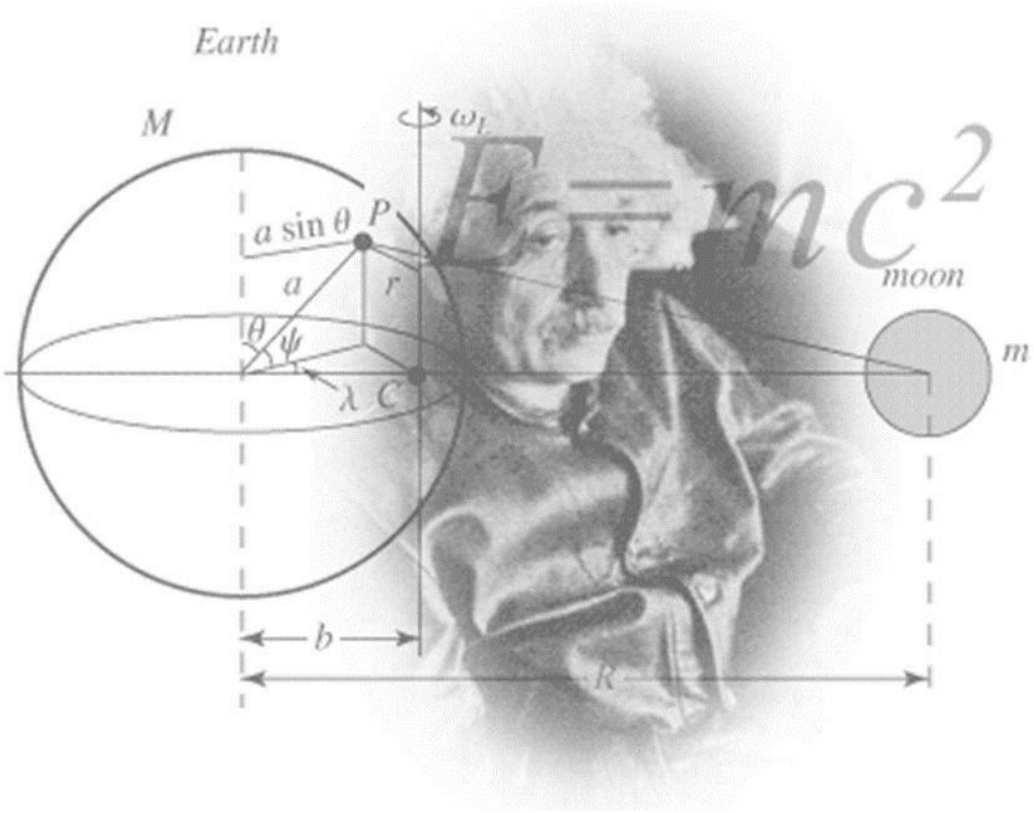
Thomas Telford School
Physics Bridging Work

