A Level Physics Pre-Enrolment Work

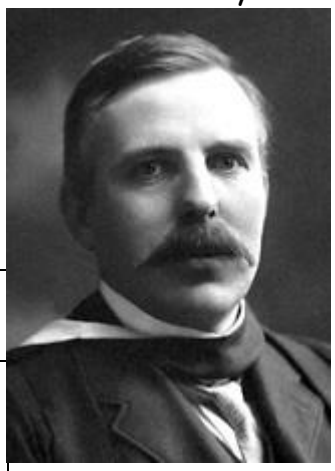
Instructions:

In the first year of the A level course you will build on work you should already have covered at GCSE on the structure of the atom, nuclear radiation and electrical circuits, as well as the skills you have developed in maths. It is important that you are 'up to speed' on all the **key concepts** surrounding these topics. Ensure that you complete all tasks and bring them with you on the **first day** of term.

Structure of the Atom

Ernest Rutherford:

In 1911 Ernest Rutherford instructed his assistants to fire _____ particles at a very thin sheet of _____. List below their observations (try to find 3 if you can) and what those observations mean for the model of the atom:



Observation	Conclusion (what it tells us about the atom)

'Modern' model of the atom:

Following on from Rutherford, a modern model of the atom was developed by _____ _____.

An uncharged atom has an equal number of _____ and _____.

Isotopes are atoms with the same number of _____ but a different number of _____.

The element Aluminium can be written as $^{27}_{13}Al$. What are the numbers of:

1. Protons in the nucleus? _____
2. Nucleons in the nucleus? _____
3. Neutrons in the nucleus? _____

Radioactive isotopes are atoms which emit one of the following types of radiation

Type	Made of ...	Produced when ...	Absorbed by ...
	2 protons, 2 neutrons		
Beta minus, β^-		Neutron changes into a _____, beta particle and _____	
Beta positive, β^+			

Electricity

Power Calculations:

mains voltage is 230 V	power = voltage × current
power *(* in W or Js^{-1}*)* = energy ÷ time	

1 a A hairdryer is connected to the 230 V mains and has a power rating of 1150 W.
Calculate the current in the hairdryer when working normally.

b Use the equation $V = IR$ to calculate the electrical resistance of the hairdryer.

2 An electric fire is rated 230 V 3 kW. How many joules of energy are transformed:

i in 1 second?

ii in 2 hours?

3 A microwave oven was used to cook some potatoes. It transformed 150 000 J of energy in 5 minutes.

a Calculate the power of the microwave oven.

b What did it cost to cook the potatoes if one unit (1 kWh) of electricity costs 8 p?

Scientific units and maths skills for physics

Although you are not required to study A-level Maths in order to study Physics you are expected to have good mathematical and analytical skills.

Standard form

Standard form helps tidy up very small or very large numbers in calculations.

For example:

There are about 31,600,000 seconds in a year, this format is sometimes referred to as decimal form.
In standard form this can be written as 3.16×10^{7} seconds

The size of the charge on an electron is 0.000 000 000 000 000 000 160 Coulombs
In standard form this can be written as 1.60×10^{-19} Coulombs

1: A current in an electrical circuit is measured as 0.00064 A. Rewrite this in standard form.

2: The half-life of a radioactive isotope is measured as 1.34×10^{5} s. Rewrite this in decimal form.

Complete the following calculations to determine a value for R. Give all answers in standard form.

3: $R = \dfrac{8.23 \times 10^{-6} \times 0.424}{3.85 \times 10^{-8}}$

4: $R = \dfrac{8.23 \times 10^{-6} \times 0.424}{3.85 \times 10^{8}}$

5: $R = \dfrac{8.23 \times 10^{6} \times 0.424}{3.85 \times 10^{-8}}$

6: $R = \dfrac{1.55 \times 10^{-6} \times (0.125 + 2.6 \times 10^{-2})}{4.55 \times 10^{-7}}$

Units

A measurement without a unit is meaningless and can lead to massive mistakes in calculations.

You need to make sure any quantities you are using are in the correct units before you use them in calculations.

The Système International (S.I.) is a set of standard units that are used around the world.

Complete the table with the correct S.I. base unit for the quantity given.

Quantity	S.I. base unit
time	
length	
mass	
temperature	
current	

Many more units can be derived from these base units. Units like this are called S.I. derived units.

The S.I. derived unit for speed comes from the equation $speed = \frac{distance}{time}$ the S.I. unit for distance is the metre the S.I. unit for time is the second so the S.I. derived unit for speed = $\frac{metres}{seconds}$ = m/s or ms^{-1}

1: Density is calculated using the formula density = $\frac{mass}{volume}$

What is the unit for density in terms of S.I. base units?

Numerical Prefixes

Quantises in physics come in a huge range of sizes. Prefixes are scaling factors that can help you write numbers across this range, you will already have come across some of them at GCSE.

For example: 1 centimetre = 0.01 metres or $1x10^{-2}$ metres
1 kilometre = 1000 metres or $1x10^{3}$ metres

Complete the table below showing the different prefixes you may encounter in A-level physics

For small quantities

Multiple	$1x10^{-15}$	$1x10^{-12}$	$1x10^{-9}$	$1x10^{-6}$	$1x10^{-3}$	$1x10^{-2}$	$1x10^{-1}$
Prefix						centi (c)	

For large quantities

Multiple	$1x10^{3}$	$1x10^{6}$	$1x10^{9}$	$1x10^{12}$
Prefix	kilo (k)			

Estimating

Estimates are useful when it's either not possible to be accurate (for example something that is hard to measure or that cannot be measured directly), or when a rough value is all that is required.

