Transition Pack for A-Level Physics

Get ready for A-level!

Activities to prepare you for A-level Physics

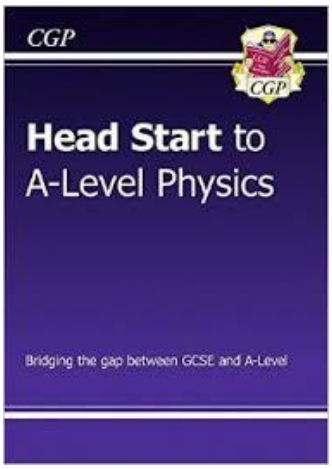


Welcome

We are happy that you have chosen to study A-Level Physics. You have chosen a very desirable subj for Universities and employers. The subject is, however, very demanding and requiring dedication. Please use this booklet to ease your transition into A-Level Physics. The recommended books and movie/video clips are just that, recommendations. This booklet also contains a range of activities on 'Pre-Knowledge Topics' that you can work through to prepare for the course. There is more informatio on these later in the booklet.

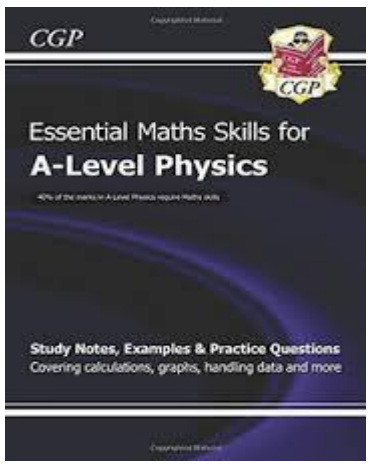
Preparation Book Recommendations

In addition to the mandatory, preparation work that you must complete before you sign on in September, you could use the Summer break to get a further head start to A- Physics. These books are excellent resources that will help you to hit the ground running as you start you're A-Level Physics course.



This fantastic Head Start book from CGP is the ideal way to bridge the gap between GCSE and A-Level Physics. It recaps all the crucial topics you'll need to remember from GCSE, with crystal-clear study notes and examples, plus practice questions to test your understanding. It also includes introductions to some of the key topics you'll meet at A-Level! (~ £4.95)

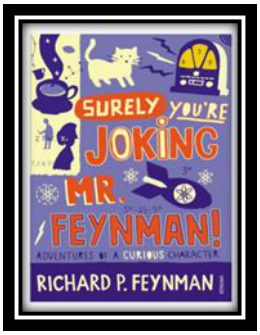
This brilliant CGP book covers all the maths skills needed in AS and A-Level Physics (the use of maths is required for up to 40% of the marks in the final exams and assessments). It explains Calculations, Geometry, Trigonometry, Graph Skills and Handling Date, with clear study notes and step-by-step examples in the context of Physics. And to make sure you've really got to grips with it all, there are practice questions for each topic - with answers included at the back of the book.
(~ £7.50)



Reading Recommendations

You may also want to spend some of your time over the Summer holidays having a read of one of these Physics and Physics related books. These books are not textbooks full of equation work and practice questions, rather they provide an insight into either the application of Physics or deals with an area of study that you will be encountering at A-Level for the first time.

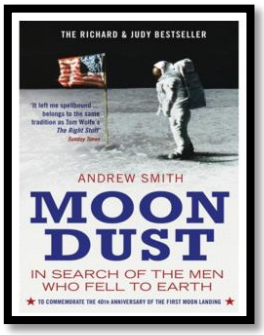
1. Surely You're Joking Mr Feynman: Adventures of a Curious Character



ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. This book will give you an insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle physics.
(Also available on Audio book).

https://www.waterstones.com/books/search/term/surely+youre+joking+mr+feynman++adventures+of+a+curious+character

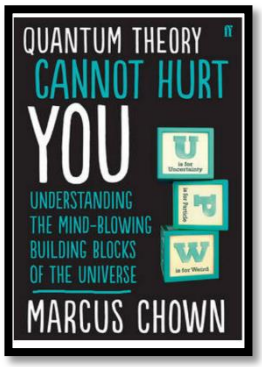
2. Moondust: In Search of the Men Who Fell to Earth