A LEVEL PHYSICS

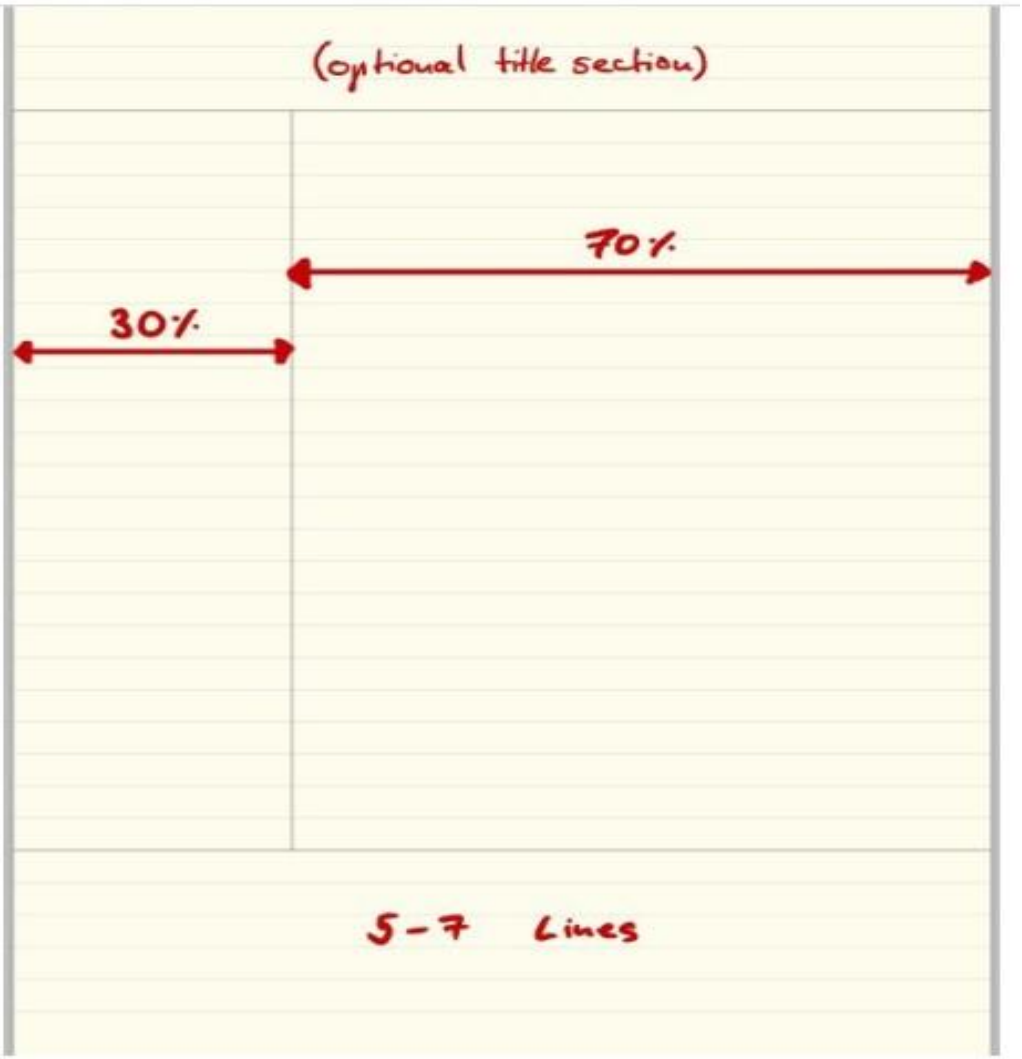


How to take Cornell Notes

Taking notes is essential to learning. One of the best proven ways is called "Cornell Note Taking". You separate your page into 4 sections:

1) Title section at the top: used to put the title, date, and other information (like your name)
2) Left column (30%): used to questions about the notes that can be answered when reviewing and keywords or comments that make the whole reviewing and exam preparation process easier.
3) Main section (70%): all actual notes from the lecture/video/etc. go into this section.
4) Row at the bottom: this is for a brief summary of what you're learning.

You should use this format for some of the tasks in this assignment.



Week 1: Research Activity

The website physics.aps.org provides daily online news and commentary about a selection of papers from the academic journals published by the American Physical Society (APS). The website is aimed at a reader who wants to keep up with highlights of Physics research with explanations that don't rely on jargon and technical detail.

For **at least one** of the following topics, you are going to use the resources to produce 1-2 pages of Cornell-style notes. The topics are not at the same level of difficulty: the first one relates to the Year 12 Physics topic of Materials and is aimed at a Grade C A-level target (i.e. someone who gains a GCSE grade 7 in Physics or 7-7 in Combined Science). The second and third topics relate to the Year 13 topics of Cosmology and Particle Physics, respectively. The second topic is aimed at a Grade B target and the third one at a Grade A target. If you choose to do this one, it is expected that you find your own resources in addition to this website.

Select from these three activities which differ in difficulty:

1) Why soft solids get softer (C target)

Soft materials like gels and creams exhibit fatigue resulting from the stretching of their constituent fibers, according to experiments and simulations. Available at:
https://physics.aps.org/articles/v11/50

2) Listening for the cosmic hum of black holes (B target – i.e. GCSE grade 8)

A new analysis technique would allow the gravitational-wave "background" from distant black hole mergers to be detected in days instead of years. Available at:

https://physics.aps.org/articles/v11/36

3) Sizing up the top quark's interaction with the Higgs (A target – i.e. GCSE grade 9)

A proton collision experiment at CERN provides a new handle on the Higgs boson's interaction with the heaviest of the quarks. Available at:

