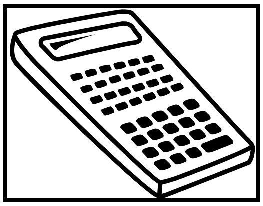

Numeracy

across the

curriculum

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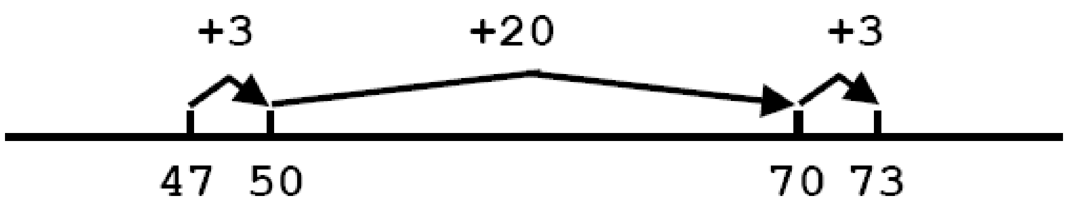
Addition and subtraction

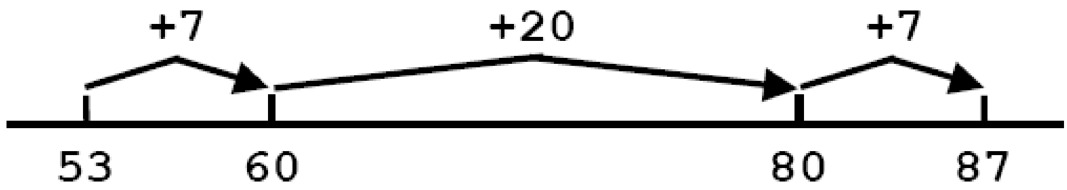
The number line

47 + 26 = 73



87 - 53 = 34

(Start at 53 and count up to 87)



Long multiplication

Method 1: Traditional method

146 × 24

$$
\begin{array}{r}
1\ 4\ 6 \\
\times\ 2\ 4 \\
\hline
5^{1}8^{2}4 \\
2\ 9^{1}2\ 0 \\
\hline
3^{1}5^{1}0\ 4 \\
\hline
\end{array}
$$

First multiply by the units

Put a zero, then multiply by the tens

Add the two tens together

Method 2: Partitioning method

- First partition into hundreds, tens and units.

146 = 100 + 40 + 6

24 = 20 + 4

- Construct a grid and multiply.

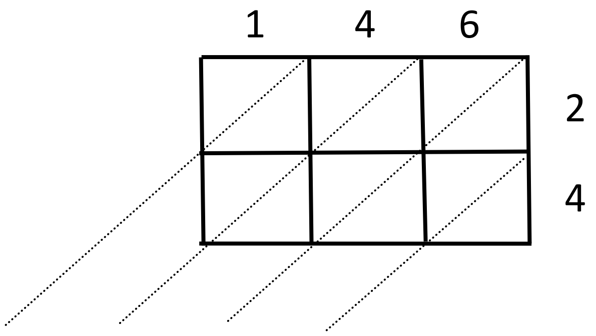
	100	40	6
20	2000	800	120
4	400	160	24

- Add the numbers in the grid.

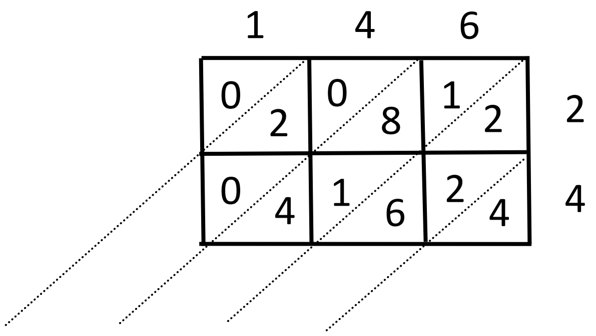
2000+800+120+400+160+24=3504

Method 3: Grid Method

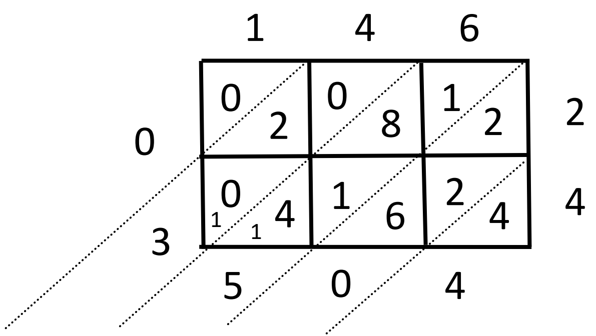
- Draw a grid with diagonal lines and put the hundreds, tens, units etc with one number running across the top and the other running down the side.



- Multiply the digits at the top and end of the square putting in 0's for single digit numbers



- Add down each diagonal, carrying to the next diagonal where necessary.



- Read off the digits from left to right.

Answer = 3504

Estimation

Estimation is finding a number that is **close enough** to the right answer.

- You are **not** trying to get the **exact** answer
- What you want is something that is **good enough** (usually in a hurry!)

- Round the numbers up or down *before* the calculation.
  Example: 206 x 390
  206 is nearly 200, and 390 is nearly 400, the answer will be close to 200 x 400 = 80 000
  Check the number of zeros in your calculation!
  After multiplying 2x4 to get 8, take the two zeros from 200 plus the two zeros from 400, to make four zeros after the 8 = 80 000

- You can even use decimal numbers:
  Example: what is 0.3126 x 53.81? Multiply 0.3 x 50 to get 15.

