Roding Valley High School

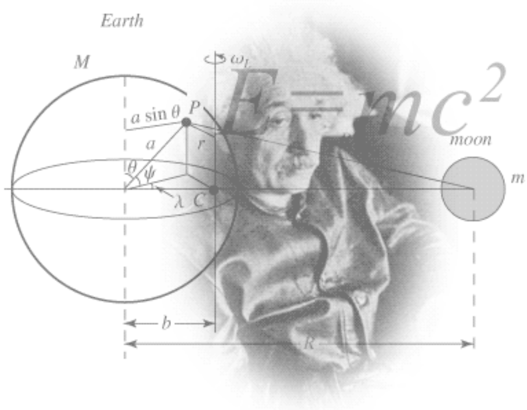
A Level Physics Transition booklet

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.

What is included:

- Book recommendations
- Movie recommendations
- Guidance on how to make notes
- **Research activities – you must complete all tasks.**
- **Pre-knowledge topics – you must complete all**
- Ideas for day trips
- Science on social media
- Science websites
- Science things to do



The compulsory activities highlighted in red must be submitted on google classroom. Please use the code thd6mfz to join the classroom and complete any additional work set here.

Please complete as much of this booklet as possible, including the self-assessment below, then hand in during the first week of teaching in September.

Confidence: ***A = all parts correct and understood*** ***C = some parts correct and mostly understood*** ***E = few parts correct or poorly understood***	**Self Assessment**		
	Mark	**Confidence (A-E)**	**ISSUES / COMMENTS**
1. Expectations – read and remember!	- - -		
2. Unit Prefixes – complete table + questions	............../25		
3. (a) SI system of units – complete table (b) Derived units – complete table	............../11		
4. Maths-powers of ten and standard form – complete calculations	............../18		
5. Significant figures – read + complete calculations			
6. Rearranging equations	............../10		
7. Showing your working – read			
8. Bringing it all together – How many of these challenging questions did you crack?	............../10		
9. Revise and Extend: Energy and Power	............./30		
10. Revise and Extend: Speed and Acceleration	............./30		

FEEDBACK:

Tips on completing this bridging work

- Please write all of your answers clearly in **blue** or **black ink**.
- In calculations show all steps in your working clearly and underline the final answer.
- Where answers or a mark scheme is given mark and correct your work in **purple pen**.

1. Expectations

Attendance

1. Attend every lesson
2. Arrive on time
3. Ensure any assignments due are <u>complete</u> and <u>presentable</u> – no excuses

Equipment

4. Bring the following equipment every lesson:
    a. An A4 clip file
    b. pre-punched A4 paper for your notes
    c. plastic wallets for handouts
    d. pen, pencil, ruler (30cm is best), protractor, compasses
    e. Scientific calculator

Private study & Assignments

5. Plan to spend roughly an equal time studying physics outside class as inside.
6. Some of this time will be for assignments ('homework'), the rest for reading around the subject, practicing questions, writing up practicals and improving your notes.
7. Record homework and deadlines clearly.
8. Expect homework at the end of every session – if you are not sure what it is <u>ask</u>.
9. Make a note of anything you get stuck on or do not understand.
10. Don't always work alone - working with a physics partner can be very effective (not one person copying another, but arguing and thinking a problem out together)

In Class

11. **Be proactive**: ask for help if there is anything you don't understand, don't let an idea remain vague ask, think and question until it becomes clear – it will!
12. **Interact**: put your hand up & ask questions as much as possible – don't leave it to others.
13. **Be efficient**: don't waste time chatting or being off task – you will drag yourself and others down if you do.
14. **Listen**: pick up on <u>all</u> the tips and advice then put them into practise, don't ignore them.

2. Unit Prefixes

Prefixes are written in front of units to indicate multiplication or division by multiples factors of 1000. So mega means x1,000,000. (One exception is 'centi', as in cm, which means divide by 100)

YOU MUST LEARN THE PREFIXES BY HEART AND BECOME ADEPT AT WORKING WITH THEM.