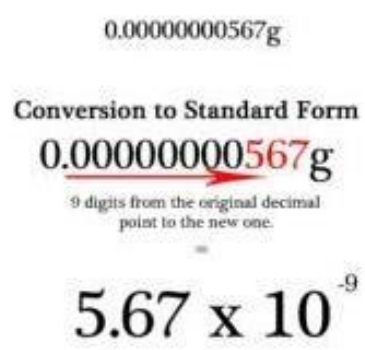
https://physics.aps.org/articles/v11/56

Week 2: Pre-Knowledge Topic

A level Physics will use your knowledge from GCSE and build on this to help you understand new and more demanding ideas. Complete **one** of following tasks to make sure your knowledge is up to date and you are ready to start studying:

1) Standard form, symbols and prefixes

At A level, quantities will be written in standard form, and it is expected that your answers will be too. For example, if your answer is 12 000 kg, you would write 1.2 x 10^4 kg.



For more information visit: https://www.bbc.co.uk/bitesize/guides/zxsv97h/revision/1

At A level you will need to remember all units, their symbols and all the prefixes used for powers of ten:

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	$x 10^{9}$

These are quantities and symbols you already know –you will use them more during your A level:

Quantity	Symbol	Unit
Velocity	v	$m s^{-1}$
Acceleration	a	$m s^{-2}$
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	$kg m s^{-1}$
Power	P	W
Density	ρ	$kg m^{-3}$
Charge	Q	C

Task: complete the following problems:

1. Write 2 530 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.
13. How many metres in 2.4 km?
14. How many joules in 8.1 MJ ? *(for Q14-22, use standard form where needed)*
15. Convert 326 GW into W .
16. Convert 54 600 mm into m.
17. How many grams in 240 kg?
18. Convert 0.18 nm into m.
19. Convert 632 nm into m.
20. Convert 1 002 mV into V.
21. How many eV in 0.511 MeV?
22. How many m in 11 km? **2) Waves (B grade)**

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.

https://www.bbc.co.uk/bitesize/guides/zgf97p3/video

https://www.khanacademy.org/science/physics/mechanical-waves-andsound/mechanicalwaves/v/introductionto-waves

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Task:

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

b) Describe the difference between longitudinal and transverse waves and give an example of each.

3) Atomic structure (A grade)

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 currently accepted model was discovered:

www.youtube.com/watch?v=wzALbzTdnc8

Task: 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. Include:

- a diagram
- an explanation of how this model was discovered by Rutherford and his associates
- a summary of more recent developments and how they affected our model of what an atom is

Week 3: Further Pre-Knowledge Tasks

The more engaged you can get with the subject, the easier it will be for you when you come back in September. So here are some more pre-knowledge tasks, and some book and film recommendations:

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:
https://www.khanacademy.org/math/algebra-home/alg-basic-eq-ineq/alg-old-schoolequations/v/solving-for-a-variable

https://www.youtube.com/watch?v=_WWgc3ABSj4

Task

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 v2 to find m
4. E = ½ m v2 to find v
5. v = u + at to find u
6. v = u + at to find a
7. v2 = u2 +2as to find s
8. v2 = u2 +2as

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 figures, 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
https://www.purplemath.com/modules/rounding2.htm

Task

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 the link to the OCR Physics practical handbook so you can familiarise yourself with expectations.

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

Task

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. 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

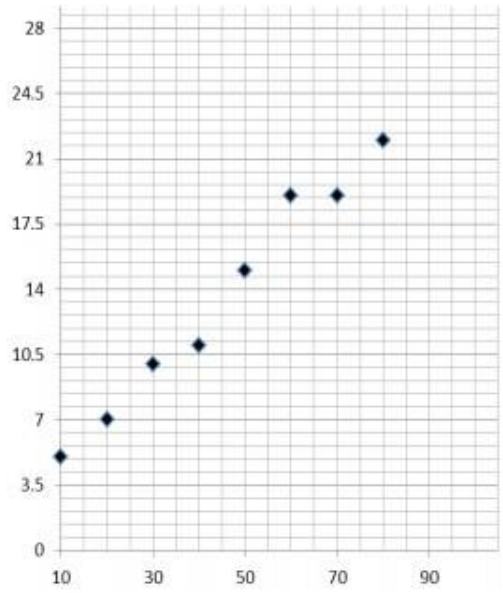
After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

- 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)