- When doing division, change the numbers to fit in with the multiplication tales
  Example: What is 176 divided by 3?
  Change 176 to 180 (because 3x6=18) and then do:
  180/3 = 60

- With decimals, percentages and fractions try to think what the number **means**. Think: Is it close to 1? Close to half? Close to zero?
  Example: 1.6 x 30
  1.6 is close to 1.5, which is **1 and a half**.
  So 1.6 x 30 is close to **30 plus half of 30**, which is 30 + 15 = 45.

Fractions, decimals and percentages

This table shows the really common conversions which students should know without having to work them out.

Fraction	Decimal	Percentage
$\frac{1}{2}$	0·5	50%
$\frac{1}{4}$	0·25	25%
$\frac{3}{4}$	0·75	75%
$\frac{1}{3}$	0·333333	$33\frac{1}{3}$%
$\frac{2}{3}$	0·666666	$66\frac{2}{3}$%
$\frac{1}{10}$	0·1	10%
$\frac{2}{10}$	0·2	20%
$\frac{7}{10}$	0·7	70%
$\frac{1}{5}$	0·2	20%
$\frac{2}{5}$	0·4	40%

Calculating percentages

Percentages of quantities

Students should be encouraged to find simple percentages without the use of calculators.

50% = ½, so find half of the number.

25% = ¼, so find a quarter of the number.

10% can be found by dividing by ten.

1% can be found by dividing by 100.

Examples

1. Find 20% of £2.80

X2 10% = 28p X2
20% = 56p

2. Find 15% of £25

÷2 10% = £2.50 ÷2
5% = £1.25

10% + 5% = 15% = £3.75

Writing one number as a percentage of another

To express one thing as a percentage of another,

Use **FDP** method

Fraction → Make a fraction using the two numbers — they must be in the same units.

Decimal → Divide the numbers to give a decimal.

Percentage → Multiply by 100 to get a percentage.

Example

Express 35p as a percentage of £2.80

→ 2·80 = 280p.

$\frac{35}{280} \xrightarrow{35 \div 280} 0{\cdot}125 \xrightarrow{0{\cdot}125 \times 100} 12{\cdot}5\%$

Percentage Change

Subtract the old from the new, then divide by the old value. Show that as a Percentage.

The Formula

You can also put the values into this formula:

$$\frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \times 100\%$$

Method 1

Step 1: Calculate the change (subtract old value from the new value)

Step 2: Divide that change by the old value (you will get a decimal number)

Step 3: Convert that to a percentage (by multiplying by 100 and adding a "%" sign)

Note: when the new value is greater than the old value, it is a percentage increase, otherwise it is a decrease.

Method 2

Step 1: Divide the New Value by the Old Value (you will get a decimal number)

Step 2: Convert that to a percentage (by multiplying by 100 and adding a "%" sign)

Step 3: Subtract 100% from that

Note: when the result is positive it is a percentage increase, if negative, just remove the minus sign and call it a decrease.

Example: There were 160 smarties in the box yesterday, but now there are 116, what is the percentage change?

Answer (Method 1): 160 to 116 is a decrease of 44. Compared to yesterday's value: 44/160 = 0.275 = **27.5% decrease**.

Answer (Method 2): Compare today's value with yesterday's value: 116/160 = 0.725 = 72.5%, so the new value is 72.5% of the old value.

Subtract 100% and you get −27.5%, or a **27.5% decrease.**

Ratios

A ratio is a way to compare amounts of something. Recipes, for example, are sometimes given as ratios. To make pastry you may need to mix 2 parts flour to 1 part fat. This means the ratio of flour to fat is 2:1.

If pastry is 2 parts flour to 1 part fat, then there are 3 parts (2 + 1) altogether. Two thirds of the pastry is flour; one third fat.

Ratios are similar to fractions; they can both be simplified by finding common factors. Always try to divide by the highest common factor.

Examples

Using ratios

There are 15 girls and 12 boys in a class. What is the ratio of girls to boys? Give your answer in its simplest form.

The ratio of girls to boys is 15:12

However, both sides of this ratio can be divided by 3

Dividing both numbers by 3 gives 5:4

5 and 4 have no common factors (apart from 1).

So the **simplest form** of the ratio is 5:4

This means there are 5 girls in the class for every 4 boys.

Ratios can be used to solve many different problems - for example, with recipes, scale drawings or map work.

Sam does a scale drawing of his kitchen. He uses a scale of 1:100.

He measures the length of the kitchen as 5.9m.

How long is the kitchen on the scale drawing? Give your answer in mm.

The answer is **59mm**.

Remember that the scale of 1:100 means that the real kitchen is 100 times bigger than the scale drawing.

The actual kitchen measures 5.9m = 590cm (multiply by 100) = 5900mm (multiply by 10)

So the scale drawing would be 5900 ÷ 100 = 59mm.

Another typical question will give you a recipe to modify for a different number of people.

A recipe to make lasagne for 6 people uses 300 grams of minced beef. How much minced beef would be needed to serve 8 people?

Find out how much 1 person would need first.

- Six people need 300g.
- So 1 person needs 50g (300 ÷ 6).
- So 8 people need 50g × 8 = **400g**.

Converting from one metric unit to another

The most common metric conversions are between mm, cm, m and km but the same method works for the g and the l.

