

# A-LEVEL MATHS

## Posters

The posters are colourful and informative. Using the posters in the classroom, noticeboards and corridors makes learning fun and interesting and teaching becomes easy and effective too. The large A1 size makes the bright and informative chart highly readable from a distance, complementing every learning environment.

### Reasons for using posters

1. About one third of students in an average classroom are visual learners.
2. Visual learners respond well to **colour**.
3. Images, photographs and diagrams are helpful learning aids for visual learners.
4. Words linked to pictures help visual learners grasp and remember new concepts.
5. Posters help reinforce important concepts and can be referred to regularly.
6. Posters can act as reference for students instead of asking the teachers.
7. Posters can keep your classroom/school fresh and **stimulating**.

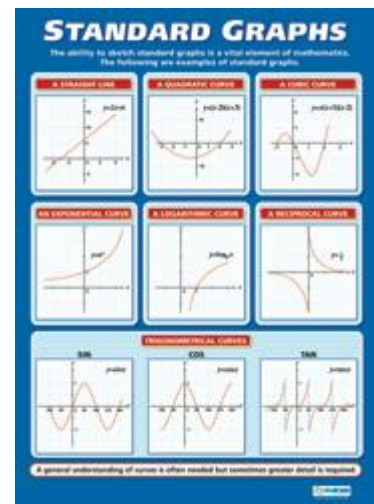
## Posters – Pure Maths



Surds (A1 size)  
Code: MAL 1



Series (A1 size)  
Code: MAL 2



Standard Graphs (A1 size)  
Code: MAL 3

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# Posters – Pure Maths

**TRANSFORMATION OF GRAPHS**

It is important to understand the relationship between changes to the algebraic form of a curve and the effect on the graph of the curve.

If  $y = f(x)$  is an expression involving  $x$ , then  $ax + c$  can write  $f(ax + c)$ . In the following examples it is important to remember that  $f$  is a constant.

- If  $f(x)$  is a parabola opening upwards, then  $f(x + a)$  is a parabola opening upwards,  $a$  units parallel to the  $x$  axis.
- If  $f(x)$  is a parabola opening upwards, then  $f(x - a)$  is a parabola opening upwards,  $a$  units parallel to the  $x$  axis.
- In this case  $f(x)$  is translated  $a$  units parallel to the  $x$  axis.
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- In this case  $f(x)$  is translated by a scale factor  $|k|$  parallel to the  $x$  axis.
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Transformation of Graphs  
Code: MAL 4 (A1 size)

**SPECIAL TRIANGLES**

There are two special right-angled triangles that have neat properties. They are the 30°-60° right-angled triangle and the right-angled isosceles triangle.

**EQUILATERAL TRIANGLE**

Consider an equilateral triangle ABC, with each side 2 units in length. If one side is vertical,  $h$ , the height of the side opposite, is, then 30°-60° right-angled triangles are formed.

A single use of Pythagoras' Theorem in triangle ADB, establishes the height of the triangle.

Notes:  $AC = (2^2 - 1^2) = \sqrt{3}$

Consequently:  $\sin 60^\circ = \frac{\sqrt{3}}{2}$ ,  $\sin 30^\circ = \frac{1}{2}$ ,  $\cos 60^\circ = \frac{1}{2}$ ,  $\cos 30^\circ = \frac{\sqrt{3}}{2}$ ,  $\tan 60^\circ = \sqrt{3}$ ,  $\tan 30^\circ = \frac{1}{\sqrt{3}}$

**ISOSCELES RIGHT-ANGLED TRIANGLE**

Consider an isosceles right-angled triangle with equal sides 1 unit in length. The triangle contains two angles of 45° and two equal sides.

Another application of Pythagoras' Theorem establishes the length of the hypotenuse.

