Morecambe Bay Academy

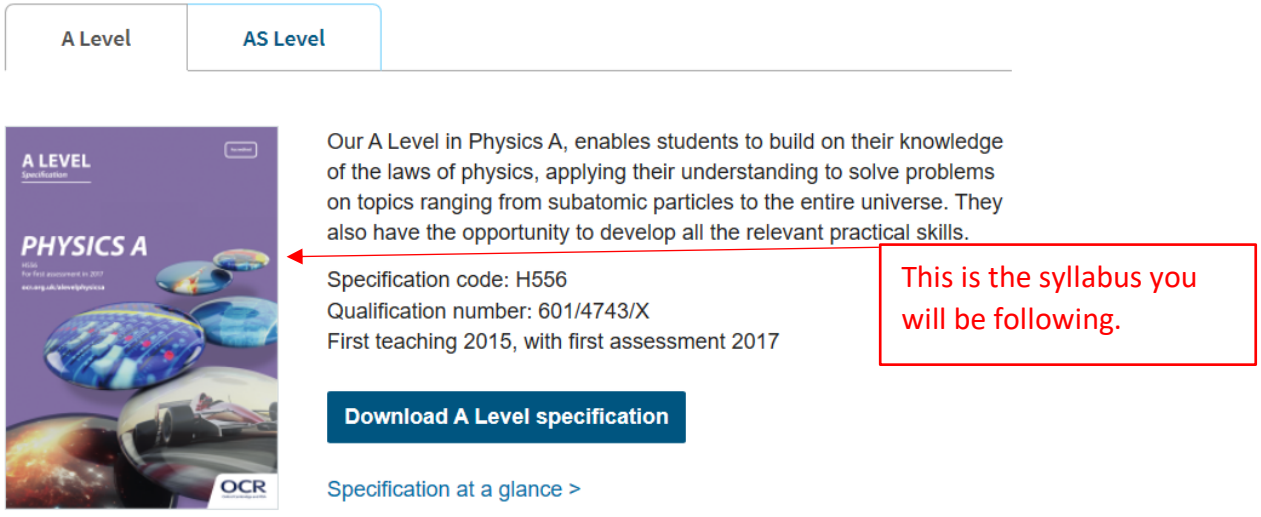
A level Physics Transition Work

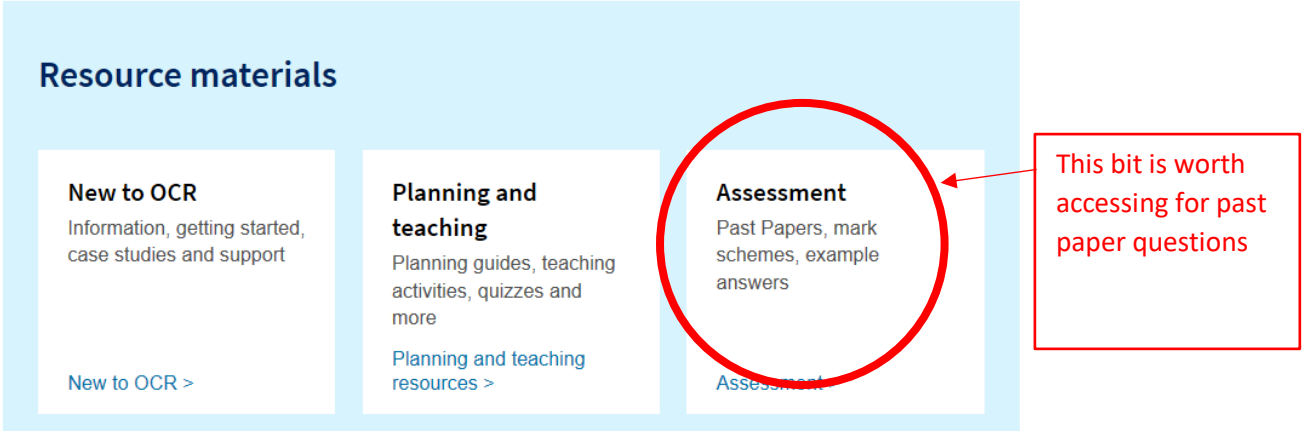
Welcome

We are happy that you have chosen to study A-Level Physics. You have chosen a very desirable subject for Universities and employers. The subject is, however, very demanding and requires dedication. Please use this booklet to ease your transition into A-Level Physics. The recommended books and movie/video clips are just that, recommendations. There are additional questions on 'Pre-Knowledge Topics' that should be completed before you start. There is more information on this later in the booklet.