	$\div 10$		$\div 100$		$\div 1000$	
mm	→	cm	→	m	→	km
mg		cg		g		kg
ml		cl		l		kl

To go in the inverse direction, do the inverse operation (multiply!)

kilo means **1000**, so 1 km = 1000 m

cent is **French** for **100, mille** is **French** for **1000**

Converting units of mass and capacity

1 km = 1000 m, so 1 kg = 1000 g

1 m = 100 cm, so 1 l (litre) = 100 cl (centilitres)

1 m = 1000 mm, so 1 g = 1000 mg (milligrams)

A packet of biscuits weighs 150 g. Find the weight of 12 packets of biscuits:
1: in g
2: in kg

1. $12 \times 150 = 1800$, so 12 packets of biscuits weigh 1800g.
2. To convert from g to kg, we divide by 1000.
   So 1800g divided by 1000 = 1.8**kg**.

Converting between metric and imperial units

Here are some examples of metric and imperial measures of length, mass and capacity:

	Metric	**Imperial**
Length	mm, cm, m, km	inch, foot, yard, mile
Mass	mg, g, kg	ounce (oz), pound (lb), stone
Capacity	ml, cl, l	pint, gallon

You will be expected to know some common conversions between metric and imperial units. Some of these are shown below, but check with your teacher which ones you need to learn.

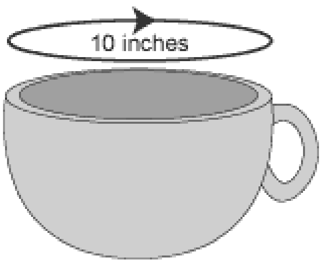
- 1 km = $^5/_8$ mile
- 1 m = 39.37 inches
- 1 foot = 30.5 cm
- 1 inch = 2.54 cm
- 1 kg = 2.2 lb
- 1 gallon = 4.5 litres
- 1 litre = 1 $^3/_4$ pints

A cup has a circumference of 10 inches. What is it in cm?

We know that **1 inch = 2.54 cm**.

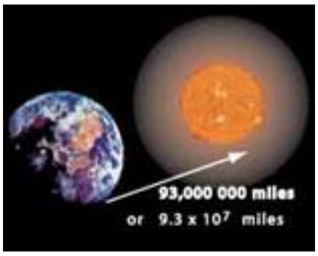
We are converting from inches to cm, so we **multiply** by 2.54

10 × 2.54 = **25.4 cm**.



Standard (index) form

Standard index form is also known as standard form. It is very useful when writing very big or very small numbers.



In standard form, a number is always written as: **$A \times 10^n$**

A is always between 1 and 10. **n** tells us how many places to move the decimal point.

Write 15 000 000 in standard index form.

15 000 000 = 1.5 × 10 000 000

This can be rewritten as:

1.5 × 10 × 10 × 10 × 10 × 10 × 10 × 10

= 1.5×10^7

You can convert from standard form to ordinary numbers, and back again.

1) $3 \times 10^4 = 3 \times 10\,000 = 30\,000$ (Since $10^4 = 10 \times 10 \times 10 \times 10 = 10\,000$)

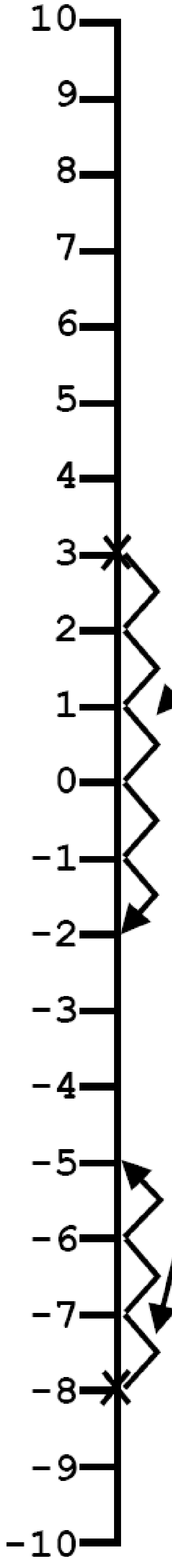
2) $850\,000 = 2.85 \times 1\,000\,000 = 2.85 \times 10^6$

Remember the single non-zero digit before the decimal point.

3) $0.000467 = 4.67 \times 0.0001 = 4.67 \times 10^{-4}$

Negative numbers

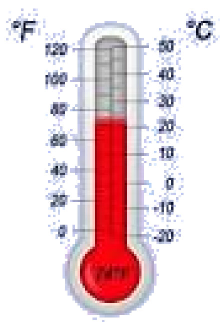
- Numbers bigger than zero are **positive numbers**.
- Numbers smaller than zero are **negative numbers**.



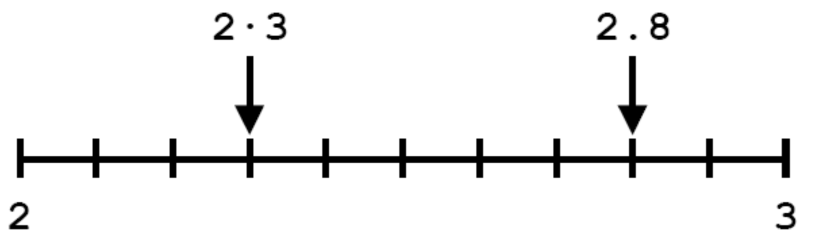
The best way to deal with negative numbers is to relate the topic to a temperature scale. Adding moves you up the scale. Subtracting moves you down the scale.