Notes:  $AC = (\sqrt{1^2 + 1^2}) = \sqrt{2}$

Consequently:  $\sin 45^\circ = \frac{1}{\sqrt{2}}$ ,  $\sin 45^\circ = \frac{1}{\sqrt{2}}$ ,  $\tan 45^\circ = 1$

Special Triangles (A1 size)  
Code: MAL 5

**CIRCULAR MEASURE**

Angles are not always measured in degrees. There are times when other units are used.

**RADIANS**

In mathematics, it is sometimes easier to use the radian as a measure of angle in preference to the degree.

One radian is defined as the angle subtended at the centre of a circle by an arc equal in length to the radius.

$1 \text{ radian} = 1 \text{ rad} = 1^r$

**RELATIONSHIPS**

What is the relationship between the degree and the radian?

$180^\circ = \pi \text{ rad} \approx 3.14 \text{ rad}$

The relationship between the degree and the radian can also be expressed as follows:

$60^\circ = \frac{\pi}{3} \text{ rad}$ ,  $30^\circ = \frac{\pi}{6} \text{ rad}$ ,  $45^\circ = \frac{\pi}{4} \text{ rad}$ ,  $120^\circ = \frac{2\pi}{3} \text{ rad}$ ,  $45^\circ = \frac{\pi}{4} \text{ rad}$ ,  $1^\circ = \frac{\pi}{180} \text{ rad}$ ,  $1^\circ = \frac{\pi}{180} \text{ rad}$ ,  $1^\circ = \frac{\pi}{180} \text{ rad}$ ,  $1^\circ = \frac{\pi}{180} \text{ rad}$

Length of minor arc AB =  $r\theta$  where  $\theta$  is in radians.

Area of minor sector AOB =  $\frac{1}{2}r^2\theta$  where  $\theta$  is in radians.

Circular Measure (A1 size)  
Code: MAL 6

# Posters – Statistics

**CORRELATION**

Mathematicians frequently need to represent pairs of observations. One way of doing this is by using a scatter diagram. When plotted, these observations may suggest a trend and this trend can be described by a line of best fit. This is a measure of linear relationship.

One measure of this relationship is called the product moment correlation coefficient,  $r$ . This is a measure of linear relationship.

These formulae may be provided as information for use during exams. Suitable substitutes may also have the calculation of  $r$  as a function.

**CORRELATION EXAMPLE**

Prior to calculating the value of  $r$  it is useful to plot the observations on a scatter diagram. Calculating  $r$  is not useful in estimating how these relationships.

**REMARKS**

A correlation coefficient only measures agreement between observations and not the cause of the agreement. Further investigation would be needed to establish this.

Correlation (A1 size)  
Code: MAL 7

**LINEAR REGRESSION**

In an experiment you may be confident that there is an underlying relationship between two variables. Consequently, you may need to establish the equation of the linear relationship.

For example,  $y = ax + b$  where  $x$  and  $y$  are population values. We use  $x$  and  $y$  as estimates for  $x$  and  $y$ .

- $x$  is called the independent variable (sometimes called the explanatory variable).
- $y$  is called the dependent variable (sometimes called the response variable).
- It is assumed that the values of the independent variable are accurate but the values of the dependent variable are subject to error.

To obtain the equation of the least squares regression line of  $y$  on  $x$ , we use:

$\frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$  and  $y = \bar{y} + b(x - \bar{x})$

A car is tested at different speeds and the corresponding rates of fuel consumption are measured.

Check for linearity by plotting points on a scatter diagram.

Calculate  $b$  that  $b = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2} = \frac{11279}{424.7} = 26.54$

$\bar{y} = 17.26$ ,  $\bar{x} = 77.26$

Least squares regression line of  $y$  on  $x$  is  $y = 26.54x - 2071.7$

Note: The line passes through  $(\bar{x}, \bar{y})$ .

Linear Regression (A1 size)  
Code: MAL 8

**BINOMIAL DISTRIBUTION**

A binomial distribution is a discrete distribution which occurs when a variable has:

- Only two possible outcomes e.g. success/failure, event/non-event.
- A fixed number of independent trials  $n$ .
- A constant probability of success for each trial  $p$ .