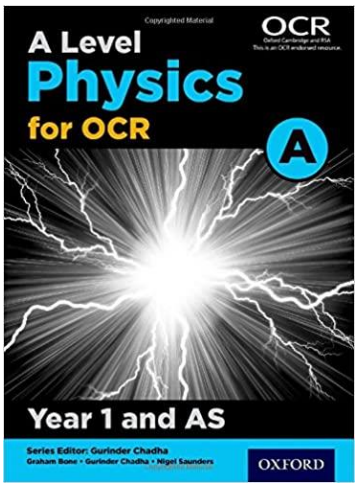
The course you will be following is OCR A level Physics A (H556). The home page is:-

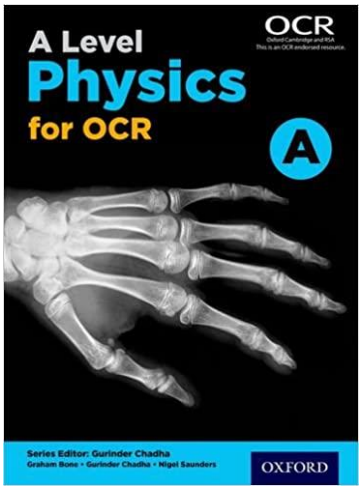
https://www.ocr.org.uk/qualifications/as-and-a-level/physics-a-h156-h556-from-2015/





This is the text book we will be using. It is very good and you will not need an additional revision guide. We will provide you with the Year 1 and AS book for Year 12, then the full book for Year 13

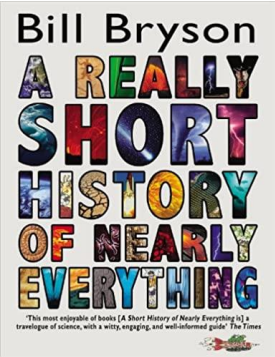




Get Inspired! Find out about Physics.

Recommended (Not compulsory!) reading, podcasts and websites

A Short History of Nearly Everything- Bill Bryson

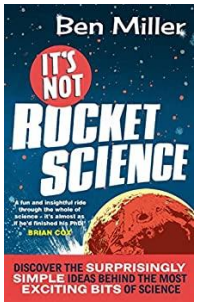


ISBN – 0552997048 – This is a modern classic; popular science writing at its best. It covers everything that has happened from the Big Bang to the rise of civilization - how we got from there, being nothing at all, to here, being us. Hopefully by reading it you will gain an awe-inspiring feeling of how everything in the universe is connected by some fundamental laws. The Physics bits are great and cover everything you need to know up to A level, but all of it's a good read.

Free download here!

https://archive.org/details/AShortHistoryofNearlyEverything_201706/page/n27/mode/2up

It's not Rocket Science- Ben Miller (you'll recognize him from TV)



Black holes. DNA. The Large Hadron Collider. Ever had that sneaking feeling that you are missing out on some truly spectacular science? You do? Well, fear not, for help is at hand.

Ben Miller was working on his Physics PhD at Cambridge when he accidentally became a comedian. But first love runs deep, and he has returned to his roots to share with you all his favourite bits of science. This is the stuff you really need to know, not only because it matters but because it will quite simply amaze and delight you.

Podcast: The infinite Monkey Cage

The Infinite Monkey Cage is a BBC Radio 4 comedy /popular science series. Hosted by physicist Brian Cox and comedian Robin Ince it is a "witty and irreverent look at the world according to science"

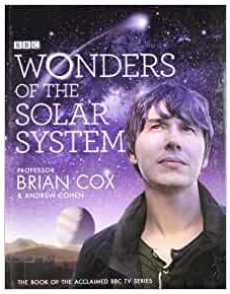
https://www.bbc.co.uk/programmes/b00snr0w/episodes/downloads

Online Clip / Series: **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?”

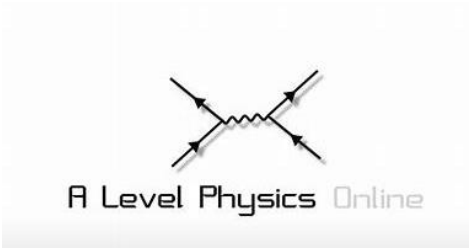
https://www.youtube.com/user/minutephysics

TV Series. Wonders of the Universe / Wonders of the Solar System



Both available of Netflix. Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

Useful YouTube Channel. A level Physics Online



This covers all of the OCR A level Physics course that you will be following.

HIGHLY RECOMMENDED FOR REVISION

https://www.youtube.com/channel/UCZzatyx-xC-DI_VVUVHYDYw

On YouTube just type in a subject e.g. ‘a level physics on line free fall’- and you get a run through of what you need to know.