ISBN – 1408802384 - One of the greatest scientific achievements of all time was putting mankind on the surface of the moon. Only 12 men made the trip to the surface, at the time of writing the book only 9 are still with us. The book does an excellent job of using the personal accounts of the 9 remaining astronauts and many others involved in the space program at looking at the whole space-race era, with hopefully a new era of space flight about to begin as we push on to put mankind on Mars in the next couple of decades.

https://www.waterstones.com/books/search/term/moondust++in+search+of+the+men+who+fell+to+earth

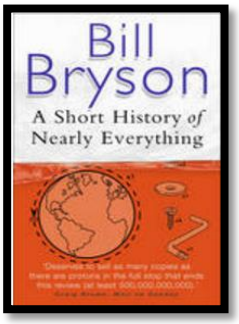
3. Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe



ISBN - 057131502X - Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics that requires no prior knowledge. In your first year of A-Level study you will meet the quantum world for the first time. This book will fill you with interesting facts and handy analogies to whip out to impress your peers!

https://www.waterstones.com/book/quantum-theory-cannot-hurt-you/marcus-chown/9780571315024

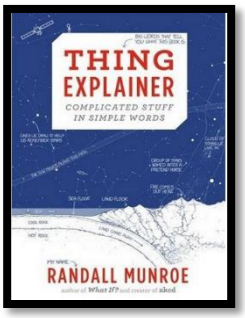
4. A Short History of Nearly Everything



ISBN – 0552997048 - A modern classic. Popular science writing at its best. A Short History of Nearly Everything Bill Bryson's quest to find out everything that has happened from the Big Bang to the rise of civilization - how we got from there, being nothing at all, to here, being us. Hopefully by reading it you will gain an awe-inspiring feeling of how everything in the universe is connected by some fundamental laws.

https://www.waterstones.com/books/search/term/a+short+history+of+nearly+everything

5. Thing Explainer: Complicated Stuff in Simple Words



ISBN – 1408802384 - This final recommendation is a bit of a wild-card – a book of illustrated cartoon diagrams that should appeal to the scientific side of everyone. Written by the creator of online comic XTCD (a great source of science humour) is a book of blueprints from everyday objects such as a biro to the Saturn V rocket and an atom bomb, each one meticulously explained BUT only with the most common 1000 words in the English Language. This would be an excellent coffee table book in the home of every scientist.
https://www.waterstones.com/book/thing-explainer/randall-munroe/9781473620919

Movie / Video Clip Recommendations

Hopefully you'll get the opportunity to soak up some of the Sun's rays over the summer – synthesising some important Vitamin-D – but if you do get a few rainy days where you're stuck indoors here are some ideas for films to watch or clips to find online.

Check out these great museums in Cambridge...entry is free!
- Whipple Museum of the History of Science
- Museum of Zoology (re-opening soon!)
- Sedgwick Museum of Earth Sciences

Science Fictions Films

1. **Moon (2009)**
2. **Gravity (2013)**
3. **Interstellar (2014)**
4. **The Imitation Game (2015)**
5. **The Prestige (2006)**

Online Clips / Series

Minute Physics – Variety of Physics questions explained simply (in felt tip) in a couple of minutes. Addictive viewing that will have you watching clip after clip – a particular favourite of mine is "Why is the Sky Dark at Night?"

https://www.youtube.com/user/minutephysics

Wonders of the Universe / Wonders of the Solar System – Both available of Netflix as of 17/4/16 – Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

Shock and Awe, The Story of Electricity – A 3 part BBC documentary that is essential viewing if you want to see how our lives have been transformed by the ideas of a few great scientists a little over 100 years ago. The link below takes you to a stream of all three parts joined together but it is best watched in hourly instalments. Don't forget to boo when you see Edison. (alternatively watch any Horizon documentary – loads of choice on Netflix and the I-Player)

https://www.youtube.com/watch?v=Gtp51eZkwoI

NASA TV – Online coverage of launches, missions, testing and the ISS. Plenty of clips and links to explore to find out more about applications of Physics in Space technology.

http://www.nasa.gov/multimedia/nasatv/

The Fantastic Mr. Feynman – I recommended the book earlier, I also cannot recommend this 1 hour documentary highly enough. See the life's work of the "great explainer", a fantastic mind that created mischief in all areas of modern Physics.

