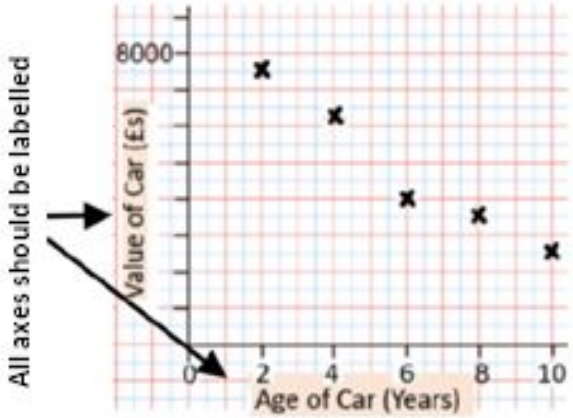
Year 11 Autumn 2 Knowledge Organiser

DRAWING SCATTER GRAPHS

Age of Car (Years)	2	4	6	8	10
Value of Car (£s)	7500	6250	4000	3500	2500

- *The data may not be given in size order*
- *The data forms information pairs for the scatter graph*
- *Not all data has a relationship*



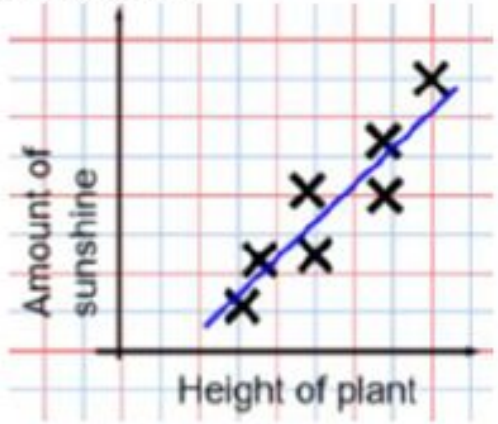
The axis should fit all the values and have equal spacing

You can explain links between variables in words:

"As the age of a car increases, the value of the car decreases"

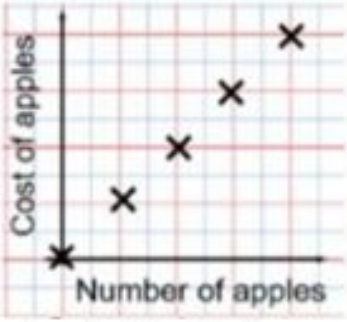
LINE OF BEST FIT

We can use a line of best fit to highlight the correlation and to make estimates about other data points.

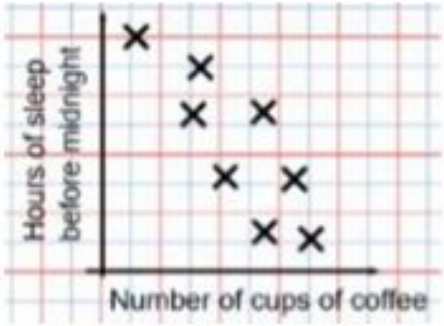


- The line of best fit does not need to go through any data points
- It should have the same number of points above and below the line
- Read off from the line of best fit to make estimates regarding new data points

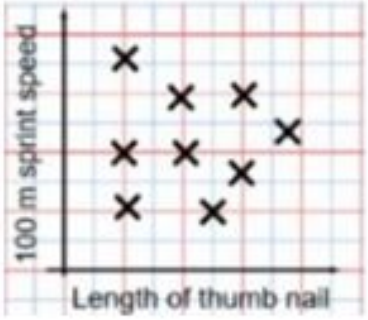
CORRELATION



Graphs like this show a *Positive Correlation* between two variables.
"As _____ increases, _____ also increases"



Graphs like this show a *Negative Correlation* between two variables.
"As _____ increases, _____ decreases"



Graphs like this show *No Correlation* between two variables.
"Changing _____ has no effect on _____"

Scan the QR codes for Exam questions on this topic!

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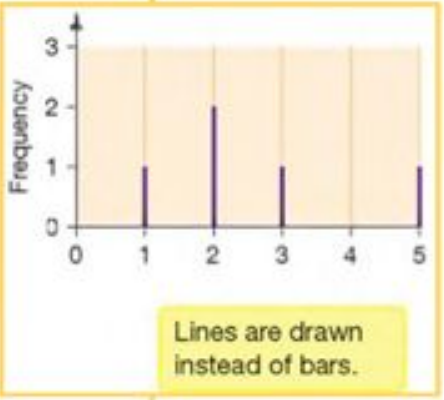
You can use a **bar chart** to display data.