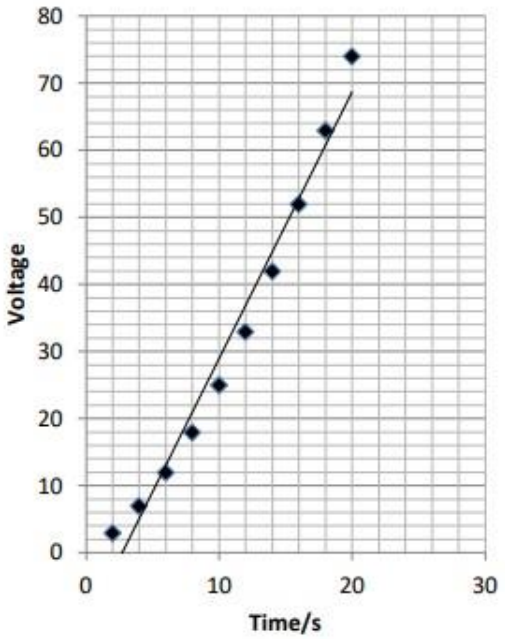
Task

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 website below covers Newton's laws of motion and has links to the laws in action.

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

Task

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

Electricity

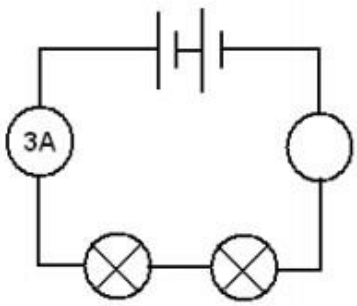
At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

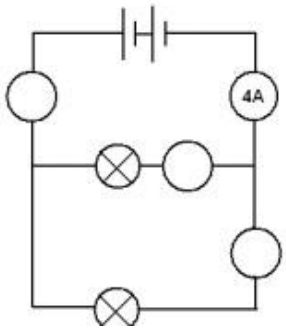
https://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/

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

Task

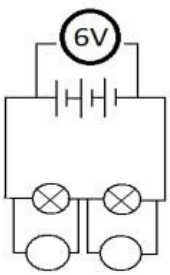
1a) Add the missing ammeter readings on the circuits below.

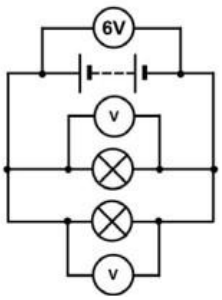




a) Explain why the second circuit has more current flowing than the first.

2) Add the missing potential differences to the following circuits:





Week 4: Physics Baseline Assessment

40 Marks – 40 Minutes

A single piece of graph paper is required for the completion of the assessment. The rest can be done on this sheet, or on lined paper. You may use a calculator.

Q1 Complete the following table:

Unit prefix	Meaning
k (kilo)	x 1000
	x 0.000 001
M (mega)	

N (nano)	

[3]

Q2

a) Write the following numbers into standard form.

i. 0.012 ii. 120 000

iii. 0.000 000

12

[3]

b) Complete the following calculations and write your answers to an appropriate number of significant figures.

i. 2.1 X 0.15

ii. 0.345 ÷ 0.114

[4]

Q3 Re-arrange the following equations to make R the subject of the equation. a) $\boldsymbol{Q=WERTY}$

b) $\boldsymbol{Q_2=WR_2}$

c) $\boldsymbol{Q=W-RT^2}$

[3]

Q4 Name the three particles (from GCSE) that make up an atom.

…… [1]

a) Which one of the above particles is not found in the nucleus of an atom?

…… [1]

b) Which of the above particles will be found in varying quantities in the nuclei of isotopes of the same element?

…… [1]

Q5 Complete the following table

Voltage (__)	_ _____ (A)		
	Repeat 1	Repeat 2	Average
2	0.23	0.26	0.25
4	0.46	0.53	
6	0.69	0.78	0.74
8	0.92	1.04	0.98