If  $X$  denotes the number of successes in  $n$  independent trials with the probability of success being  $p$ , then:

$X \sim B(n, p)$  and  $P(X = x) = {}^nC_x p^x q^{n-x}$  for  $x = 0, 1, 2, \dots, n$

Also  $E(X) = np$  and  $\text{Var}(X) = npq$

**EXAMPLE**

It is known that a drawing pin has a probability of 0.5 of landing point up. The drawing pin is tossed 3 times.

If we count the number of times that the drawing pin lands point up, then the number of times that this occurs is a variable which is binomially distributed. I.e. the total number of independent trials = 3 and  $p = \text{probability of success} = 0.5$ .

If  $X$  denotes the number of successes then  $X \sim B(3, 0.5)$ .

- Only two possible outcomes (point down/up)
- There are a fixed number of independent trials = 3
- A constant probability of success (point up) = 0.5

Therefore, in our example, if we need to calculate the probability that the drawing pin lands point up 4 times then:

$P(X = 4) = {}^3C_4 (0.5)^4 (0.5)^{3-4} = 0.0009$  (to 4 d.p.)

Binomial Distribution (A1 size)  
Code: MAL 9

**NORMAL DISTRIBUTION**

An attribute may be a vital continuous distribution. Many everyday situations can be modelled using a normal distribution, e.g. height and weight.

The main features of a normal distribution are:

- The variable is continuous.
- The distribution is symmetrical.
- Normal values are common.
- The distribution is unimodal.
- The mean is  $\mu$ .
- The mean is  $\mu$ .
- Extreme values are rare.
- The distribution is often referred to as being 'bell-shaped'.

The mean  $\mu$  and the variance  $\sigma^2$  are used to describe a variable that is normally distributed.

**STANDARD NORMAL DISTRIBUTION**

If  $Z$  is distributed normally with mean = 0 and variance = 1, then  $Z \sim N(0, 1)$ .

This form of the distribution is called the standard normal distribution.

We write  $P(Z < z) = \Phi(z)$

When using statistical tables as a calculator, always check the convention used for calculating probabilities.

Then  $Z$  is continuous.

$P(0 < Z < 1) = P(Z < 1) - P(Z < 0) = \Phi(1) - \Phi(0) = 0.2420 - 0.5000 = 0.2580$

**OTHER NORMAL DISTRIBUTIONS**

All other normal distributions are considered to be changes in position, scale or both of the standard normal distribution.

**STANDARDISING A NORMAL DISTRIBUTION**

If  $X \sim N(\mu, \sigma^2)$  then  $Z = \frac{X - \mu}{\sigma} \sim N(0, 1)$

Hence, if  $X \sim N(10, 16)$  then  $P(X < 12) = P\left(\frac{X - 10}{4} < \frac{12 - 10}{4}\right) = P\left(\frac{X - 10}{4} < 0.5\right) = P(Z < 0.5) = 0.6915$

Normal Distribution (A1 size)  
Code: MAL 10

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## Snap Frames

**Snapframes** are designed for quick and hassle free changeover of posters. They are sold fully assembled and ready to use, with clear PVC cover sheet to protect your poster. The frames are light enough to wall-mount with 4 screws.



All four sides of the Snap Frames can be easily snapped open. Just lift up four sides of frame by hand, insert your poster, place protective sheet on top and then snap frames to close without tools, as easy as 1-2-3!

### Features & Benefits of Snap Frame

- Simple - access on all sides of the frame, simply flip open and change posters!
- Good visibility - clear and non-reflective PVC cover
- Durable - made of lightweight yet strong aluminium
- Instant - requires no assembly and arrives ready to use.
- Quick - Change poster from the front, no tools required!
- Eye catching - attracts attention of customers walking past
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