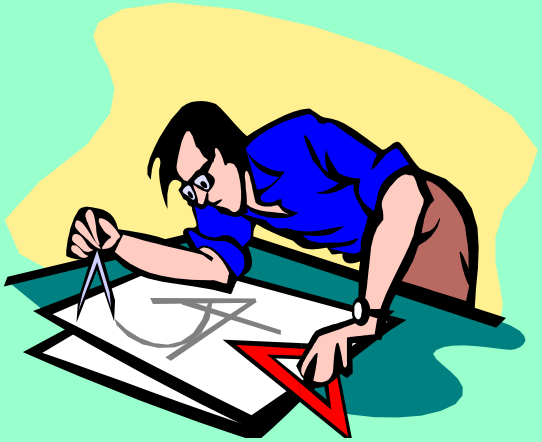
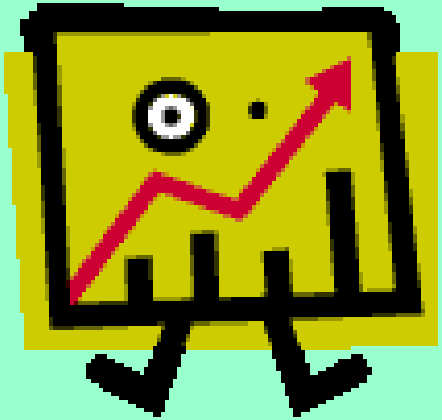
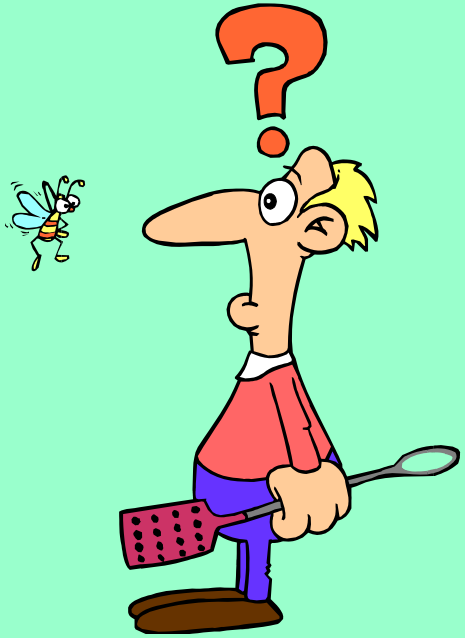




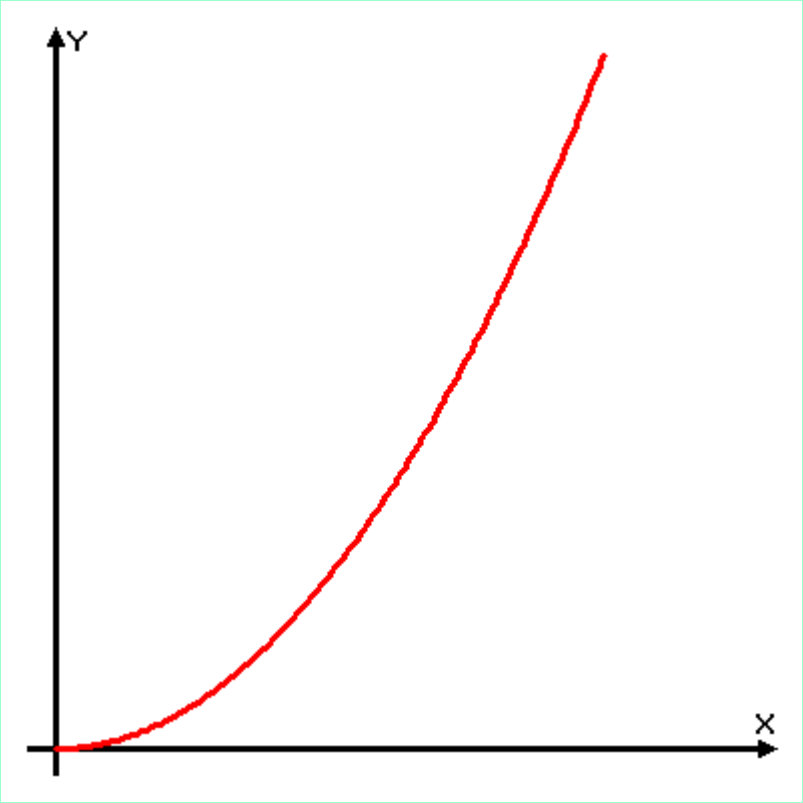
6.

