digits – multiple of 3?
5	Ends in 0 or 5
6	Is it divisible by both 2 and 3?
9	Add the digits – multiple of 9?
10	Ends in 0

7.2 Decimals and metric measurement

Decimal place value

$\frac{1}{10} = 0.1$ $\frac{1}{100} = 0.01$ $\frac{1}{1000} = 0.001$ $\frac{1}{10000} = 0.0001$

1000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$
		2	7	.	0	5	8	

$27.058 = (2 \times 10) + (7 \times 1) + \left(5 \times \frac{1}{100}\right) + \left(8 \times \frac{1}{1000}\right)$

Multiplication and division examples

$1.25 \times 1000 = 1250$
$1.25 \div 0.001 = 1250$

digits move left 3 columns

1000	100	10	1		0.1	0.01	0.001	0.0001
			1	.	2	5		
1	2	5	0	.				

We need to put the final zero in as a **placeholder** to keep the digits 1, 2, 5 in the correct columns.

$0.34 \div 100 = 0.0034$
$0.34 \times 0.01 = 0.0034$

digits move right 2 columns

1000	100	10	1		0.1	0.01	0.001	0.0001
			0	.	3	4		
			0	.	0	0	3	4

Irrational numbers have an infinitely many non-repeating digits after the decimal point. Two famous examples:
$\pi = 3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862 80...$
$\sqrt{2} = 1.4142135623730950488016887242096980785696718753769480731766797379907324784621070388 50...$

Multiplying and dividing by powers of ten (see the examples on the left)

$5.4 \times 100 = 540$			$5.4 \div 100 = 0.054$		
$\times 10$	$\times 10^1$	digits move left 1 column	$\div 10$	$\div 10^1$	digits move right 1 column
$\times 100$	$\times 10^2$	digits move left 2 columns	$\div 100$	$\div 10^2$	digits move right 2 columns
$\times 1000$	$\times 10^3$	digits move left 3 columns	$\div 1000$	$\div 10^3$	digits move right 3 columns

Dividing by 100 is the same as multiplying by 0.01
Why?
Hint: how many 0.01s fit into one unit?

Multiplication of any decimals (for example, finding percentages of quantities)

Find 27% of 12.8

0.27×12.8 (observe 3 decimal places in total)

Ignore decimal points: $27 \times 128 = 3456$ (use your normal method)

Put the decimal point back in: $0.27 \times 12.8 = \underline{\mathbf{3.456}}$ (observe 3 decimal places in the answer)

If possible, estimate to check your answer:
0.27 is about one-quarter. One-quarter of 12 is 3, so the answer is roughly 3.

Metric units

Mass 1 tonne = 1000kg 1kg = 1000g

Capacity 1 litre = 1000 millilitres

Data (but ask about binary values)
1GB = 1000MB 1MB = 1000KB 1KB = 1000B

Length
1km = 1000m 1m = 100cm 1cm = 10mm

÷ 1000 ÷ 100 ÷ 10

0.0003km = 0.3m = 30cm = 300mm

× 1000 × 100 × 10

Division of any decimals

Work out
$1614.62 \div 3.8$

Use equivalent fractions to get an integer divisor

$\frac{1614.62}{3.8} = \frac{16146.2}{38}$ (× 10 top and bottom)

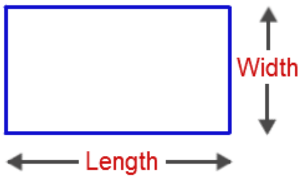
Then use a standard division method

```
      424.9
38 ) 16146.2
     152
      94
      76
      186
      152
       342
       342
         0
```

Appendix 1: mathematical equations (memorise)