https://www.youtube.com/watch?v=LyqIeIxXTpw

Maths skills

1. Convert the following measurements:
   a) 5.6 cm to mm
   b) 76.9 cm to m
   c) 87.58 mm to m
   d) 0.245 m to mm

2. What is the area of the following in m^2:
   [Hint: convert the dimensions to m before doing the calculation]

   a) a rectangle that is 59.5 cm by 0.25 cm
   b) a square that is 55 mm by 55 mm
   c) a circle with a radius of 0.25 cm
   d) a circle with a diameter of 590 mm
   e) a right angle triangle with a base of 2.58 cm and a height of 12.8 cm

3. Write the following in standard form:
   a) 0.0025
   b) 125000
   c) 0.0000568
   d) 7840000000

4. Solve the following:
   a) 5% of 9.81
   b) 2% of 125000
   c) 1% of 5000

5. Express the following as a percentage:
   a) 45 out of 1245
   b) 3.6 out of 12.8
   c) 0.25 out of 1.5

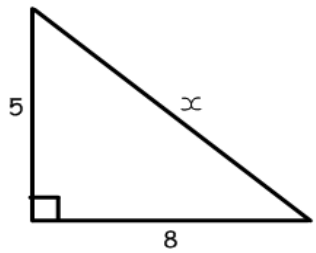
6. Answer the following:
   a) $12.58x10^{19} + 1.2x10^{18}$
   b) $2.2x10^{23} \times 1.2x10^{18}$
   c) $1.5x10^{34} / 2x10^{18}$
   d) $6.859x10^{-7} \times 2.8x10^{-5}$

7. Solve the following equations:
   a) $15.85x10^{19} + 1.2x10^{8}$
   b) $2.2x10^{3} \times 1.2x10^{18}$
   c) $2.5x10^{34} / 0.8x10^{18}$
   d) $6.859x10^{-8} \times 2.8x10^{-4}$
   e) $1.85x10^{-8} + 1.2x10^{6}$
   f) $2.895x10^{5} \times 1.2x10^{-7}$
   g) $6.54x10^{34} / 0.6x10^{25}$
   h) $2.65x10^{-2} \times 2.8x10^{-4}$
   i) $1.23x10^{-7} + 5.2x10^{12}$
   j) $2.25x10^{-3} \times 1.58x10^{16}$

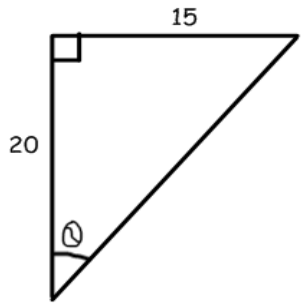
8. Determine the unknown:
   a) $37 = 17 + 0.5t$
   b) $25^2 = 10^2 + 2 \times a \times 15$
   c) $1.5 \times 10^{-13} = 6.2 \times 10^{-7} f$
   d) $5.6 \times 10^{-23} = 6.3 \times 10^{-13} + 0.5 \times m \times (2.5 \times 10^{3})^2$
   e) $12 = 16 - 2.3r$

k) Find the unknowns using trigonometry:

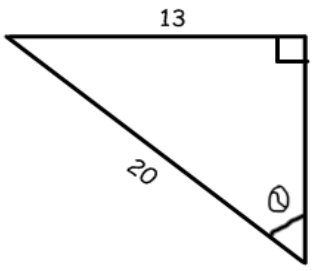
a)



b)



c)



1. Plot a scatter graph with a line of best fit for the following data. The line of best fit needs to occupy at least $\frac{2}{3}$ of the graph paper. You can use a false origin.

length (cm)	time for oscillation (s)
51	104
62	125
70	150
88	185
99	202
102	210
110	224

2. Plot a scatter graph with a line of best fit for the following data. The line of best fit needs to occupy at least $\frac{2}{3}$ of the graph paper. You can use a false origin.

Voltage (V)	Current (A)
-6	-0.0510
-5	-0.0411
-4	-0.0350
-3	-0.0222
-2	-0.0180
-1	-0.0079
0	0.0000
1	0.0085
2	0.0179
3	0.0310
4	0.0312
5	0.0420
6	0.0516

Basic Knowledge questions from GCSE to A-Level Physics

Current electricity

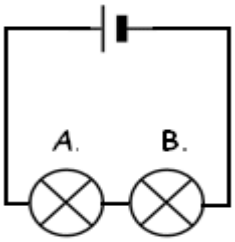
1) Calculate the current if the voltage is 10V and the resistance is 2.5Ω.