Experimental data



Data from experiments

Often data in scientific experiments do not come out as nice straight lines.



This graph is a curve, and the suggestion is that it is the graph of an exponential function.

$$i.e.\ y = kx^n$$

We know that we can write straight lines as Y = mX + c and this is easier to interpret than the graph shown.

Data from experiments

When scientists produce results like those in the last graph one of the first things they do is replot the graph taking log of both x and y coordinates.

Can you see why?

$$if \quad y = kx^n$$

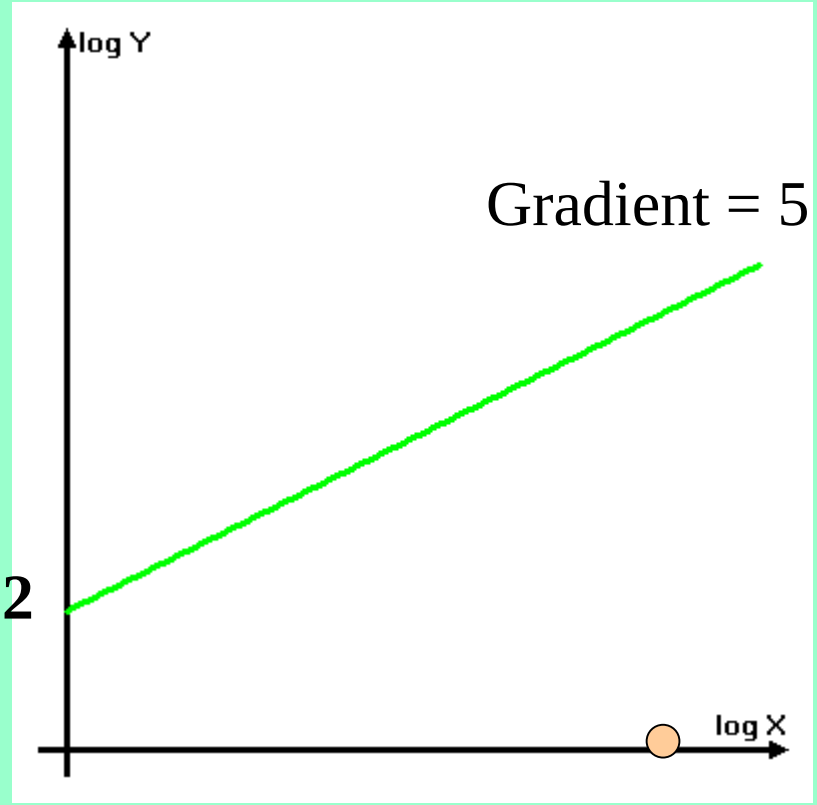
$$\log y = \log k + \log x^n$$

$$\log y = n \log x + \log k$$

$y = mx + c$

Gradient = power of x and $k=a^c$

Example 1



$k = a^c = 10^2$

Express y in terms of x.