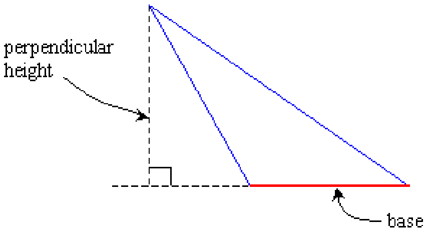
Area and Volume Formulae

Rectangle



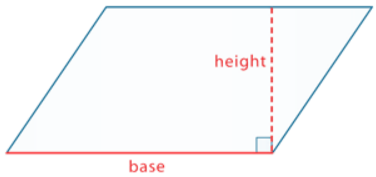
Area = Length x Width

Triangle



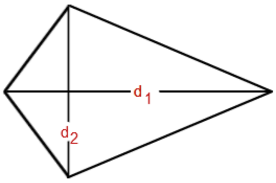
Area = ½ x Perp. Height x Base

Parallelogram



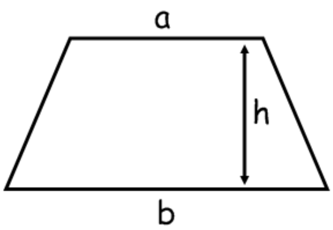
Area = base x height

Kite



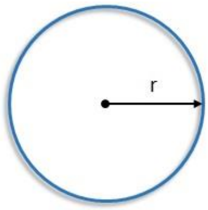
Area = ½ x d_1 x d_2

Trapezium



Area = ½ (a + b) h

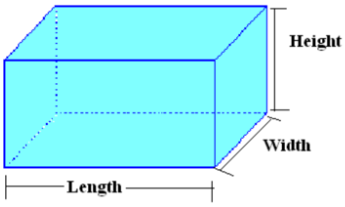
Circle



Area = πr^2

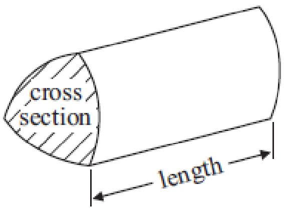
Circumference = $2 \pi r$

Cuboid



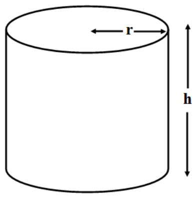
Volume = Length x width x Height

Prism



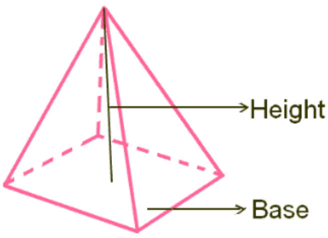
Volume = cross sectional area x length

Cylinder



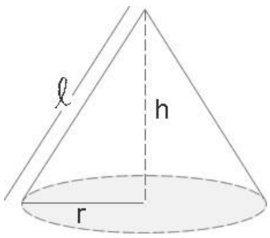
Volume = $\pi r^2 h$

Pyramid



Volume = $\frac{1}{3}$ x base area x height

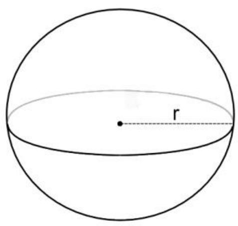
Cone



Volume = $\frac{1}{3}\pi r^2 h$

Curved surface area = $\pi r \ell$

Sphere



Volume = $\frac{4}{3}\pi r^3$

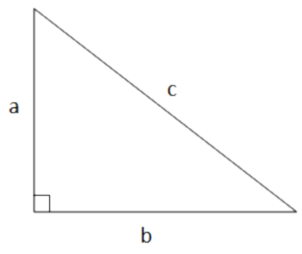
Surface Area = $4\pi r^2$

Algebraic Formulae

Solution to a quadratic equation of the form $ax^2 + bx + c = 0$ is

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometry and Pythagoras



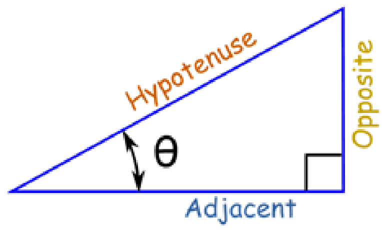
Pythagoras' Theorem

$a^2 + b^2 = c^2$

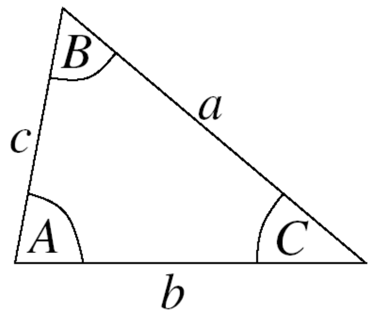
$\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$

