

## Preparing for A-Level Physics

**Section 1:** This first section is a re-cap of GCSE skills and knowledge that are essential to working as A-level Physicist.

### Pre-Knowledge Topics

Below are ten topics that are essential foundations for you study of A-Level Physics. Each topics has example questions and links where you can find our more information as you prepare for next year.

#### Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	$\times 10^{-9}$
Micro	$\mu$	$\times 10^{-6}$
Milli	m	$\times 10^{-3}$
Centi	c	$\times 10^{-2}$
Kilo	k	$\times 10^3$
Mega	M	$\times 10^6$
Giga	G	$\times 10^9$

At A level, unlike GCSE, you need to remember all symbols, units and prefixes. Below is a list of quantities you may have already come across and will be using during your A level course

Quantity	Symbol	Unit
Velocity	v	$\text{ms}^{-1}$
Acceleration	a	$\text{ms}^{-2}$
Time	t	S
Force	F	N
Resistance	R	$\Omega$
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	$\text{kgms}^{-1}$
Power	P	W
Density	$\rho$	$\text{kgm}^{-3}$
Charge	Q	C

Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many eV in 0.511 MeV? Express in standard form.
10. How many m in 11 km? Express in standard form.

### Standard Form

At A level quantity will be written in standard form, and it is expected that your answers will be too.

This means answers should be written as  $\dots \times 10^y$ . E.g. for an answer of 1200kg we would write  $1.2 \times 10^3$ kg. For more information visit: [www.bbc.co.uk/education/guides/zc2hsbk/revision](http://www.bbc.co.uk/education/guides/zc2hsbk/revision)

1. Write 2530 in standard form.
2. Write 280 in standard form.
3. Write 0.77 in standard form.
4. Write 0.0091 in standard form.
5. Write 1 872 000 in standard form.
6. Write 12.2 in standard form.
7. Write  $2.4 \times 10^{-2}$  as a normal number.
8. Write  $3.505 \times 10^{-1}$  as a normal number.
9. Write  $8.31 \times 10^{-6}$  as a normal number.
10. Write  $6.002 \times 10^{-2}$  as a normal number.
11. Write  $1.5 \times 10^{-4}$  as a normal number.
12. Write  $4.3 \times 10^3$  as a normal number.

### Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

[www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable](http://www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable)

[www.youtube.com/watch?v=WWgc3ABSj4](http://www.youtube.com/watch?v=WWgc3ABSj4)

Rearrange the following:

1.  $E = m \times g \times h$  to find  $h$

2.  $Q = I \times t$  to find  $I$

3.  $E = \frac{1}{2} m v^2$  to find  $m$

4.  $E = \frac{1}{2} m v^2$  to find  $v$

5.  $v = u + at$  to find  $u$

6.  $v = u + at$  to find  $a$

7.  $v^2 = u^2 + 2as$  to find  $s$

8.  $v^2 = u^2 + 2as$  to find  $u$

## Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

<http://www.purplemath.com/modules/rounding2.htm>

Give the following to 3 significant figures:

1. 3.4527

4. 1.0247

2. 40.691

5. 59.972

3. 0.838991

Calculate the following to a suitable number of significant figures:

6.  $63.2/78.1$

7.  $39+78+120$

8.  $(3.4+3.7+3.2)/3$

9.  $0.0256 \times 0.129$

10.  $592.3/0.1772$

## Atomic Structure

You will study nuclear decay in more detail at A level covering the topics of radioactivity and particle physics. In order to explain what happens you need to have a good understanding of the model of the atom. You need to know what the atom is made up of, relative charges and masses and how sub atomic particles are arranged.

The following video explains how the current model was discovered

[www.youtube.com/watch?v=wzALbzTdnc8](http://www.youtube.com/watch?v=wzALbzTdnc8)

Describe the model used for the structure of an atom including details of the individual particles that make up an atom and the relative charges and masses of these particles. You may wish to include a diagram and explain how this model was discovered by Rutherford

## Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table. Don't wait until the end, discard anomalies and then write it up in neat.