Bar charts give a visual picture of the size of each category.

- A bar chart shows
  - how each category compares with the others
  - all the data, but in categories.

The bars can be horizontal or vertical.

- **Bar-line charts** are a good way to display (discrete) numerical data.



Frequency: The number which tells us how many pieces of data there are.

Discrete Data: Data that can only be set values e.g. you cannot have half of a person so counting people would be discrete data.

Continuous Data: Data that can be *any* value e.g. height and time.

Outliers are values that lie outside most of the other values of a set of data.

In this data set

1, 1, 2, 2, 3, 4, 4, 4, 16

16 is an outlier.

The mean and range are both affected by outliers.

- The **mean** of a set of data is the total of all the values divided by the number of values.
- The **mode** is the value that occurs most often.
- The **median** is the middle value when the data is arranged in order.
- The **range** is the highest value – lowest value.

Tally marks are used to help count things. Each vertical line represents one unit. The fifth tally mark goes down across the first four to make it easier to count. The frequency column is completed after all the data has been collected.

You must represent 5 like this.

Eye Colour	Tally	Frequency
brown	𝍸 |	6
blue	𝍸 |||	8
green	|||	3
grey	||||	4
hazel	𝍸	5

HISTOGRAMS

CUMULATIVE FREQUENCY

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HARROW HIGH MATHEMATICS

Key Terms:

Discrete data: countable data that can be categorised e.g. *Shoe size, eye colour*

Continuous data: data that is measured and can take any value e.g. *Height, time, temperature*

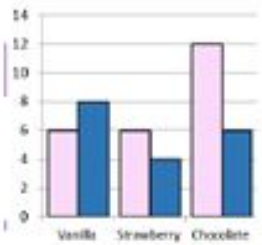
Qualitative data: text-based data that describes something *e.g. colours, race*

Quantitative data: numerical data *e.g. age, height, temperature*

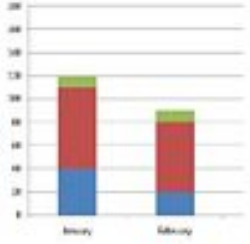
Frequency: the number of occurrences of an event

Extrapolate: to predict values from outside the range of data

Bar Charts



Comparative bar charts show data side by side

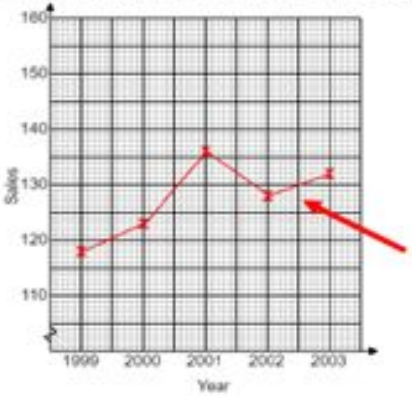


Compound bar charts show data stacked

Time-series Graphs

Plot the following sales information on the graph below and describe the overall trend:

Year	1999	2000	2001	2002	2003
Sales	118	123	136	128	132



Step 1 – Label the x and y axes, and use an appropriate scale

Try to fill the graph paper

Step 2 – Plot each point onto the graph

Double check what one square represents

Step 3 – Join up each point with a straight line

Step 4 – Identify the overall pattern shown = generally increasing

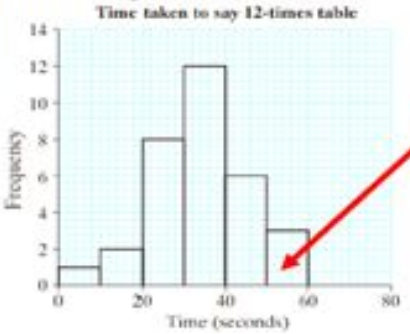
Visualising a line of best fit through the plotted points can help you to see the overall trend

Histograms with Equal Class Intervals

A group of 32 students were asked to say the 12-times table as fast as possible.

a) Draw a histogram for the following data:

Time, t (s)	Frequency
$0 < t \leq 10$	1
$10 < t \leq 20$	2
$20 < t \leq 30$	8
$30 < t \leq 40$	12
$40 < t \leq 50$	6
$50 < t \leq 60$	3



See *Cumulative Frequency, Box Plots, and Histograms* for more on drawing histograms