3 – 5 = -2
(see diagram)
(Start at 3 and go down 5)

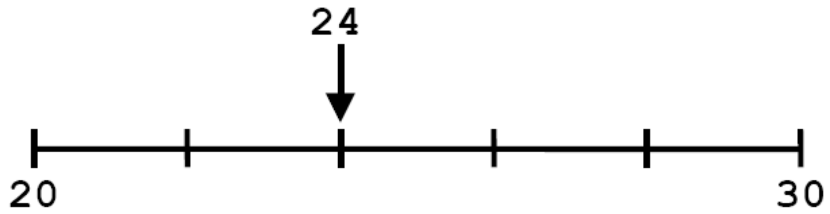
-8 + 3 = -5
(Start at -8 and go up 3)



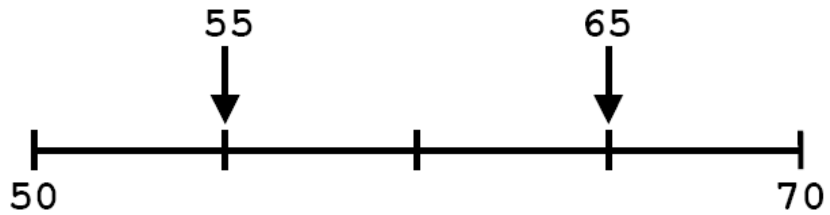
Reading scales



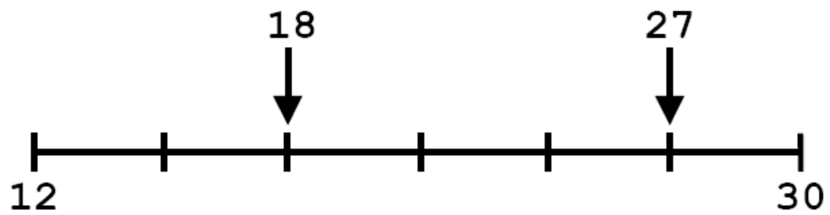
The gap is split into 10 equal bits. So each line is: 1 ÷ 10 = 0.1



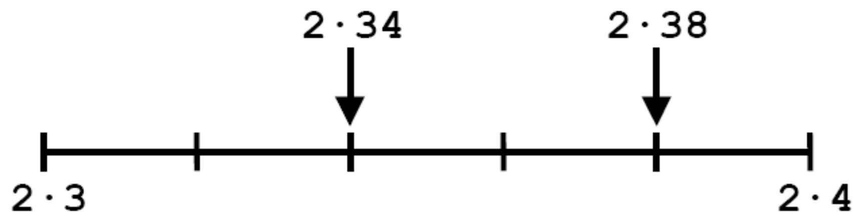
The gap is split into 5 equal bits. So each line is: 10 ÷ 5 = 2