Tables should have column heading and units in this format quantity/unit e.g. length /mm

All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

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

<http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf>

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Below is a table of results from an experiment where a ball was rolled down a ramp of different lengths. A ruler and stop clock were used.

1) Identify the errors the student has made.

Length/cm	Time			
	Trial 1	Trial 2	Trial 3	Mean
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

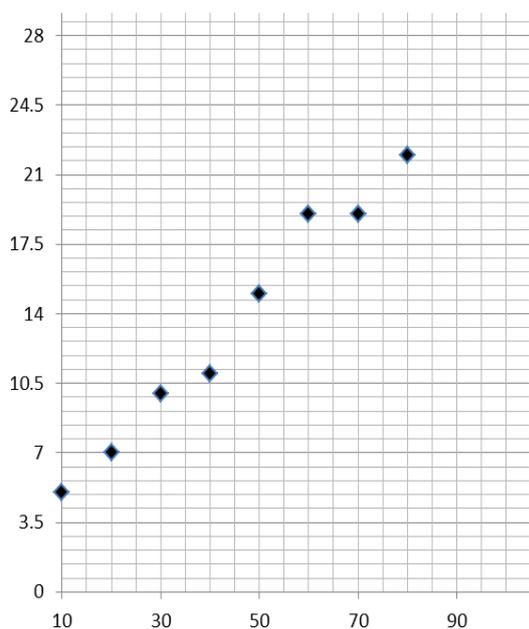
## Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

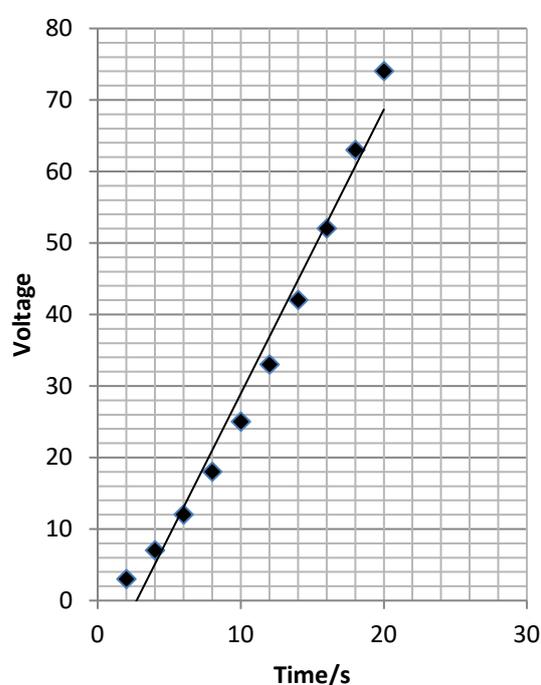
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Identify how the following graphs could be improved

**Graph 1**



**Graph 2**



## Forces and Motion

At GCSE you studied forces and motion and at A level you will explore this topic in more detail so it is essential you have a good understanding of the content covered at GCSE. You will be expected to describe, explain and carry calculations concerning the motion of objects. The websites below cover Newton's laws of motion and have links to these in action.

<http://www.physicsclassroom.com/Physics-Tutorial/Newton-s-Laws>

<http://www.sciencechannel.com/games-and-interactives/newtons-laws-of-motion-interactive/>

Sketch a velocity-time graph showing the journey of a skydiver after leaving the plane to reaching the ground.

Mark on terminal velocity.

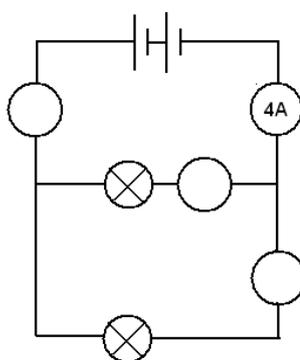
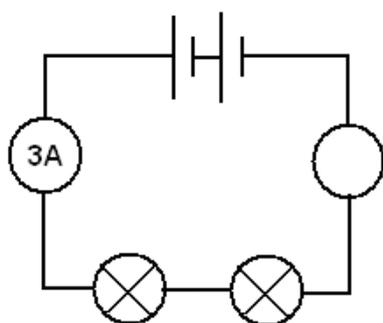
## Electricity