$\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$

$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$



Sine and Cosine Rule



<u>Sine Rule</u>

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$$ or $$\frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$

(for finding sides) (for finding angles)

<u>Cosine Rule</u>

$$a^2 = b^2 + c^2 - 2bc\cos(A)$$ or $$\cos(A) = \frac{b^2 + c^2 - a^2}{2bc}$$

(for finding sides) (for finding angles)

Area of a triangle = ½ a b sin C (two lengths and the included angle)

Statistical Formulae

To find the mean of n pieces of data: $\bar{x} = \frac{\sum x}{n}$

To find the mean from a grouped frequency table where x is the mid-interval value of a group and f the frequency of the group $\bar{x} = \frac{\sum fx}{\sum f}$

Appendix 2a: physics equations (memorise)

Equation number	Word equation	Symbol equation
1	weight = mass × gravitational field strength (g)	$W = m\,g$
2	work done = force × distance (along the line of action of the force)	$W = F\,s$
3	force applied to a spring = spring constant × extension	$F = k\,e$
4	moment of a force = force × distance (normal to direction of force)	$M = F\,d$
5	pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$	$p = \frac{F}{A}$
6	distance travelled = speed × time	$s = v\,t$
7	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
8	resultant force = mass × acceleration	$F = m\,a$
9 HT	momentum = mass × velocity	$p = m\,v$
10	kinetic energy = 0.5 × mass × (speed)^2	$E_k = \frac{1}{2} m\,v^2$
11	gravitational potential energy = mass × gravitational field strength (g) × height	$E_p = m\,g\,h$
12	power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
13	power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
14	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
15	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
16	wave speed = frequency × wavelength	$v = f\,\lambda$
17	charge flow = current × time	$Q = I\,t$
18	potential difference = current × resistance	$V = I\,R$
19	power = potential difference × current	$P = V\,I$
20	power = (current)^2 × resistance	$P = I^2\,R$
21	energy transferred = power × time	$E = P\,t$
22	energy transferred = charge flow × potential difference	$E = Q\,V$
23	density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$

Appendix 1b: physics equations (given)

Equation number	Word equation	Symbol equation
1 HT	pressure due to a column of liquid = height of column × density of liquid × gravitational field strength (g)	$p = h \rho g$
2	(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2 a s$
3 HT	force = $\frac{\text{change in momentum}}{\text{time taken}}$	$F = \frac{m \Delta v}{\Delta t}$
4	elastic potential energy = 0.5 × spring constant × (extension)^2	$E_e = \frac{1}{2} k e^2$
5	change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m c \Delta \theta$
6	period = $\frac{1}{\text{frequency}}$	
7	magnification = $\frac{\text{image height}}{\text{object height}}$	
8 HT	force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length	$F = B I l$
9	thermal energy for a change of state = mass × specific latent heat	$E = m L$
10 HT	$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_p}{V_s} = \frac{n_p}{n_s}$
11 HT	potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_s I_s = V_p I_p$
12	For gases: pressure × volume = constant	$p V = constant$

Appendix 1c: biology equation (memorise)

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

Appendix 1d: chemistry equations (memorise)

$$\text{percentage atom economy} = \frac{\text{RFM of desired product}}{\text{Sum of RFMs of all reactants}} \times 100$$