You may need to make estimates when planning an experimental procedure. Before starting the experiment it is useful to make rough estimate of the effect a change on the independent variable will have on the dependant variable. This helps you make a decision on the increments you should change your independent variable by and also on the equipment you will need to use to make your measurements. For example if you are expecting that by changing the resistance of a circuit the current flowing will change each time by a large number of amps then there is no point trying to measure the change with a milli-ammeter.

1: A student is investigating what happens to the length of a spring when different masses are suspended from the spring. She uses a ruler with mm increments to measure the length of the spring. A 25g mass causes the spring to extend about 1mm. Suggest a suitable increment for her to increase the mass between measurements.

2: A spherical balloon is filled with water.
a: Estimate the volume of the balloon. The volume of a sphere is given by $\frac{4}{3}\pi r^3$ where r is the radius of the sphere.

b: Estimate the mass of the balloon when filled with water.

Working with equations

In physics you need to be able to manipulate equations to give you the value you require rather than just using them as they are given.

For example:

The formula to calculate the kinetic energy of an object is $E_k = \frac{1}{2}\, mv^2$

When E_k = the kinetic energy, in Joules
m = the mass of the object, in kilograms
v = the velocity of the ball in ms^{-1}

Calculate the velocity of a ball of mass 5g with a kinetic energy of $6.25x10^{-2}$ J

$E_k = \frac{1}{2}\, mv^2$ must be rearranged to make velocity the subject of the formula to give.

$v = \sqrt{\frac{2E_k}{m}}$ then we substiutute in our known values $v = \sqrt{\frac{2\ x\ 6.25\ x10^{-2}}{5x10^{-3}}}$ = $5ms^{-1}$

1: The final velocity of an object travelling at a constant acceleration can be calculated from
v = u+at

Research what the following stand for in this equation.

v =

u =

a =

t =

A car is travelling at $15ms^{-1}$ calculate how much time it would take to reach a velocity of $22ms^{-1}$ if it had a constant acceleration of $0.80ms^{-2}$?

2: The electric force between two charged particles can be calculated by $F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$

Research what the following stand for in this equation.

F =

Q_1 =

Q_2 =

ε_0 =

r =

If the force between two electrons (each with a charge of $-1.60 \times 10^{-19} C$) is $2.6 \times 10^{-11} N$ what is the distance between them?

Graphs

Which of the graphs at the bottom of the page:

1: show that y is directly proportional to x?

2: show that there is a linear relationship between y and x?

3: show that y is inversely proportional to x?

Which of the graphs below is in the form y = mx +c

4: where c = 0 and m is +ve?

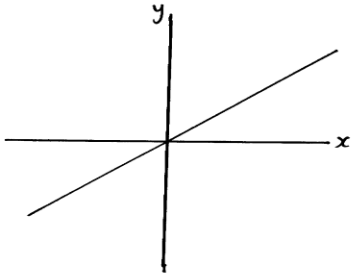
5: where c = +ve and m is +ve?

6: where c = +ve and m is –ve?

7: where c = -ve and m is +ve?

Note: - There may be more than one answer to each question

A



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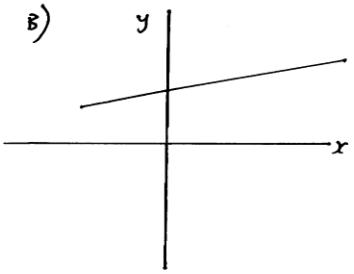

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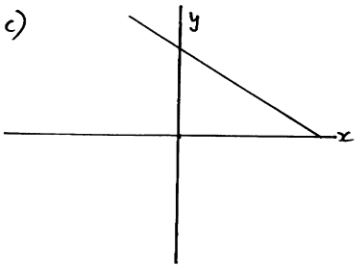

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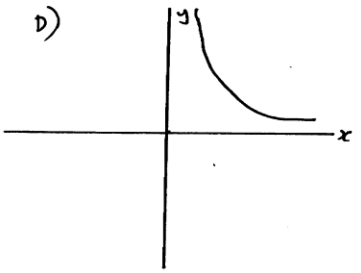

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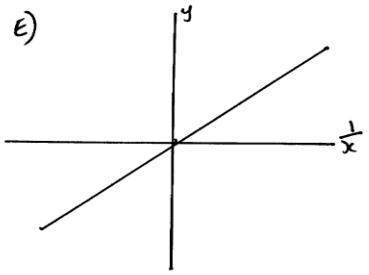

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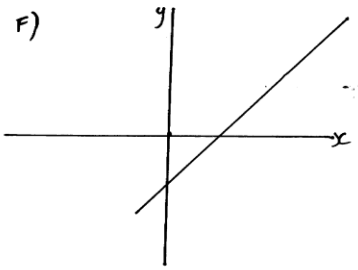

Useful Links and Further Information

Current GCE A Level Specification

http://www.aqa.org.uk/subjects/science/as-and-a-level/physics-7407-7408

Link to the Required Practical Handbook

http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF

If you are concerned that you may struggle to 'bridge the gap' between GCSE and A-level then I can recommend the **CGP** book '**Head Start to AS Physics**'.

https://www.cgpbooks.co.uk/secondary-books/as-and-a-level/science/physics/pbr71-head-start-to-a-level-physics

You will be issued with an AQA Year 1 Physics textbook and later on a Year 2 Physics textbook through the library.

However, you may wish to purchase your own copy.

The AQA Year 1 & 2 Complete Revision & Practice will be available through the college following enrolment in September.

https://www.cgpbooks.co.uk/secondary-books/as-and-a-level/science/physics/par73-new-a-level-physics-aqa-year-1-2-comple