At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

<http://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/>

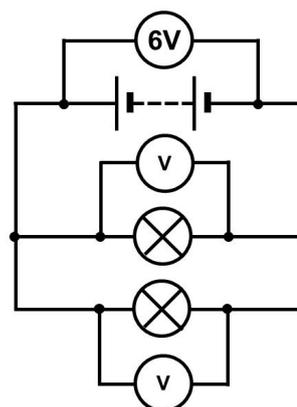
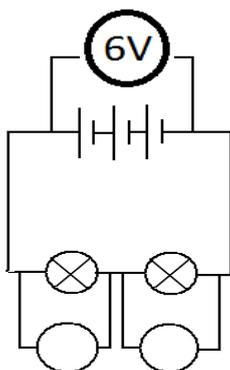
<http://www.physicsclassroom.com/class/circuits>

1a) Add the missing ammeter readings on the circuits below.



b) Explain why the second circuit has more current flowing than the first.

2) Add the missing potential differences to the following circuits



## Waves

You have studied different types of waves and used the wave equation to calculate speed, frequency and wavelength. You will also have studied reflection and refraction.

Use the following links to review this topic.

<http://www.bbc.co.uk/education/clips/zb7gkqt>

<https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves>

<https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves>

**1)** Draw a diagram showing the refraction of a wave through a rectangular glass block. Explain why the ray of light takes this path.

**2)** Describe the difference between a longitudinal and transverse waves and give an example of each

**3)** Draw a wave and label the wavelength and amplitude

## Section 2: Research and Reading Ahead

The topics studied in the first term of Year 12 are as follows

- Higher, Faster Stronger: A study of mechanics in the context of sports
- The Sound of Music – Fundamentals of waves in the context of music and sound
- Technology in Space – Circuits and the Photoelectric Effect, in the context of understanding how satellites function.

Your task is to read and research **one** of the contexts from the list below and produce a 1 to 2 page summary report to explain the physics

**Choose ONE of the following:**

1. **Tyrolean Transit:** In rock climbing the “tyrolean transit” is a way to cross a gorge or ravine using ropes. Find an image of a person doing a this and then find out:
  - \*the properties of the ropes required (in terms of strength, elasticity etc)
  - \*How the angle of transit affects the weight
  - \*How vectors can be used to calculate the force acting through the rope
2. **Archery:** Firing arrows from a bow towards a target requires the correct angle of launch and the perfect initial velocity. This can be understood by studying projectiles
  - \*Find out the definition of a projectile
  - \*Describe how the angle of launch affects the vertical and horizontal distances travelled
  - \*Describe how the initial velocity of the arrow will affect the distance travelled.

Use diagrams to help explain these points
3. **Stringed Instruments:** Instruments such as guitars, violins, ukuleles and cellos all have strings stretched over a hollow unit, which when plucked give notes. These instruments can be tuned by adjusting the tension on each string.
  - \*Research how a “standing wave” is formed on a string fixed at both ends to produce a harmonic note (a diagram would help)
  - \*Find out how the tension in the string affects the frequency (and therefore pitch) of note
  - \*What purpose does the hollow body of a stringed instrument serve?
4. **Wind Instruments:** Instruments such as flutes, oboes and recorders have a hollow tube. The air vibrates in this tube when it is played to produce a note, which is changed when holes are blocked along the instrument.
  - \*Research and describe how standing waves are produced in pipes (hollow tubes), using diagrams to explain what is meant by a harmonic
  - \*Explain why blocking holes (by moving fingers on the instruments) will lead to different notes being produced and explain why the position of these is crucial to having an instrument in tune.
  - \*Most wind instruments require a reed inserted in the mouthpiece to produce notes. Explain the purpose of the reed.
5. **Solar Panels:** Solar panels allow light from the sun to be transferred as electrical energy. These panels are also called photovoltaic panels. Research how solar panels work, including diagrams and an explanation of the photovoltaic effect.