During the lockdown, they are doing live stream lessons everyday at 12PM which might be useful too

What you should do.

The entry requirements for A level Physics is Grade 6 in Physics or Combined Science GCSE. It helps (but is not necessary) to also take Maths.

First, check how good you are at the GCSE work. Here are links to the 2018 Physics exam papers and markschemes.

Paper 1 Higher

https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2018/june/AQA-84631H-QP-JUN18.PDF

https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2018/june/AQA-84631H-W-MS-JUN18.PDF

Paper 2 Higher

https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2018/june/AQA-84632H-QP-JUN18.PDF

https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2018/june/AQA-84632H-W-MS-JUN18.PDF

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

Maths/ Practical skills questions to do

(answers at the back of this booklet)

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 10y. E.g. for an answer of 1200kg we would write 1.2 x 103kg. 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-avariable

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 = ½ m v^2 to find m
4. E = ½ 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 = 6.75ms^{-1}

(note: units such as m/s, m/s^2 are now expressed ms^{-1}, ms^{-2})

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:

6. 63.2/78.1

7. 39+78+120

8. (3.4+3.7+3.2)/3

9. 0.0256 x 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 is a link to the OCR A level practical handbooks so you can familiarise yourself with expectation.

https://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.

	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

Identify the errors the student has made.

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

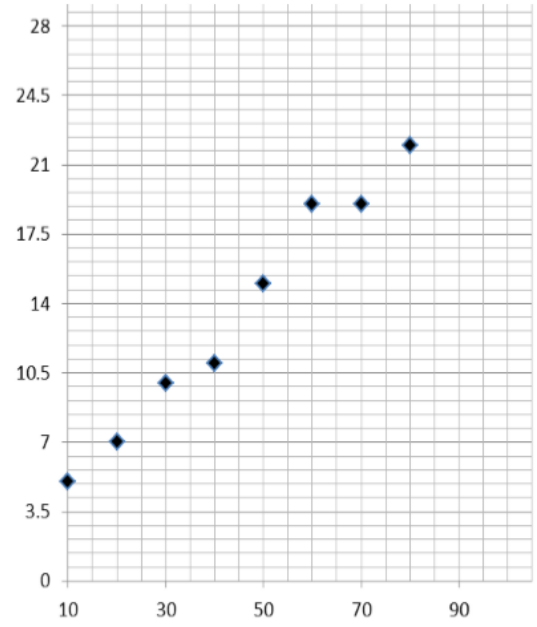
• whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.

• the plots should cover at least half of the grid supplied for the graph.

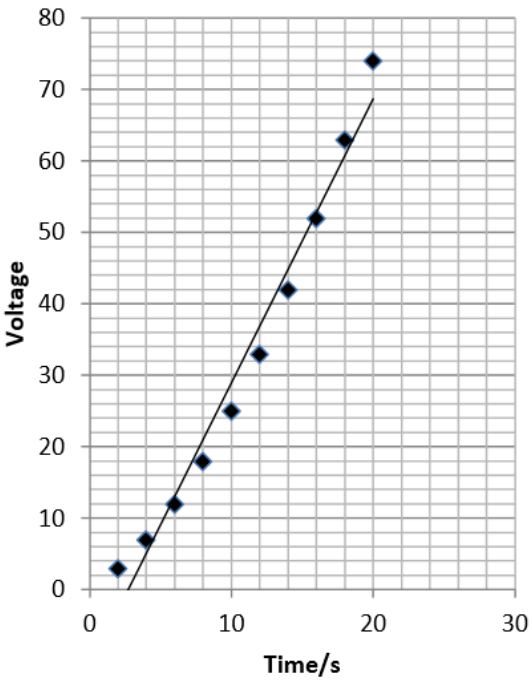
• the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Identify how the following graphs could be improved

Graph 1



Graph 2



Physics Subject Questions.