The gap is split into 4 equal parts. So each line is: 20 ÷ 4 = 5



The gap is split into 6 equal parts. So each line is: 18 ÷ 6 = 3

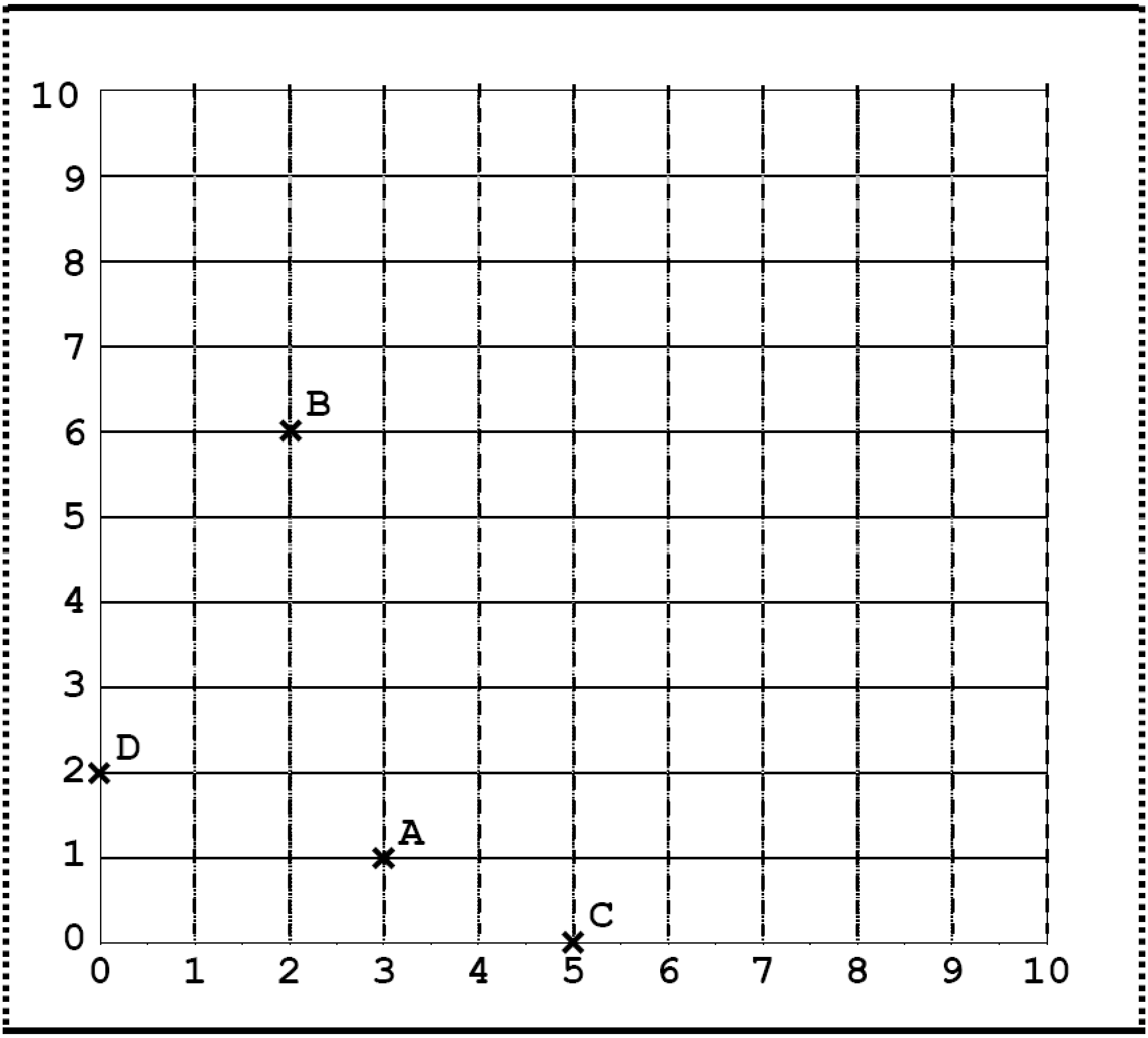


The gap is split into 5 equal bits. So each line is: 0·1 ÷ 5 = 0·02

Coordinates

- Coordinates are always given in the form (x,y).
- When plotting coordinates, always go along, then up/down.
- You mark the position of a coordinate with a cross (×).

Example



The following coordinates are all plotted on the grid above.

A(3,1)   B(2,6)   C(5,0)   D(0,2)

Remember "along the corridor, up the stairs"

Graphs and diagrams

The following rules apply every time a graph is drawn.

- Always draw in pencil.
- Always draw straight lines with a ruler.
- Label both the axes.
- Give the graph/chart a title.
- If appropriate, include a key.

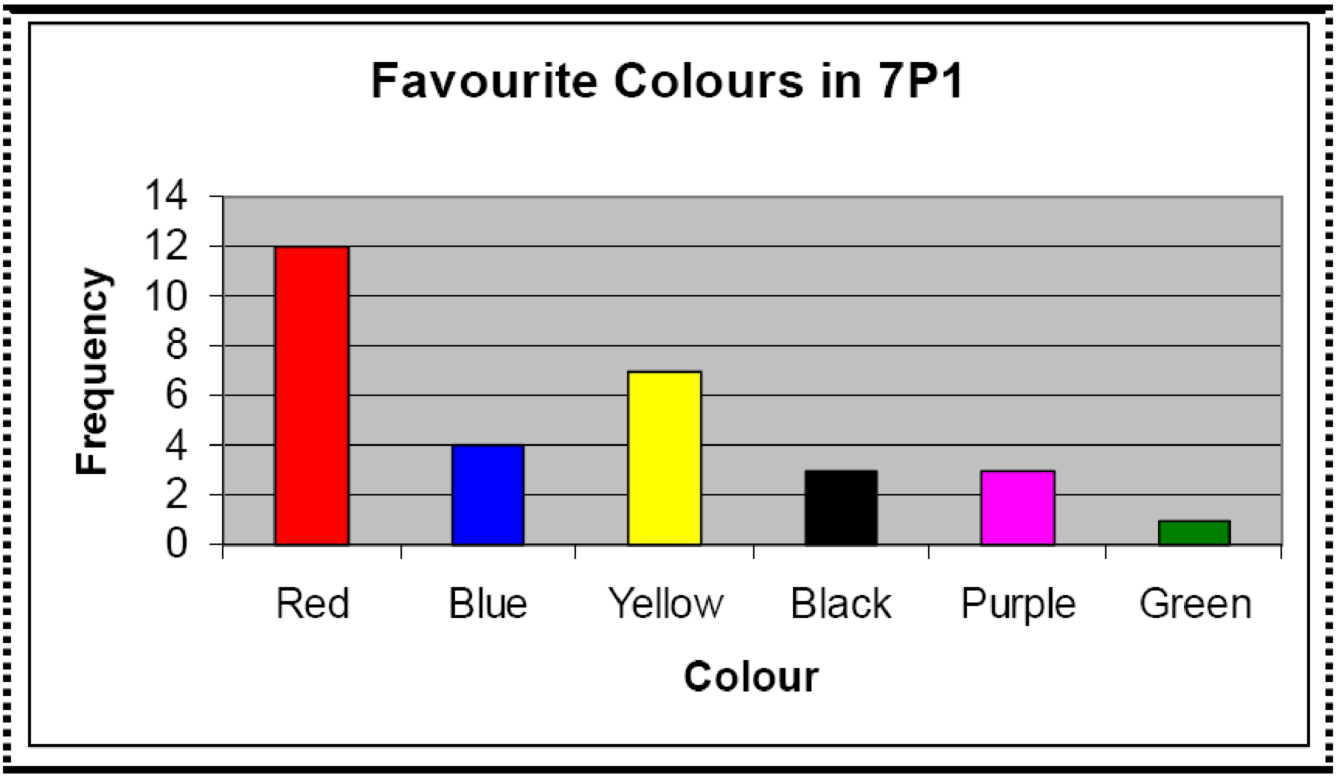
Tally charts

- Each tally mark equals 1.
- Tally marks are drawn in groups of five. The fifth tally mark goes across the other four.

