Memorisation – unit prefixes

Bigger

Kilo	k	x 1000	x 10^{3}
Mega	M	x 1,000,000	x 10^{6}
Giga	G	x 1,000,000,000	x 10^{9}
Tera	T	x 10^{12}	

Smaller

Milli	m	x 0.001	x 10^{-3}
Micro	μ	x 0.000001	x 10^{-6}
Nano	n	x 0.000000001	x 10^{-9}
Pico	p	x 10^{-12}	
Femto	f	x 10^{-15}	

You **must** know all of these off by heart!

Uncertainties Calculations

1 Write down these measurements with their absolute uncertainty.

a 6.0 cm length measured with a ruler marked in mm (*1 mark*)

b 0.642 mm diameter measured with a digital micrometer (*1 mark*)

c 36.9 °C temperature measured with a thermometer which has a quoted accuracy of: '± 0.1 °C (34 to 42 °C), rest of range ± 0.2 °C'. (*1 mark*)

2 Calculate the percentage uncertainty in these measurements.

a 5.7 ± 0.1 cm (*1 mark*)

b 2.0 ± 0.1 A (*1 mark*)

c 450 ± 2 kg (*1 mark*)

d 10.60 ± 0.05 s (*1 mark*)

e 47.5 ± 0.5 mV (*1 mark*)

f 366 000 ± 1000 J (*1 mark*)

3 Calculate the absolute uncertainty in these measurements.

a 1200 W ± 10% (*1 mark*)

b 34.1 m ± 1% (*1 mark*)

c 330 000 Ω ± 0.5% (*1 mark*)

d 0.008 00 m ± 1% (*1 mark*)

6 A runner completes 100 (± 0.02) m in 18.6 (± 0.2) s. Calculate his average speed and the uncertainty in this value. (*2 marks*)

Using Graphs to find information

For the following equations, rearrange them such that the y-value (dependent variable) is the subject. Then state all the things you can find from the graph, using:
- gradient of a straight line
- y intercept
- area under the line

The number of marks indicates the number of things you can find from a graph

1a) $a = (v - u)/t$

v on the y axis
t on the x axis.

[2]

b) $I = P/A$

P on the y axis
A on the x axis

[1]

c) $Ft = mv - mu$

F on the y axis
t on the x axis

[1]

More applications

For these questions, you'll get given two quantities and asked to explain how you would find the third using a graph. You'll need to refer to your relationship sheet to find relevant equations.

2a) How can you find Hubble's constant (H_0) given a range of recessional velocities and distances?

[2]

b) How can you find the wavelength of light passed through a diffraction grating with a known slit separation, when given the a table of the angles between the central maximum and the successive maxima?

[3]

c) How can you find the refractive index of a material given a range of angles of incidence in air and angles of refraction in the material?

[3]

3 . The speed of the wave on a string can be described by the relationship

$$v = \sqrt{\frac{T}{\mu}}$$

Where **v** is the speed of the wave, **T** is the tension in the string and **μ** is the mass per unit length of the string.

An experiment was carried out in which the **length of the string in metres** is varied with the **mass of the string in kilograms**. The following table of results were recorded:

Mass of the String (kg)	Length of the String (m)
0.0020	0.20
0.0034	0.27
0.0046	0.38
0.0058	0.45
0.0062	0.53

a) Show that $\mathbf{T = mv^2/L}$ where $\mathbf{\mu = m/L}$. [3]

b) From the table above, draw a graph to find the gradient of the line of best fit involving **m against L**. [2]

c) Use the line of best fit in **b)** and the change in the subject of the formula in **a)** to find the tension in the string when the wave travels along the string with a **speed of 200ms^{-1}**. [3]

d) The student carrying out the experiment wishes to determine the **tension T** in the string more precisely.

Suggest an improvement to the experimental procedure that would achieve this. [1]

4. A car is placed on a track which includes a raised section.

This is shown in **Figure 2B** below.

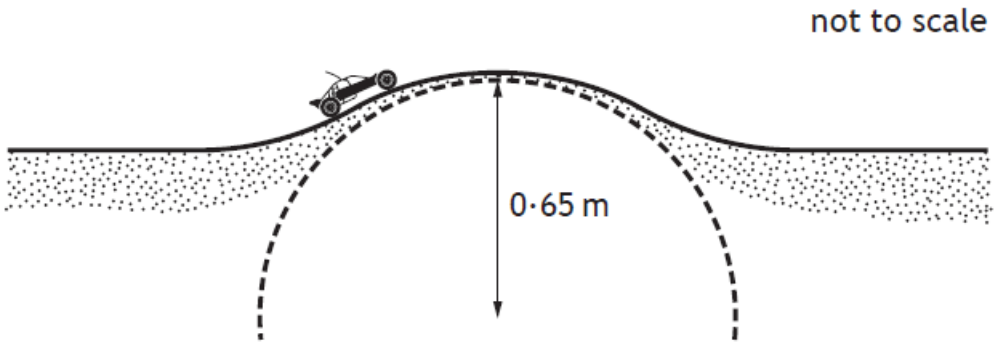

Figure 2B

The raised section of the track can be considered as the arc of the circle r, with **r = 0.65m** being one of the points used shown in **Figure 2B** above.

The car will lose contact with the raised section of track if its speed is greater than v_{max}.

v_{max} is given by the relationship

$$v_{max} = \sqrt{gr}$$

a) Change the subject of the equation to g, the acceleration due to gravity. [2]

b) Complete the table shown below for v_{max}^2.

v_{max} (ms^{-1})	v_{max}^2 (ms^{-1})^2	r (m)
1.70		0.20
1.95		0.35
2.24		0.50
2.41		0.55
2.45		0.65
2.65		0.70

[3]

c) i) Plot a graph of **v_{max}^2 against r**. [2]

ii) Find the **gradient m** of the graph plotted to find the **acceleration due to gravity g**. [2]

iii) What does the graph indicate as it is not a straight line through the origin? [1]