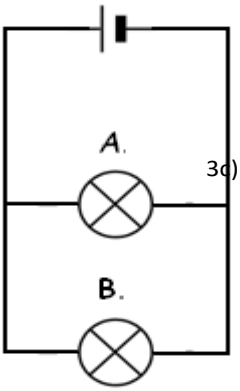
2a) Calculate the charge if the current of a phone charger is 2A and is left on for 10mins.

2b) Calculate the energy transferred of the phone charger if the voltage is 12V.

2c) Calculate the power of the phone charger.

3a) Place an ammeter and voltmeter in the circuit below so you are able to find the current in the circuit and the voltage in bulb A.





3c)

3b) Determine the voltage across each bulb in both circuits if the voltage across the cell is 6V (label diagrams with answers)?

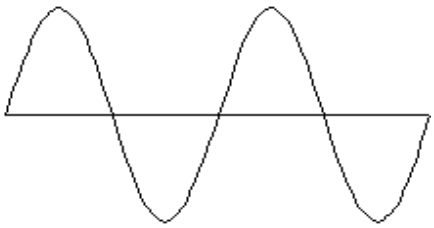
3c) Determine the current through each bulb in both circuits if the current immediately after the cell is 2A and all bulbs have equal resistance (label diagrams with answers)?

3d) Calculate the resistance of each bulb in the series circuit above, using the values you have calculated.

3e) What is the total resistance of the series circuit?

Waves

4) Label the diagram below with the amplitude and wavelength of the wave.

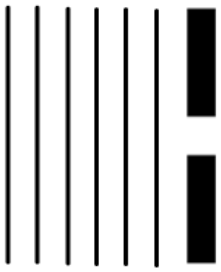


5) What happens to the noise of a sound wave if you increase the frequency?

6) What happens to the noise of a sound wave if you increase the amplitude?

7) Describe the difference between a longitudinal and transverse wave.

8a) Label the diagram below to show diffraction through a barrier.



8b) When does maximum diffraction occur?

9) Calculate the wavelength of a wave when it is travelling at 25m/s and the time period is 0.2seconds.

10) State the order of the EM spectrum and give one use of each wave.

Mechanics

11) State the difference between a scalar and a vector, and give two examples of each.

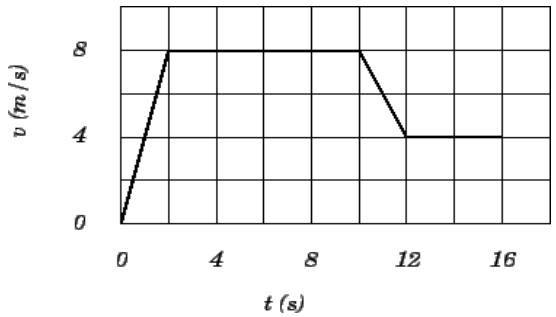
12) Calculate the speed if a car travels 108000m in 1 hour.

13) A ball is at rest, it is then kicked to a speed of 12m/s in 0.5seconds. Calculate the balls acceleration.

14a) Label the velocity-time graph below showing the motion at each stage of the journey.

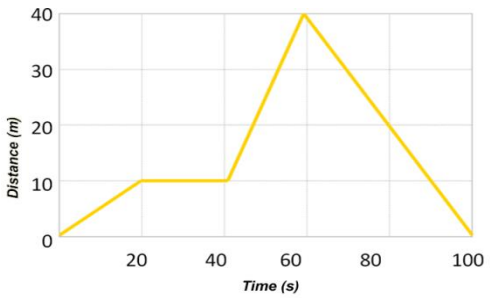
14b) Calculate the acceleration in the first 2 seconds.

14c) Calculate the total distance travelled:



15a) Label the distance-time graph below showing the motion at each stage of the journey.

15b) Calculate the velocity from 40 – 60 seconds.

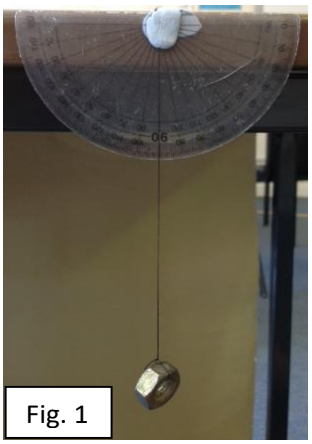


16) If an object is pushed with a resultant force of 10kN and has a mass of 2 tons, what will its acceleration be?