Favourite Colour	Tally	Frequency
Red	𝍸 𝍸 ||	12
Blue	||||	4
Yellow	𝍸 ||	7
Black	|||	3
Purple	|||	3
Green	|	1
	Total	

Bar charts

- The height of each bar represents the frequency.
- All bars should be the same width.
- All the gaps between the bars should be the same width.
- Bar charts for grouped data have their bars touching with no gaps.



Pie charts

(1) You need to know the total number of pupils.

(2) You divide 360 by this total to calculate the angle for one person.

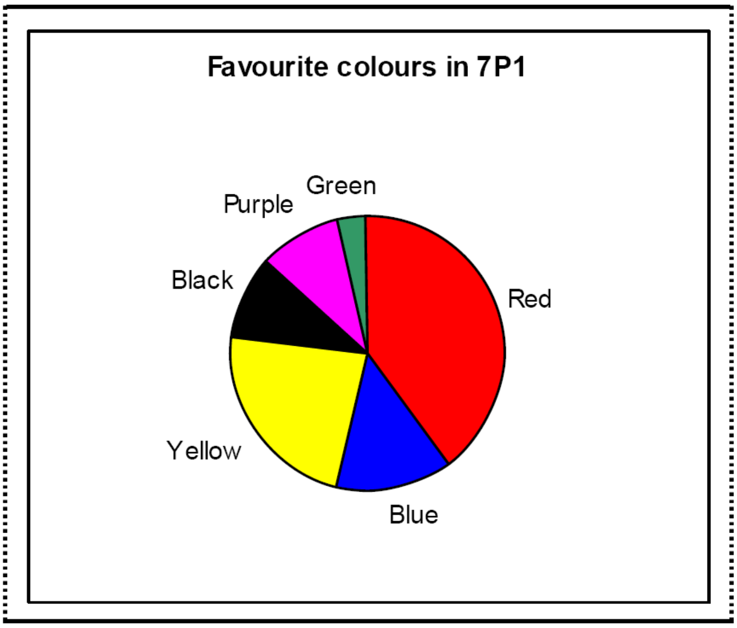
(3) Multiply each frequency by the angle calculated in (2).

Example

We need to split 360 into 30 equal parts.