No gaps between bars

$$\text{Frequency Density} = \frac{\text{Frequency}}{\text{Class Width}}$$

YOU SHOULD:

- Know what chart to use for different types of data sets
- Compare averages of two distributions
- Recognise simple patterns in graphs and charts (e.g. seasonal patterns)
- Predict future values from a time-series graph

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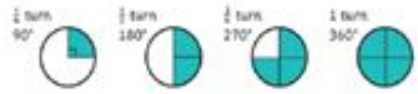
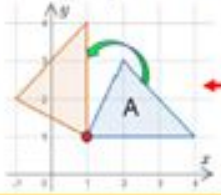
Rotation

The size does not change but the shape is turned around a point. We must use tracing paper. We need to rotate using a given number of degrees.



We need the:
- Centre
- Number of degrees
- Direction

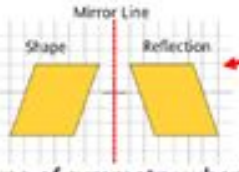
Rotate shape A anti-clockwise about (1,1).



We need to put our pencil on this centre point to complete the rotation with our tracing paper.

Reflection

A transformation in which an object is reflected across a line, creating a mirror image.

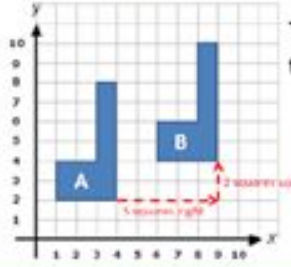


The distance from the mirror line needs to be the same for the reflection as the original shape.

Reflectional symmetry: A type of symmetry where one half of an image is the reflection of the other half. You can have many lines of symmetry.

Translation

A transformation is where every point of a shape moves the same distance in the same direction. The distance and direction is specified by a vector.



The vector to go with this transformation is $\begin{pmatrix} 5 \\ 2 \end{pmatrix}$.

This means 2 spaces up.

This means 5 spaces to the right.

Top = Left (-) Right (+)
Bottom = Down (-) Up (+)

There are 4 types of **Transformations:**

Reflection

Rotation

Translation

Enlargement

Transformation: This means something about the shape has 'changed'.

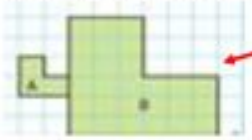
Reflection: A shape has been flipped using a mirror line.

Reflectional Symmetry: A type of symmetry where one half of an image is the reflection of the other half.

Enlargement

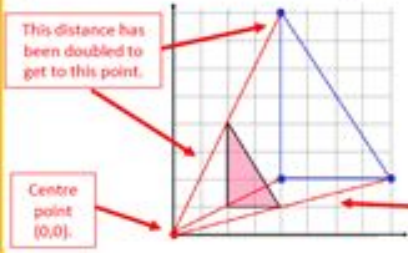
An enlargement is when a shape changes in size by using a scale factor. The scale factor can make a shape bigger or smaller. A scale factor of 2 = shape doubles in size, a scale factor of $\frac{1}{2}$ would halve the size.

Enlarge shape A by scale factor 3.



Scale factor 3 – Multiply each side length by 3. It does not matter where you draw it.

From a centre: Enlarge shape A, scale factor 2, centre (0, 0). It is important that you answers for this question is in a specific place because it is from a centre point.



This distance has been doubled to get to this point.

Centre point (0,0).

Scale factor 2 - Double the distance between each vertex (corner) and the centre of enlargement.

ENLARGEMENT

TRANSLATION

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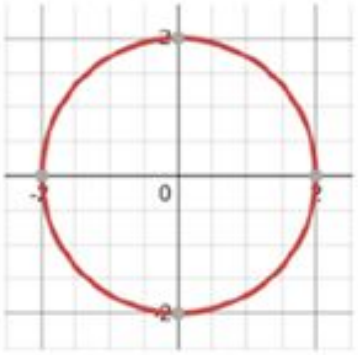
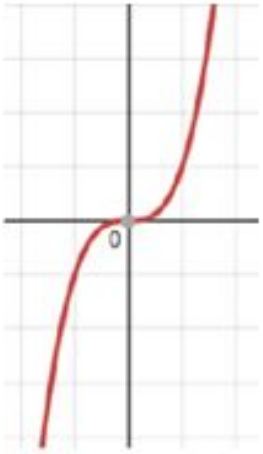
NON-LINEAR GRAPHS