17) Explain why any car would have a maximum top speed. (Hint: this is to do with terminal velocity).

Determining acceleration due to gravity, *g*, from a pendulum swing

Method


Fig. 1

1. Make a pendulum by tying a small mass (such as a nut) to a piece of cotton (or thin string) that is about 1 m long.
2. Stick (Blu-tack works well) a protractor to the edge of a table and then using another piece of Blu-tack on the front of the protractor, hang the pendulum so that the thread lines up with 90° (see Fig. 1).
3. Adjust the length of the pendulum until it is 0.1 m long
4. Pull the pendulum to one side through an angle of 20° from the vertical (see Fig. 2).
5. Release the pendulum and record the time taken for it to do 10 complete swings.
6. Repeat two more times.
7. Adjust the length of the pendulum to 0.2 m and repeat steps 4-6.
8. Adjust the length of the pendulum to 0.3 m and repeat steps 4-6.
9. Adjust the length of the pendulum to 0.4 m and repeat steps 4-6.
10. Adjust the length of the pendulum to 0.5 m and repeat steps 4-6.
11. Adjust the length of the pendulum to 0.6 m and repeat steps 4-6.

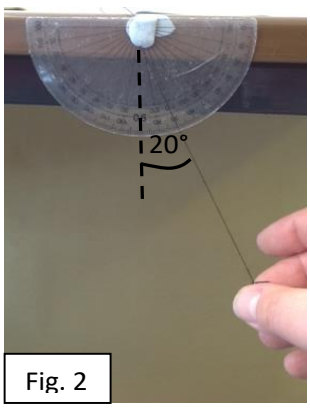


Fig. 2

Results table

- The independent variable (length of pendulum) must be in the first column.
- You must show all the repeats for each pendulum length.
- Calculate the average of the repeats for each pendulum length and record this in the results table.
- Determine the time for one swing (T) for each pendulum length and record this in the results table.
- Determine T^2 for each pendulum length and record this in the results table.
- Make sure each column has a heading and units. Length must be in metres and time in seconds. You can use second^2 (s^2) as the unit for T^2.

Graph

- Plot a scatter graph of length on the X-axis and T^2 on the Y-axis. Do not use a false origin.
- Draw the line of best fit. In this practical, the line of best is straight so must be drawn with a ruler and it goes through the origin. Remember, there must be an even spread of points each side of the line of best fit.
- Determine the gradient of the line.

Determining acceleration due to gravity, *g*.

The gradient of the line = $\frac{4\Pi^2}{g}$

Use this to determine *g*, acceleration due to gravity (it has the units ms^{-2}).

The Rationale

The time it takes a pendulum to do one complete swing (T) and the length of the pendulum (l) are related by the equation:

$$T = 2\Pi \sqrt{\frac{l}{g}}$$

where g is acceleration due to gravity.

Trying to plot graphs of equation with square roots in can become complicated so it is easiest to get rid of the square root but squaring every term. The equation now becomes:

$$T^2 = 2^2\Pi^2 \left(\frac{l}{g}\right)^2$$

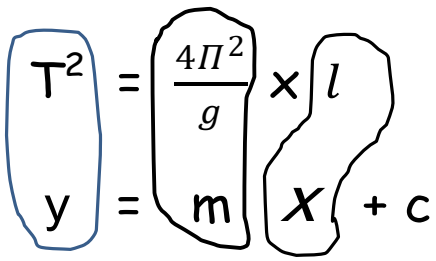
Which simplified gives us:

$$T^2 = 4\Pi^2 \frac{l}{g} \qquad \text{or another way} \qquad T^2 = \frac{4\Pi^2}{g} \times l$$

The equation of a straight line is:

$$y = mx + c$$

We need to equate $T^2 = \frac{4\Pi^2}{g} \times l$ to $y = mx + c$.



If we plot T^2 on the y-axis and l on the x-axis, then $\frac{4\Pi^2}{g}$ is the gradient of the line. There is nothing that equates to + c so the line must go through the origin.