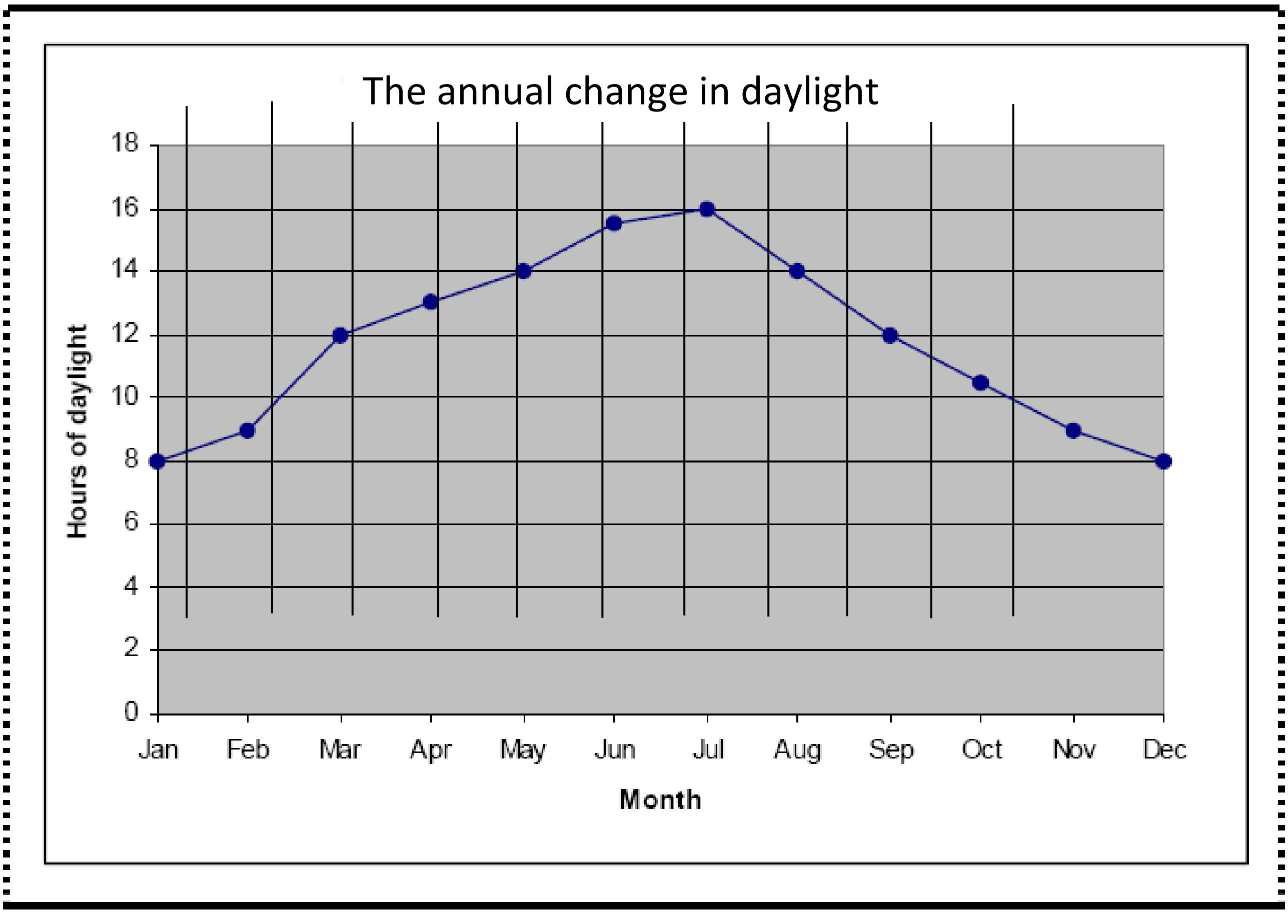
Each person = 360 / 30 = 12

Favourite Colour	Frequency	Angle Calculation
Red	11	11 × **12** = 132
Blue	5	5 × **12** = 60
Yellow	7	7 × **12** = 84
Black	3	3 × **12** = 36
Purple	3	3 × **12** = 36
Green	1	1 × **12** = 12
Total	30	



Line graphs

Line graphs are particularly useful for showing changes over a period of time.



Notice how the words on the axes straddle the grid lines and are not written in the gaps for this type of graph.

Remember to number according to a times table eg 5,10,15, 20, 25 etc

Scatter graphs

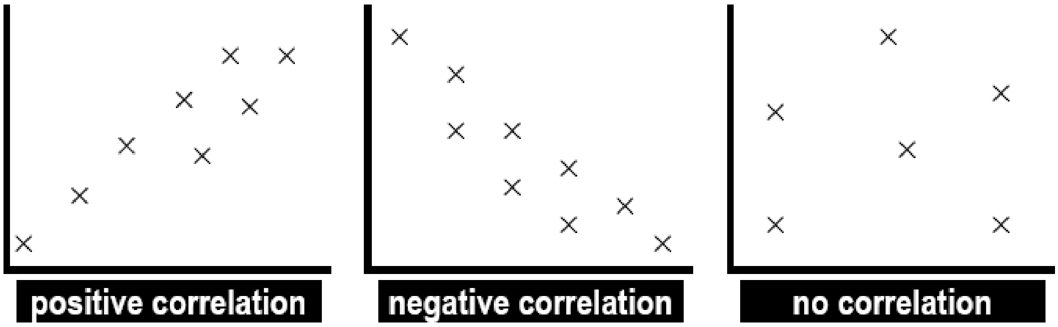
A scatter graph is a way of comparing two sets of data.

Example

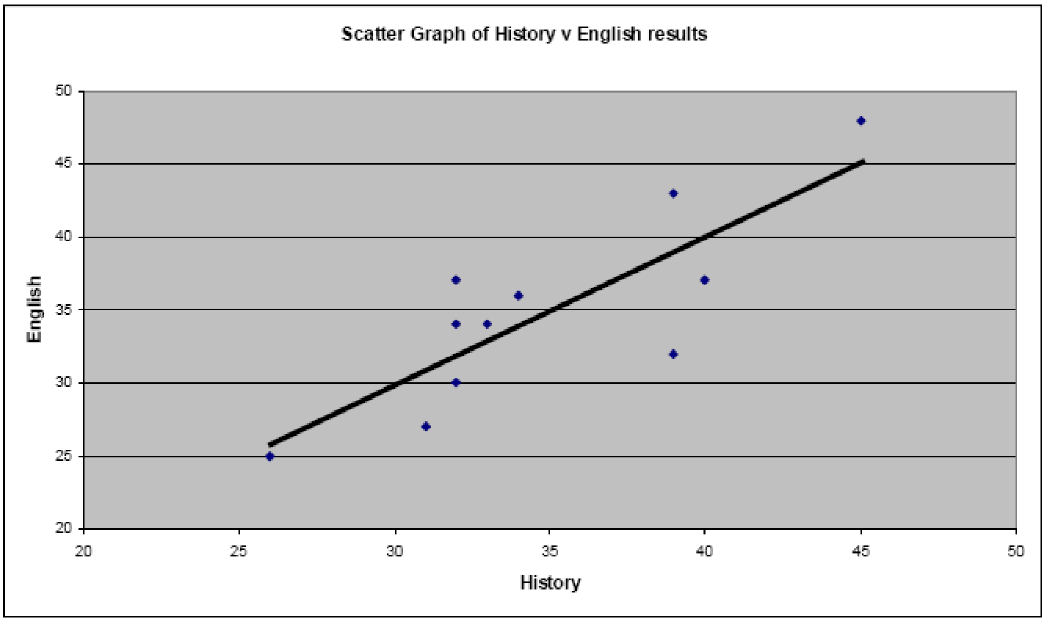
History	32	39	31	33	39	32	45	26	40	32	34
English	34	43	27	34	32	37	48	25	37	30	36

The results in the table show the History/English mark of 11 pupils.

There are **three** types of correlation.