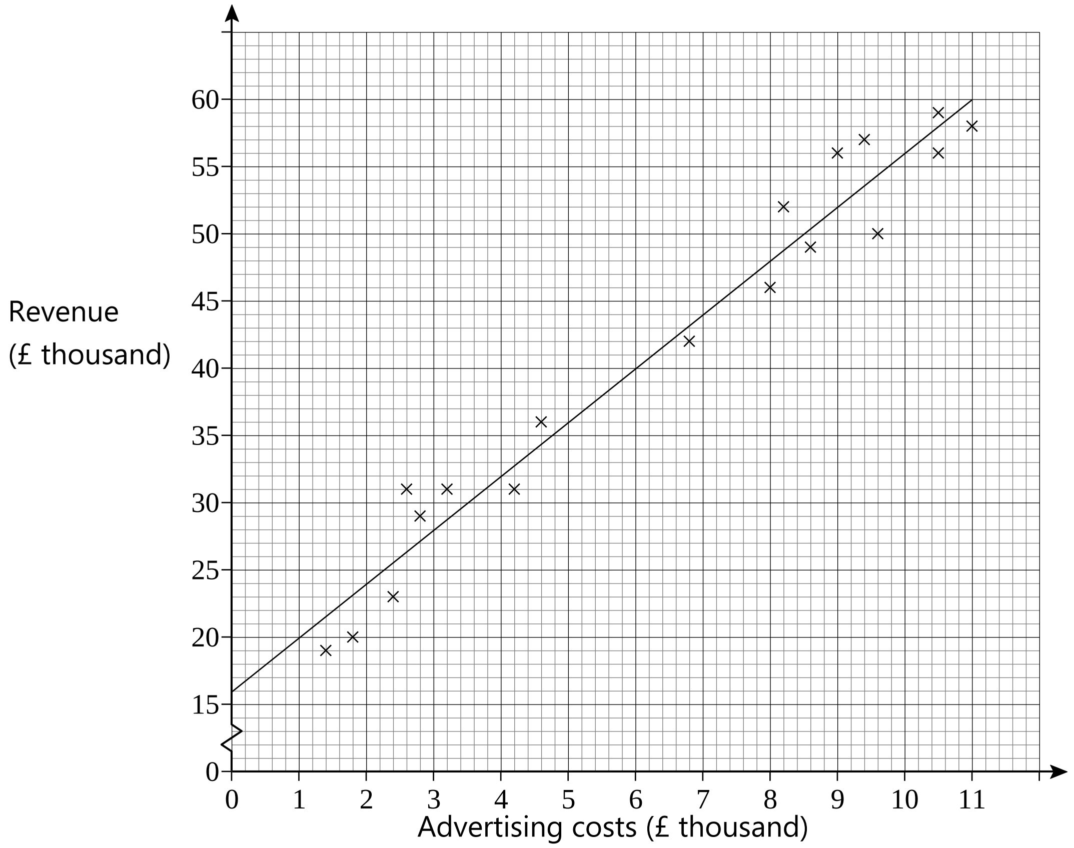
$$\text{concentration of acid} = \frac{\text{vol of alkali} \times \text{concentration of alkali} \times \text{RFM acid}}{\text{vol of acid} \times \text{RFM alkali}}$$

Possibly more for biology and chemistry?

Appendix 2: questions for comparison

SCATTER GRAPH: MATHS

The scatter diagram shows information about advertising costs and revenue for a company.



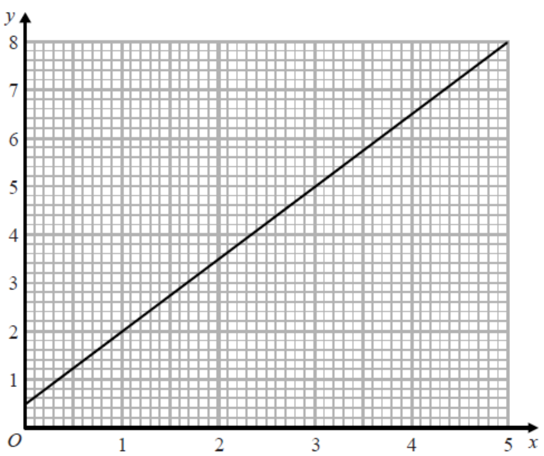
(a) Use the line of best fit to estimate the revenue for advertising costs of £600

(b) Use the line of best fit to estimate the revenue for advertising costs of £6200

(c) Which of these estimates is more reliable?