Answers not included. Write these down. These will be marked

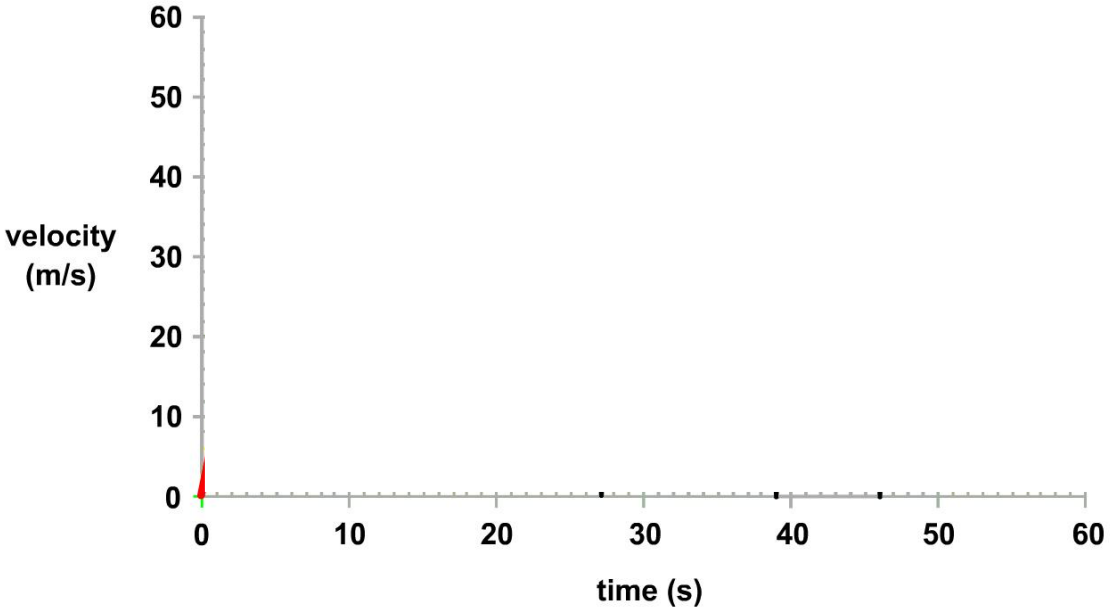
Forces and Motion

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 website below covers Newton's laws of motion and have links to these in action.

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

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

Basic Knowledge questions from GCSE to A-Level Physics

Current electricity

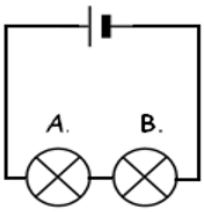
1) Calculate the current if the voltage is 10V and the resistance is 2.5Ω.

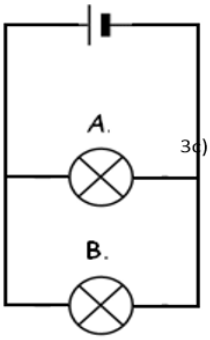
2a) Calculate the charge if the current of a phone charger is 2A and is left on for 10mins.

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.





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

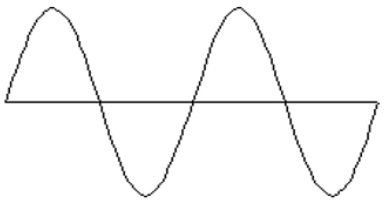
3c) 3c) Determine the current through each bulb in both circuits if the current immediately after the cell is 2A and all bulbs have equal resistance (label diagrams with answers)?

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.

You will need to look this us. Not covered in Physics GCSE

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.

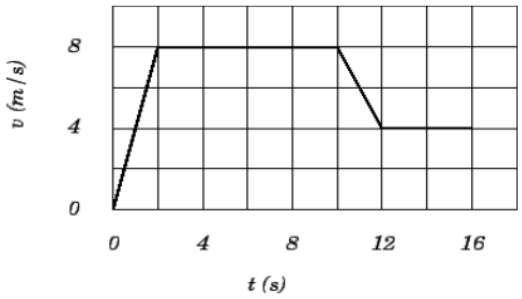
12) Calculate the speed if a car travels 108000m in 1 hour.

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.

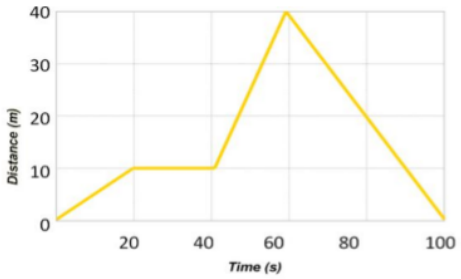
14b) Calculate the acceleration in the first 2 seconds.

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).

A practical for you to do…

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

Method

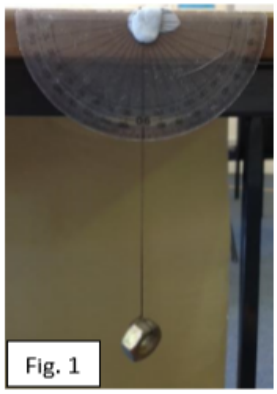


Fig. 1

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.

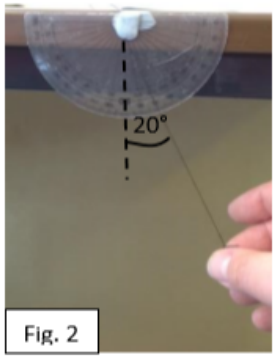


Fig. 2

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.