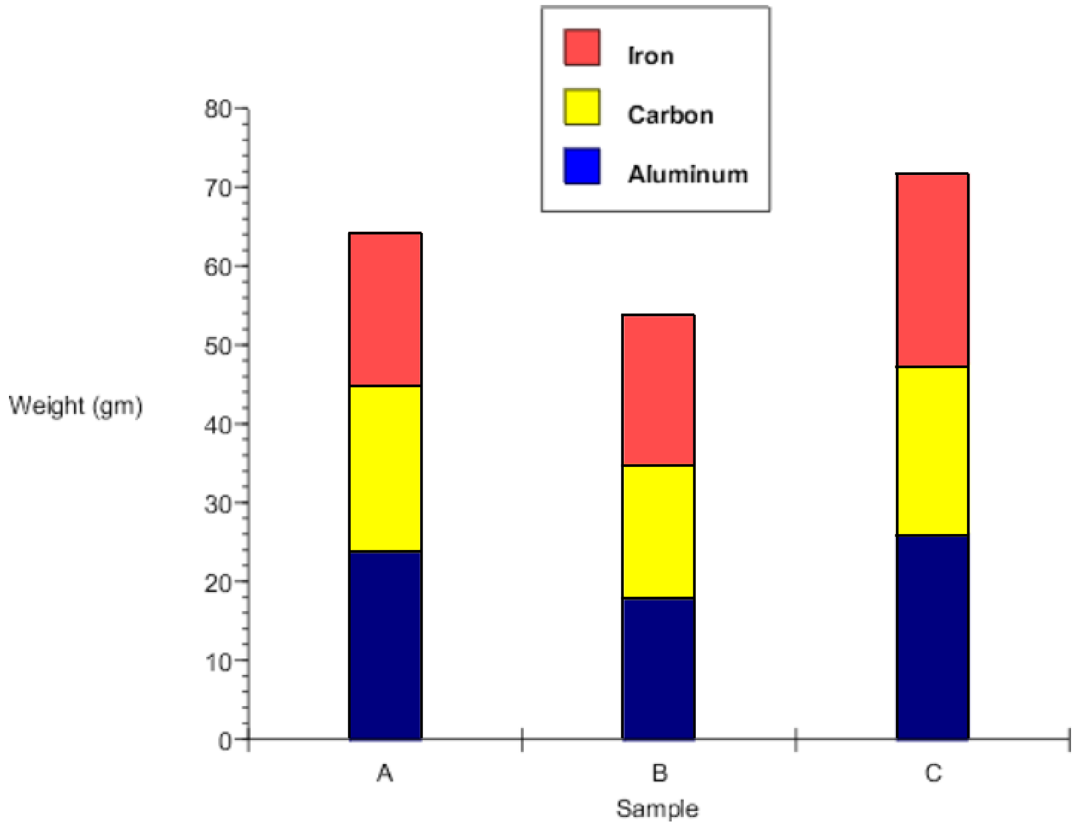
- Positive correlation: as one value increases, so does the other.
- Negative correlation: as one value increases, the other decreases.
- No correlation: no relationship between the two variables.



This scatter graph shows positive correlation. This means that the people who got high marks in History got high marks in English and vice versa.

Compound/Composite Bar Charts

In a composite bar chart, the different pieces of data are stacked one on top of the other and the key will tell you which group they belong to. All bars are drawn with the same group at the bottom, the same above and so on.



In sample A, the carbon runs from 24 up to 45. 45 – 24 = 21. There was 21g of carbon in sample A. Axes need to be labeled, the numbers placed on the axes and the dashes equally spaced, just like always.

Averages

There are three different types of average.

Mode	→	The **mode** is the most common or most popular data value. It is sometimes called the modal value.
Median	→	To find the **median** of a set of data, put the values in order of size, the median is the middle value. For **n** data values, $\frac{n+1}{2}$ gives the position of the median.
Mean	→	To find the **mean**, find the total of all the data values and divide the total by the number of data values.

Which average to use?

Average	Advantages	Disadvantages
Mean	• Uses all the data • Most accurate value	• Distorted by extreme values • Mean is not always a data value
Median	• Unaffected by extremes • Easy to calculate if data is ordered	• Not always a data value • Not easy to use for further analysis
Mode	• Very easy to find • Can be used with non-numerical data • Mode is always a data value	• There is not always a mode • Not easy to use for further analysis

Roman Numerals

There are only a few Roman numerals, so it doesn't take long to learn them:

- I = 1
- V = 5
- X = 10
- L = 50
- C = 100
- D = 500
- M = 1000

Add numbers with larger digits first. If the digits are ordered largest to smallest, all you need to do to read them is add the value of each digit. Here are some examples:

- VI = 5 + 1 = 6
- LXI = 50 + 10 + 1 = 61
- III = 1 + 1 + 1 = 3

Treat numbers with smaller digits first as subtraction
This only happens in a few situations:

- IV = 1 subtracted from 5 = 5 - 1 = 4
- IX = 1 subtracted from 10 = 10 - 1 = 9
- XL = 10 subtracted from 50 = 50 - 10 = 40
- XC = 10 subtracted from 100 = 100 - 10 = 90
- CM = 100 subtracted from 1000 = 1000 - 100 = 900 etc

Break a number into parts to understand it.
Always make sure you catch any "subtraction problems" with a smaller digit in front of a larger, and pair both the digits into the same group.

- For example DCCXCIX.
- There are two places in the number with a small digit in front of a larger one: XC and IX.
  Keep the "subtraction problems" together and break up the other digits separately: D + C + C + XC + IX.
- Translate into ordinary numerals using the subtraction rules when necessary: 500 + 100 + 100 + 90 + 9
- Add them all together: DCCXCIX = 799.