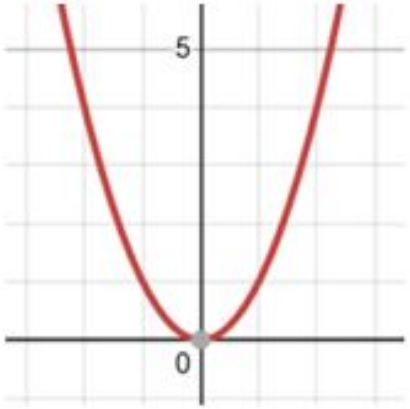
Circle graphs

$x^2 + y^2 = 4$



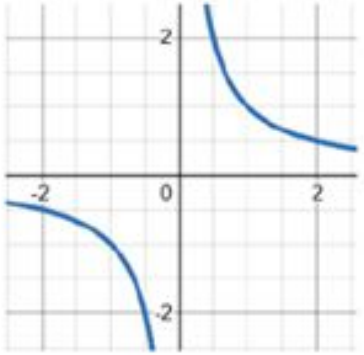
Cubic graphs

$y = x^3$



Quadratic graphs

$y = x^2$



Reciprocal graphs

$y = \frac{1}{x}$

What you need to know:

Linear graphs

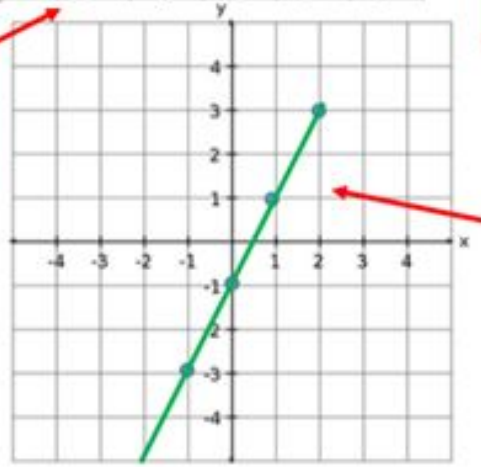
Linear graphs are straight line graphs. We substitute the x value into the equation to get the y value. Once we have both we can then plot the coordinates and draw the graph.

Draw the graph of y = 2x – 1.

To do this we multiply the x value by 2 and then subtract 1 to get the y value.

y = 2x – 1

X	-2	-1	0	1	2
Y	-5	-3	-1	1	3



Multiply this value by 2 and then subtract 1 to get the y value.

This coordinate would be (-2,-5).

Don't forget to draw a straight line through all of the coordinates you have plotted.

Notice this graph has a gradient of 2 (the y values go up by 2 each time) and a y-intercept of -1 (the graph cuts through the y axis at -1).

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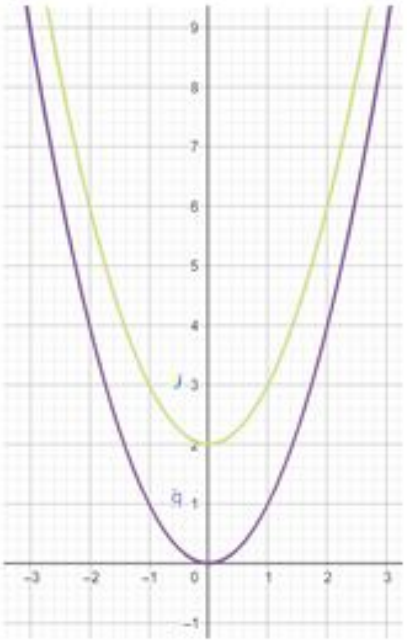
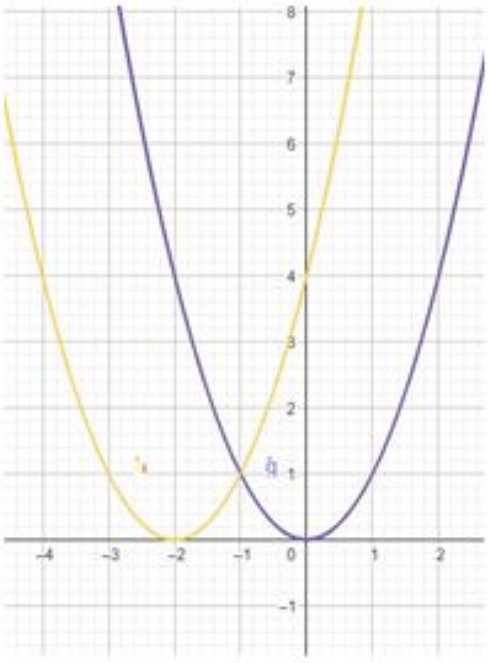
f (x) + a
Shifts the graph up a units