Give a reason for your answer.

y = mx + c: MATHS



Phone calls cost £y for x minutes.

The graph gives the values of y for values of x from 0 to 5

(a) (i) Give an interpretation of the intercept of the graph on the y-axis.

(ii) Give an interpretation of the gradient of the graph.

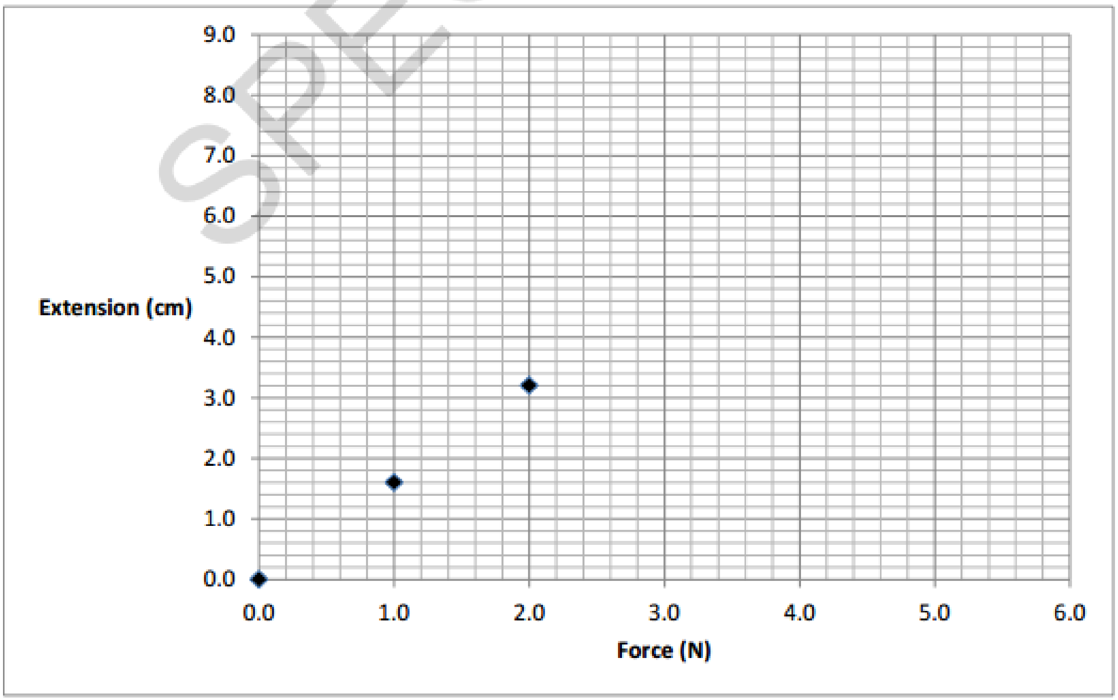
(b) Find the equation of the straight line in the form $y = mx + c$

(b) They collect the following results.

Force (N)	Extension (cm)
0.0	0.0
1.0	1.6
2.0	3.2
3.0	6.0
4.0	6.4
5.0	8.0

Circle the outlier in the results for extension. **[1]**

(c) They start to plot a graph of their results.



Plot the remaining points, **ignoring the outlier**, and draw a line of best fit. **[3]**

(d) Using the data, calculate the spring constant of the spring when the force is 4.0 N.

Force exerted = extension x spring constant

……………………………….N/m **[4]**