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	$x\ 10^{-9}$
Micro	μ	$x\ 10^{-6}$
Milli	m	$x\ 10^{-3}$
Centi	c	$x\ 10^{-2}$
Kilo	k	$x\ 10^{3}$
Mega	M	$x\ 10^{6}$
Giga	G	$x\ 10^{9}$

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	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	S
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	$kgms^{-1}$
Power	P	W
Density	ρ	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 ….x 10^{y}. E.g. for an answer of 1200kg we would write 1.2 x 10^{3}kg. For more information visit: 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 x 10^{2} as a normal number.
8. Write 3.505 x 10^{1} as a normal number.
9. Write 8.31 x 10^{6} as a normal number.
10. Write 6.002 x 10^{2} as a normal number.
11. Write 1.5 x 10^{-4} as a normal number.
12. Write 4.3 x 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

www.youtube.com/watch?v=_WWgc3ABSj4

Rearrange the following:

1. E=m x g x h to find h
2. Q= I x 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
2. 40.691
3. 0.838991
4. 1.0247
5. 59.972

Calculate the following to a suitable number of significant figures:

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

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

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

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.

	Time			
Length/cm	**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

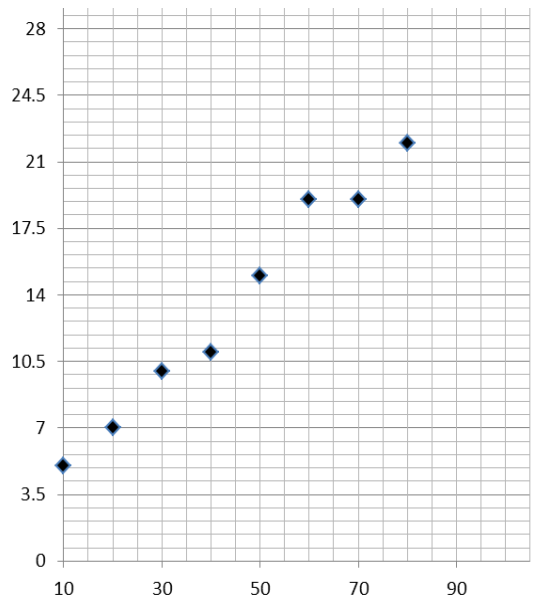
Graphs

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:

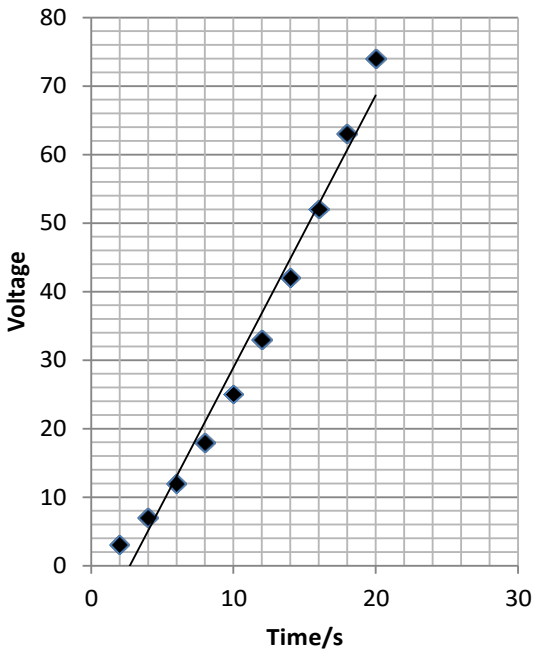
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a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

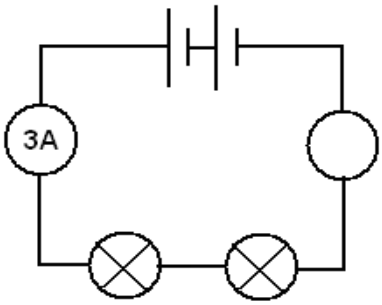
Electricity

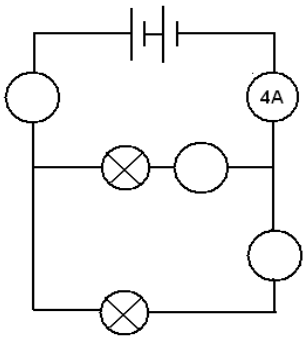
At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

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

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

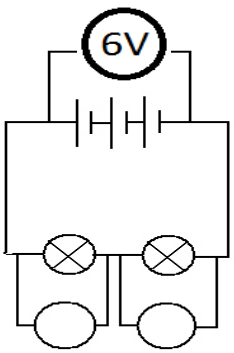
1a) Add the missing ammeter readings on the circuits below.