10	1.15	1.30	1.23

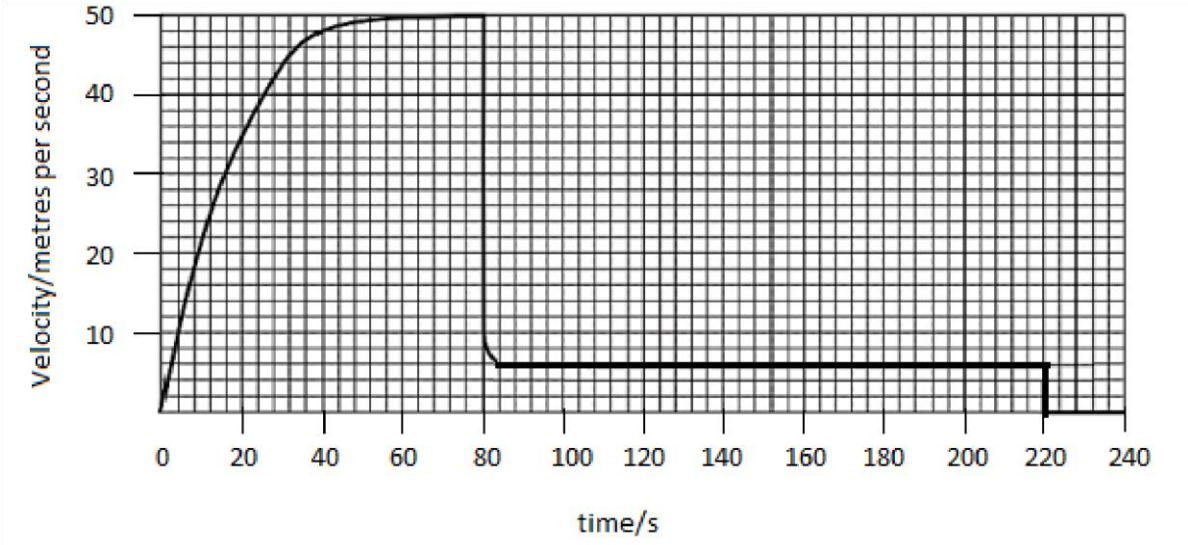
[3]

Q6 a) Use your piece of graph paper to plot a graph of Current (x-axis) against Voltage (y-axis) drawing a line of best fit through your data points.

[4] b) Find the gradient of your line of best fit

[3]

Q7 The graph below shows the journey of a skydiver after they have left the plane.



a) Explain the shape of the graph commenting on how and why the forces have changed.

_____

_____

_____ [6]

b) Calculate the distance travelled whilst at the second terminal velocity.

[2]

c) Calculate the average acceleration in the first 20 seconds.

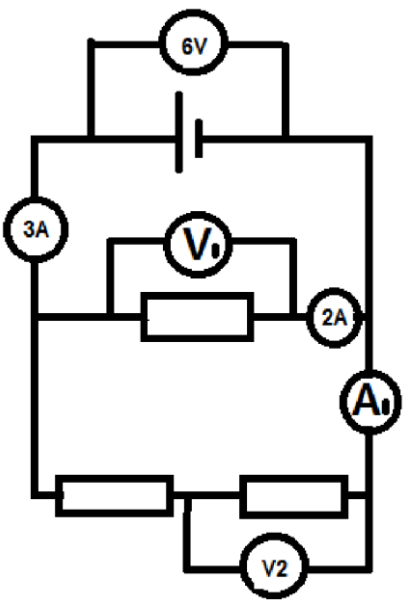
[2]

Q8

a) Draw a circuit diagram to show how the resistance of a filament bulb could be measured using an ammeter and a voltmeter.

[2]

b) Look at the circuit diagram below. All the resistors are identical.

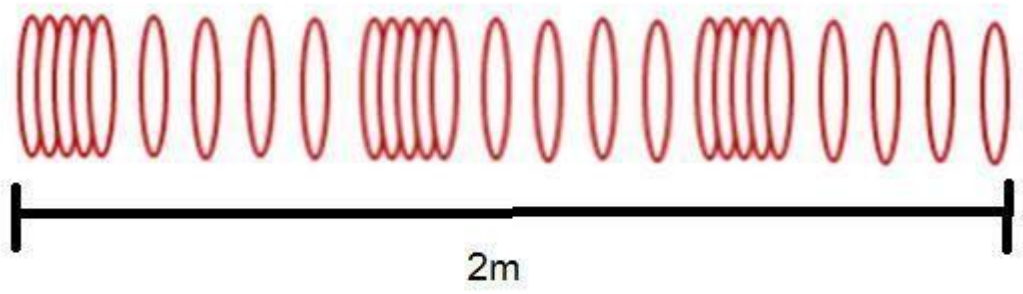


Write the missing values of current and potential difference:

i. V1 = ii. V2 = iii. A1 =

[3]

Q9 The diagram below shows a diagram of three complete longitudinal wave oscillations on a slinky:



a)

State the wavelength of the wave shown

…… [1]

b) Label a complete wavelength on the diagram above (or a copy of it) with the correct symbol used for wavelength in GCSE and A Level Physics

[1]

c) If the above wave had a frequency of 5Hz how long would it take an individual hoop to complete one full oscillation?

