PHYSICS

Introductory practical exercise

For each activity **take the measurements** you need, write down the **precision** of the equipment, give the **uncertainty** and work this out as a **percentage** error. This needs to be handed in in September with the rest of your work.

You will be assessed on the quality of your readings and the clarity of your presentation.

1) Diameter of a wire

Use the micrometer (instructions available if you do not know how) to measure the diameter of the 3 wires.

2) Dimensions of a rectangular block

Use the ruler provided to measure the 3 dimensions

3) Thickness of a single sheet of paper

Measure the pile of paper, with the ruler, to calculate the thickness of one sheet

4) Time period of a mass on a spring.

Measure the time for 10 oscillations, repeat and then find the time for one

5) Length of a metal wire

Measure the length of the wire with the metre ruler. Think carefully about the uncertainty in your measurement

Re-bend the wire for the next people

6) Angle measurement

Use the protractor to measure the angle directly

Now take measurements and calculate it using trigonometry

In September we will use your values to do follow up calculations and combine the uncertainties

* If you are not present on the induction day you should complete activities 2, 3, 4 (use a pendulum) and 6 with equipment you have at home.

Rearranging Equations

Most of the equation you met at KS4 only had three variables and so you used triangles to help you rearrange them.
Now you are starting AS you need to be confident to not use triangles and also will meet many equations where there are more than three variables.

For each of the following questions rearrange the equation to make the variable in bold the subject of the equation.

Example force = mass x **acceleration** acceleration = $\frac{\text{force}}{\text{mass}}$

1) work done = force x **distance**

2) speed = $\frac{\textbf{distance}}{\text{time}}$

3) density = $\frac{\text{mass}}{\textbf{volume}}$

4) frequency = $\frac{1}{\textbf{time period}}$

Some you met had more than three variables

5) GPE = mass x gravity x **height**

6) Pressure difference = **density** x gravity x height

7) Current x voltage = $\frac{\text{energy}}{\textbf{time}}$

8) $\frac{\text{primary voltage}}{\text{primary turns}} = \frac{\text{secondary voltage}}{\textbf{secondary turns}}$

Some had extra functions

9) KE = ½ x mass x **velocity**^{2}

10) sin **c** = $\frac{1}{\text{refractive index}}$

1 Indices, standard form and prefixes

Indices

Indices are used in scientific calculations and formulae to simplify otherwise lengthy expressions. For example, $a \times a \times a \times a$ can be written as a^4, and b^7 is a more convenient way of writing $b \times b \times b \times b \times b \times b \times b$. The raised numbers ^{4} and ^{7} are called indices. We say that a^4 is 'a to the power 4' and 8^6 is '8 to the power 6'. Different powers of the same quantity can be multiplied or divided by expanding the expressions:

$$a^3 \times a^5 = (a \times a \times a) \times (a \times a \times a \times a \times a) = a^8$$

and

$$\frac{b^7}{b^2} = \frac{b \times b \times b \times b \times b \times b \times b}{b \times b} = b \times b \times b \times b \times b = b^5$$

In general, where m and n are positive integers (whole numbers):

$$a^n \times a^m = a^{n+m},\ a^n \div a^m = a^{n-m} \text{ and } (a^n)^m = a^{nm}$$

For example:

$$a^3 \div a^5 = a^{3-5} = a^{-2}$$

i.e. $$\frac{a^3}{a^5} = \frac{a \times a \times a}{a \times a \times a \times a \times a} = \frac{1}{a^2} = a^{-2}$$

This can be extended to give the general formula:

$$a^{-n} = \frac{1}{a^n}$$

You may also meet indices in the form of fractions:

$$b^{\frac{1}{2}} = \sqrt{b},\ b^{\frac{1}{3}} = \sqrt[3]{b},\ a^{\frac{1}{n}} = \sqrt[n]{a}$$

Prefixes and standard form

Powers of 10 are often used in physics (Table 1). Powers of 10 can be used to write numbers in standard form. For example:

$7342.6 = 7.3426 \times 10^3$

$0.003\ 56 = 3.56 \times 10^{-3}$

Table 1 Powers of ten

Number	Power of 10	Name	Prefix
1 000 000	10^6	one million	mega
100 000	10^5	one hundred thousand	
10 000	10^4	ten thousand	
1000	10^3	one thousand	kilo
100	10^2	one hundred	
10	10^1	ten	
0.1	10^{-1}	one tenth	deci
0.01	10^{-2}	one hundredth	centi
0.001	10^{-3}	one thousandth	milli
0.0001	10^{-4}	one ten thousandth	

Questions

Q1 Complete these general statements:

a $x^n x^m =$

b $\frac{x^m}{x^n} =$

c $(x^m)^n =$

d $x^0 =$

e $x^{-n} =$

Q2 Write down answers to parts a, b, c of question 1 if $m = 3$ and $n = 5$.

Q3 Work out without a calculator

a $25^{\frac{1}{2}}$

b $27^{\frac{1}{3}}$

c $128^{\frac{1}{7}}$

Q4 Write each of these numbers in standard form

a 6512

b 84 200

c 0.085

d 0.000 006 81

Find a way of confirming your answer with your calculator.

Q5 Write out in full the numbers represented by the standard notation:

a 8.9×10^2

b 7.61×10^{-5}

Find a way of confirming your answer with your calculator.

Q6 a Convert the distances below to standard form (to 3 s.f.) and indicate which of these distances is greatest:

i 39 500 000 000 km

ii 370 000 000 000 km

iii 4 000 000 000 km

b Convert the masses below to standard form (to 3 s.f.) and indicate which of these masses is smallest:

i 0.000 000 003 54 kg

ii 0.000 000 000 381 kg

iii 0.000 000 002 72 kg

Q7 Light travels at 100 000 000 metres per second. Use standard form to work out how many kilometers light travels in one year (this distance is called 1 light year).