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Transition Pack for A Level Physics

Get ready for A-level!

**A guide to help you get ready for A-level Physics,
including everything from topic guides to days out and
online learning courses.**

Commissioned by The PiXL Club Ltd. February 2016

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**Please note: these resources are non-board specific. Please direct your
students to the specifics of where this knowledge and skills most apply.**

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So you are considering A Level Physics?

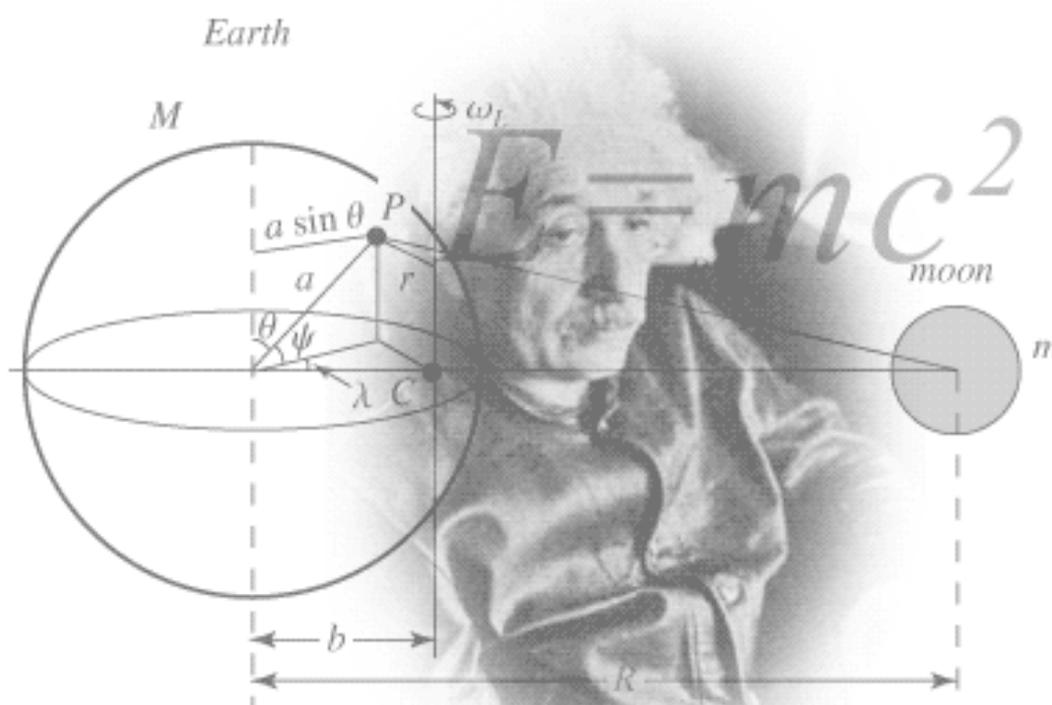


Figure 1 <http://scienceworld.wolfram.com/physics/images/main-physics.gif>

This pack contains a programme of activities and resources to prepare you to start an A level in Physics in September. It is aimed to be used after you complete your GCSE, throughout the remainder of the Summer term and over the Summer Holidays to ensure you are ready to start your course in September.

Pre-Knowledge Topics

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

Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	$\times 10^{-9}$
Micro	μ	$\times 10^{-6}$
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	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 $\dots \times 10^y$. E.g. for an answer of 1200kg we would write 1.2×10^3 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 2.4×10^{-2} as a normal number.
8. Write 3.505×10^{-1} as a normal number.
9. Write 8.31×10^{-6} as a normal number.
10. Write 6.002×10^{-2} as a normal number.
11. Write 1.5×10^{-4} as a normal number.
12. Write 4.3×10^3 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. $E = m \times g \times h$ 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. 0.0256×0.129

10. $592.3/0.1772$

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.