[1]

d) Calculate the speed of the wave

$$\boldsymbol{wave\ speed = frequency \times wavelength}$$

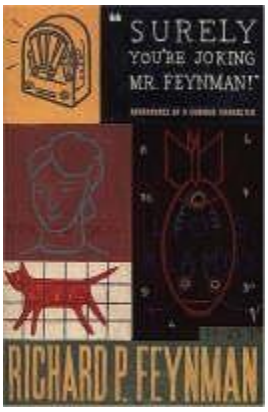
Wave speed = _____ Unit _____ [2]

End of baseline assessment

OPTIONAL: Book Recommendations

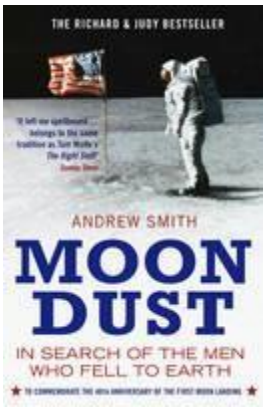
Below is a selection of books that should appeal to a physicist – someone with an enquiring mind who wants to understand the universe around us. None of the selections are textbooks full of equation work (there will be plenty of time for that!) instead each provides insight to either an application of physics or a new area of study that you will be meeting at A-level for the first time.

1. **Surely You're Joking Mr Feynman: Adventures of a Curious Character** ISBN - 009917331X



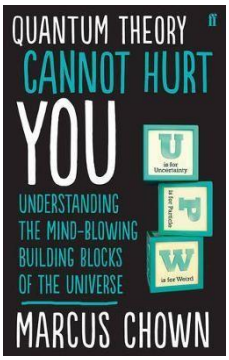
Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle physics. (Also available on Audio book).

2. **Moondust: In Search of the Men Who Fell to Earth** ISBN – 1408802384 –



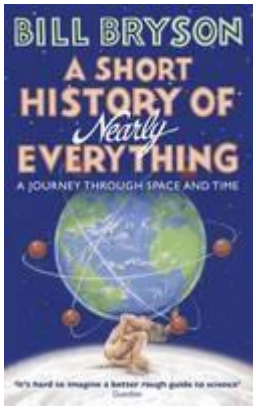
One of the greatest scientific achievements of all time was putting mankind on the surface of the moon. Only 12 men made the trip to the surface, at the time of writing the book only 9 are still with us. The book does an excellent job of using the personal accounts of the 9 remaining astronauts and many 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.

3. **Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe** ISBN - 057131502X



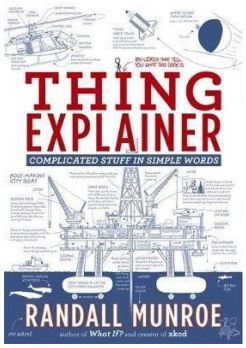
Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics that require no prior knowledge. In your first year of A-Level study you will meet the quantum world for the first time. This book will fill you with interesting facts and handy analogies to whip out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

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.

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.

OPTIONAL: Ted talks

1. **Regina Dugan: From mach-20 glider to hummingbird drone** Available at:

https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_hummingbird_drone
Regina Dugan was the director of DARPA, the United States Defence Advanced Research Projects Agency. In this talk, she describes some of the extraordinary projects her agency has created.

2. **Brian Greene: Is our universe the only universe?**

Available at:
https://www.ted.com/talks/brian_greene_is_our_universe_the_only_universe
Brian Greene shows how the unanswered questions of Physics have led to the theory that our own universe is just one of many in the "multiverse".

3. **Helen Czerski: The fascinating physics of everyday life** Available at:

https://www.ted.com/talks/helen_czerski_the_fascinating_physics_of_everyday_life

Physicist Helen Czerski presents various concepts in physics you can become familiar with using everyday things found in your kitchen.