Solution:

Gradient = power and $k=a^c$

$$if \quad y = kx^n$$

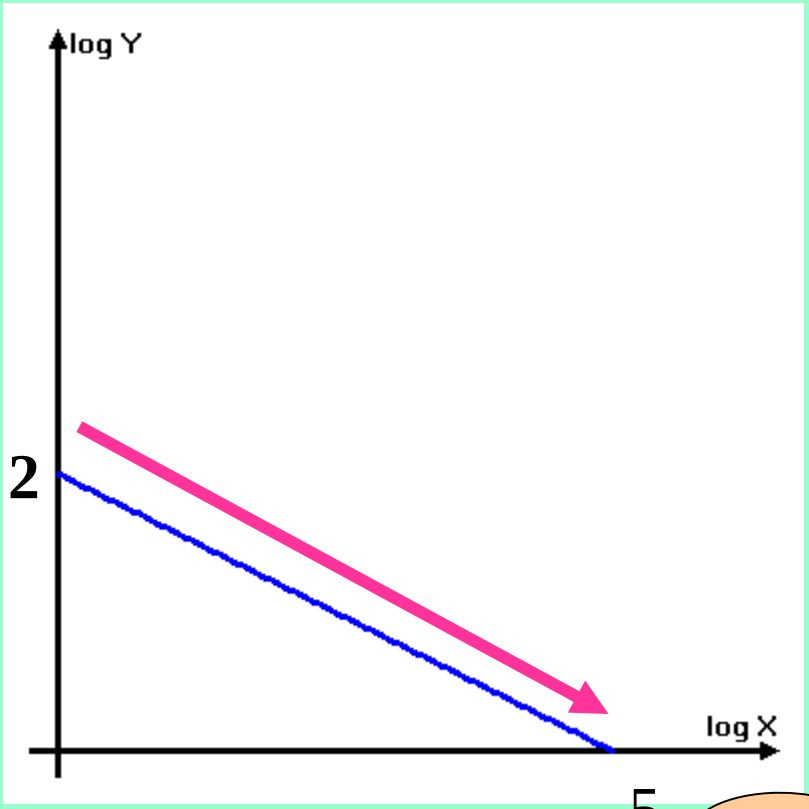
$$y = 10^2 x^5$$

$$y = 100x^5$$

Heinemann, p.292, EX 15I,
Q2 (a) to (d)

This is not the end

Example 2



Express y in terms of x.

Solution:

Gradient = power and $k=a^c$

For gradient: $m = \frac{\Delta y}{\Delta x}$

$$m = -\frac{\log_{10} 2}{\log_{10} 5}$$

$$m = -\frac{2}{5}$$

$k = a^c = 10^2$

if $y = kx^n$

$y = 10^2 x^{-\frac{2}{5}}$

$y = 100x^{-\frac{2}{5}}$ → $y = \frac{100}{\sqrt[5]{x^2}}$

Heinemann, p.292, EX 15I,
Q2 (e)

This is not the end

Example 3

The following set of data are connected by the formula $y = kx^n$.
Find the values of k and n and hence state the formula connecting x and y.

X	1.26	1.58	2.00
Y	3.98	7.94	17.78

Solution:

Using the **log** button on your calculator take logs of both x and y values.

log X	0.10	0.20	0.30
log Y	0.60	0.90	1.25

Solution (continued):

log X	0.10	0.20	0.30
log Y	0.60	0.90	1.25

Now that data is in log form all points should conform to y=mx +c

Take any two points and write them in the form Y = MX + C

$$1:\ 0\cdot 60 = m(0\cdot 1) + c$$

$$2:\ 0\cdot 90 = m(0\cdot 2) + c$$

$$3:\ 0\cdot 30 = 0\cdot 10m$$

$$\Rightarrow m = \frac{0.30}{0.10} = 3$$

Sub m = 3 into 1:

$$\Rightarrow 0\cdot 60 = 3(0\cdot 1) + c$$

$$\Rightarrow 0\cdot 60 = 0\cdot 30 + c$$

$$\Rightarrow c = 0\cdot 30$$

Solution (continued):

$$\Rightarrow m = \frac{0.30}{0.10} = 3$$

$$\Rightarrow c = 0 \cdot 30$$

Gradient = power and k=a^c

$$k = a^c = 10^{0 \cdot 3}$$

$$if \quad y = kx^n.$$

$$y = 2 \cdot 0x^3$$

Heinemann, p.291, EX 15I,
Q1 (b) & (c)