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

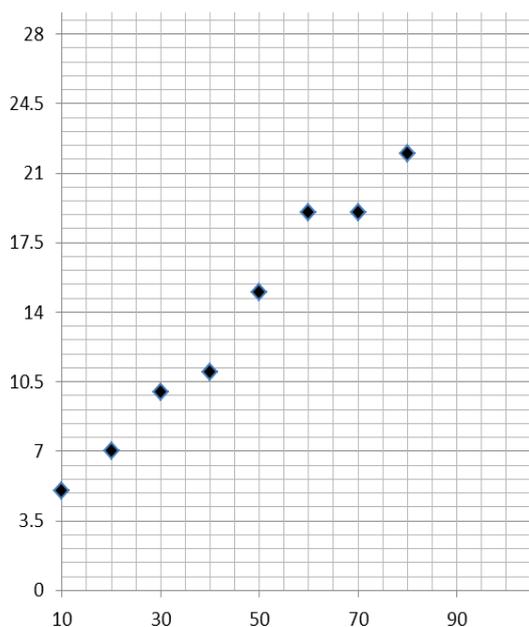
Graphs

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:

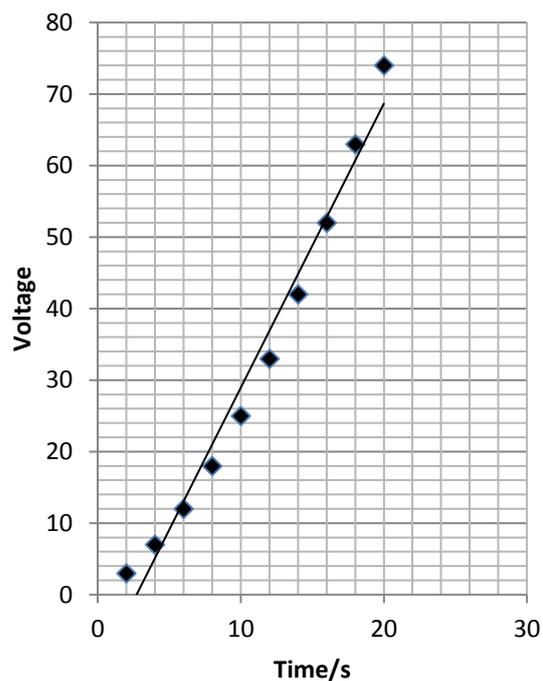
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a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

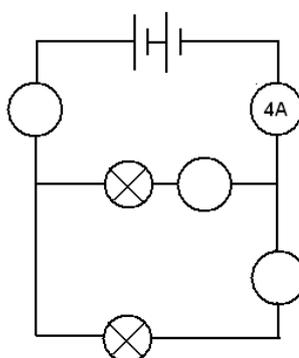
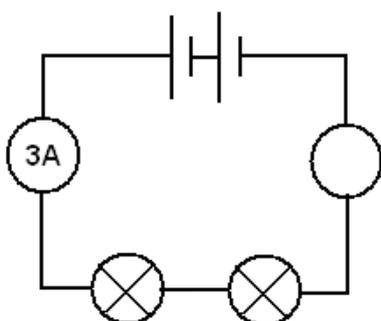
Electricity

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/>

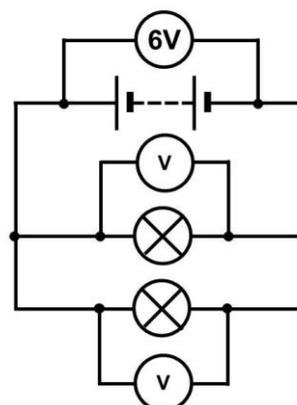
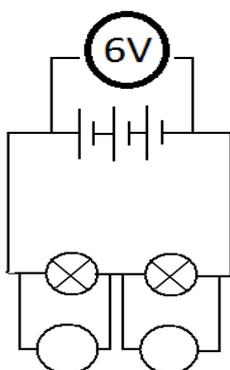
<http://www.physicsclassroom.com/class/circuits>

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

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)

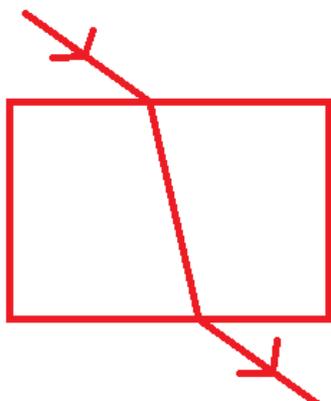
Electricity

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)