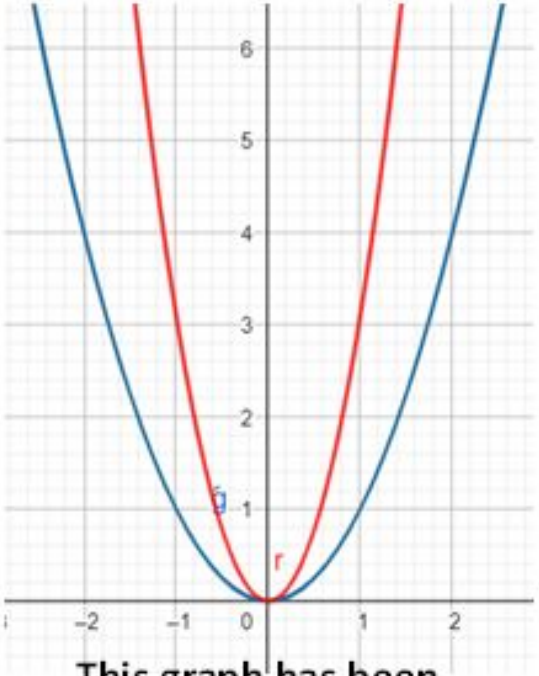
This graph shifts up 2 units, so is the graph f (x) + 2

f (x + a)
Shifts the graph to the left a units



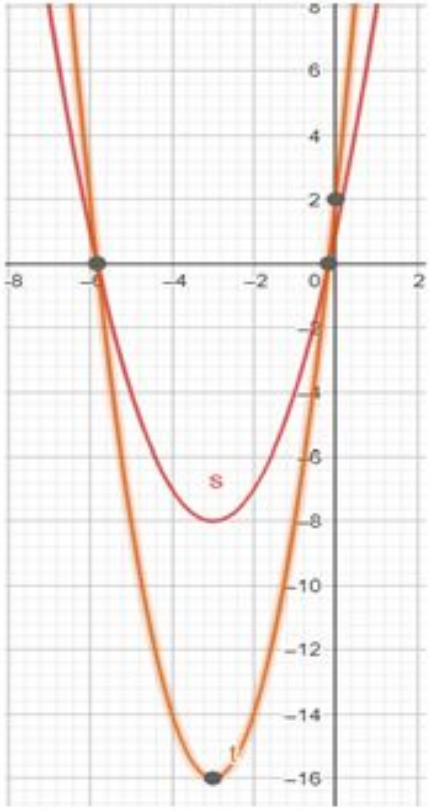
This graph shifts left 2 units, so is the graph f (x + 2)

f (ax)
Squeezes the graph horizontally with a scale factor a



This graph has been squeezed with scale factor 3 so is the graph f (3 x)

af (x)
Stretches the graph vertically with a scale factor a



This graph has been stretched with scale factor 3 so is the graph 3 f(x)

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HARROW HIGH MATHEMATICS

Iteration

Starting with $x_0 = 0$ use the iteration formula

$$x_{n+1} = \frac{2}{x_n^2 + 3}$$

3 times to find an estimate to the solution.

Calculate the values of x_1, x_2, x_3 to find an estimate for the solution to $x^3 + 3x = 2$

$$x_{0+1} = \frac{2}{0^2 + 3} = 0.\dot{6}$$

We substitute this value into the next step.

$$x_{1+1} = \frac{2}{0.\dot{6}^2 + 3} = 0.5806451613$$

$$x_{2+1} = \frac{2}{(0.58\ldots)^2 + 3} = 0.5993140006$$

An estimate of the solution is 0.6 because all of the solutions round to 1d.p.

Rearranging Formulae

Change the order of the terms so 'u' is on its own

Make u the subject: $v = u + at$

-at -at

$v - at = u$

so $u = v - at$

Make m the subject: $I = mv - mu$

If the letter appears twice you will need to factorise

$\div (v-u)$ $I = m(v-u)$ $\div (v-u)$

$I \div (v-u) = m$

$$m = \frac{I}{v-u}$$

Key Concepts

Iteration is the **repetition** of a mathematical procedure applied to the result of a previous application, typically as a means of **obtaining successively closer approximations** to the solution of a problem.