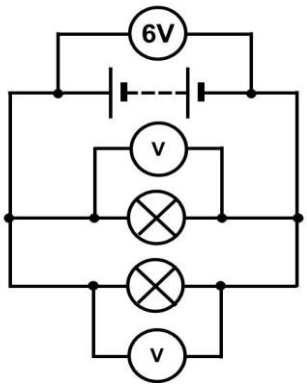




b) Explain why the second circuit has more current flowing than the first.

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

Pre-Knowledge Topics Answers:

Symbols and prefixes

1. 2400
2. 8 100 000
3. 326 000 000 000
4. 54.6
5. 240 000
6. 1.8×10^{-8}
7. 6.32×10^{-7}
8. 1.002
9. 5.11×10^{-5}
10. 1.1×10^{4}

Standard Form:

1. 2.53
2. 2.8
3. 7.7
4. 9.1
5. 1.872
6. 1.22
7. 2400
8. 35.05
9. 8 310 000
10. 600.2
11. 0.00015
12. 4300

Rearranging formulae

1. $h = E/(m \times g)$
2. $I = Q/t$
3. $m = (2 \times E)/v^2$ or $E/(0.5 \times v^2)$
4. $v = \sqrt{((2 \times E)/m)}$
5. $u = v - at$
6. $a = (v-u)/t$
7. $s = (v^2 - u^2) / 2a$
8. $u = \sqrt{(v^2-2as)}$

Significant figures

1. 3.35
2. 40.7
3. 0.839
4. 1.02
5. 60.0
6. 0.809
7. 237
8. 3.4
9. 0.00330
10. 3343

Atomic Structure

contains protons, neutrons and electrons

Relative charge:

protons are positive (+1)

electrons are negative (-1)

neutrons are uncharged (0)

Relative mass:

proton 1

neutron 1

electron (about) 1/2000

protons and neutrons make up the nucleus

the nucleus is positively charged

electrons orbit the nucleus at a relatively large distance from the nucleus

most of the atom is empty space

nucleus occupies a very small fraction of the volume of the atom

most of the mass of the atom is contained in the nucleus

total number of protons in the nucleus equals the total number of electrons orbiting it in an atom

Recording data

Time should have a unit next to it

Length can be measured to the nearest mm so should be 10.0, 22.0 etc

Length 65 trial 2 is an anomaly and should have been excluded from the mean

All mean values should be to 2 decimal places

Mean of length 61 should be 6.99 (rounding error)

Graphs

Graph 1:

Axis need labels

Point should be x not dots

Line of best fit is needed

y axis is a difficult scale

x axis could have begun at zero so the y-intercept could be found

Graph 2:

y-axis needs a unit

curve of best fit needed not a straight line

Point should be x not dots

Forces and motion

Graph to show acceleration up to a constant speed (labelled terminal velocity). Rate of acceleration should be decreasing. Then a large decrease in velocity over a short period of time (parachute opens), then a decreasing rate of deceleration to a constant speed (labelled terminal velocity)

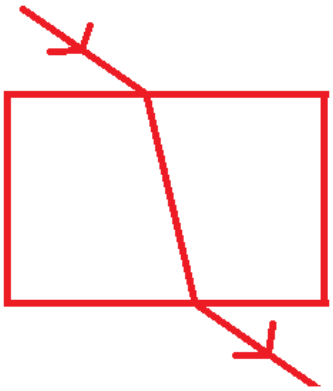
Electricity

1a) Series: 3A, Parallel top to bottom: 4A,2A,2A

b) Less resistance in the parallel circuit. Link to R=V/I. Less resistance means higher current.

2) Series: 3V, 3V, Parallel: 6V 6V

Waves



1) When light enters a more optically dense material it slows down and therefore bends towards the normal. The opposite happened when it leaves an optically dense material.

2) A longitudinal wave oscillates parallel to the direction of energy transfer (e.g. sound). A transverse waves oscillated perpendicular to the direction of energy transfer (e.g. light)

3)

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