RESULTS TABLE (make sure to include units)

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}).

$g = 4 \times \pi^2 \div \text{gradient}$ g should work out to be around $9.8ms^{-2}$

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:

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

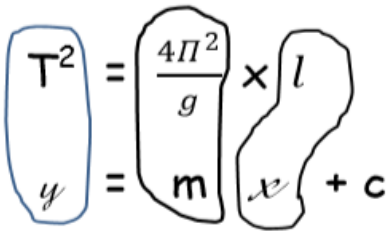
Which simplified gives us:

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

The equation of a straight line is:

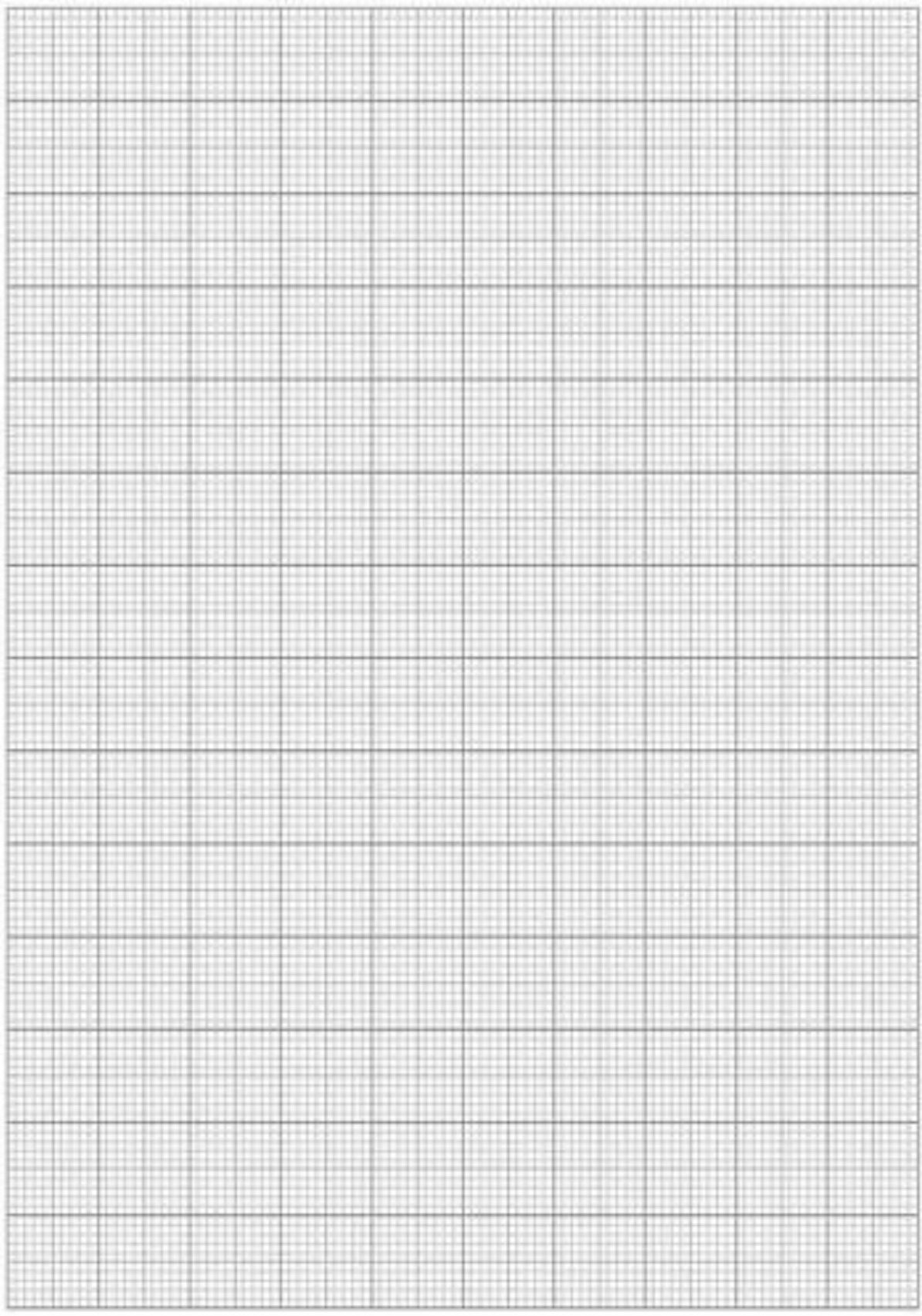
$$y = mx + c$$

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.

Graph of T^2 against length of pendulum



ANSWERS for Maths/ Practical skills questions

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

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