1. Complete the following table. (You will need to research some of the missing units).

Symbol		**Multiplier**	**Which means…**
	terra		
		$\times 10^{9}$	
M			× 1,000,000
k			× 1000
(None)	- - -	- - -	× 1
m			
	micro		/ 1,000,000
n			
		$\times 10^{-12}$	
f			

2. Expand each of these quantities to write out the answer in full (i.e. without the prefixes)
   a. 900 mV =
   b. 12 MJ =
   c. 1.67 mm =
   d. 3.456 kg =
   e. 700 nm =
   f. 0.72 pA =
3. Write each of the following using an appropriate prefix:
   g. 0.005 A =
   h. 30000 s =
   i. 5×10^{5} m =
   j. 1001 m =
   k. 0.006 V =
   l. 2,100,000 N =
4. Convert each of the following to the indicated units:
   a. 34 nm = ... mm
   b. 0.012 s = ... s
   c. 4.5 MJ = ... kJ

3. UNITS (a) The SI system of units

- **Look up the following terms and write a few sentences about each:**

Physical Quantities	
SI Units	
Base Units	
Derived Units	

- **In physics all units can be derived from six base units. Research how the base units are defined.**

Base Quantity	**Base Unit**	**Definition** (Note: you do not need to learn these definitions)
Length	metre (m)	
Mass	kilogram (kg)	
Time	second (s)	
Temperature	kelvin (K)	
Current	ampere (A)	

3. UNITS (b) Derived units

In physics all non-base quantities are called **derived quantities** and are defined by equations.
E.g. (a) Define speed. (b) Define charge.

(a) speed = distance / time **(b) charge = current × time.**

The units of these new quantities are **derived units** and are established from these same equations. So,

(b) The unit of speed = unit of distance / unit of time = m / s = <u>$m{\cdot}s^{-1}$</u> **(**'metres per second')*

(c) The unit of charge = the unit of current × the unit of time = <u>A·s</u> **(**'amp second')

*NOTE: At A level we write divided units, such as 'metres <u>per second</u>' as ms^{-1} **not** m/s.

In the SI system, many of these derived units get their own name. For example, the SI unit of charge is the coulomb (C). So we can say that one coulomb is equal to one amp second.

or **C = A s**

Any SI unit can be expressed in terms of base units. To find the base units work though the defining equations one by one, unit you end up with the base units. For example, what are the base units of a Joule? This requires two steps:

- Energy (Work) = Force × distance moved, So one joule = one newton metre (**J = N·m**)
- Force is defined from F = m a, so one newton = one kilogram metre per second squared (or **$N = kg{\cdot}m{\cdot}s^{-2}$**)
- Therefore, a joule = **N m** = (**$kg{\cdot}m{\cdot}s^{-2}$**) **m** = <u>**$kg{\cdot}m^2{\cdot}s^{-2}$**</u>

1. Complete the table below.
Try working these out rather than looking them up. You can use the earlier answers to help with the harder ones.

Derived quantity	**Defining equation**	**Standard SI unit (if applicable)**	**Equivalent base units**
speed	S = d / t	n/a	$m{\cdot}s^{-1}$
momentum	p = m v	n/a	$kg{\cdot}m{\cdot}s^{-1}$
acceleration	a = (v - u) / t	n/a	
Force	F = m a	newton (N)	
Power	power = work/time P = W/t		
frequency	frequency = 1/time period f = 1 / T		s^{-1}
Charge	charge = current × time Q = I t	coulomb (C)	A·s
potential difference	voltage = work/charge V = W/Q		
resistance	R = V / I		
specific heat capacity	SHC = Energy / (mass × temperature change) c = Q / (m ×)		

4. MATHS – Powers of 10 and standard form (aka scientific notation)

You need to be able to use your calculator to work in standard form or use power of ten notation to replace unit suffixes.

[Tip: you should use the [x10ˣ] button on your calculator for entering powers of ten.]

1. Rewrite these numbers in standard form, removing any unit prefixes:

a) 3141	b) .00055	c) 2.0002
…………………………	…………………………	…………………………
d) 120000 *(2sf)*	e) 120000 *(6sf)*	f) 843×10^{4}
…………………………	…………………………	…………………………
g) 1.5 μm	h) 12.0×10^{-2} nm	i) 999 MJ
…………………………	…………………………	…………………………
j) 245 mg	k) 16 pF	l) 97.237 GN
…………………………	…………………………	…………………………

All of the equations we use in Physics require variables to be converted to standard SI units. This means any prefixes must first be removed. For example to calculate resistance in ohms () you divide the p.d. in volts (V) by the current in amps (A), If current = 8.0 mA (milliamps) and the voltage was 12 kV (kilovolts) the correct calculation would be:

$$R = V/I = 12 \times 10^{3} / 8.0 \times 10^{-3} = 1.5 \times 10^{6}$$

Try the above on your calculator before you continue.

2. Calculate the following showing your working, giving the answers in appropriate units. (This means removing suffixes, except for grams which need to be converted to kg)

a) Area (m^2) = 120 mm × 250 mm

b) Area (m^2) = 2.4 m × 60 cm

c) Density ($kg \cdot m^{-3}$) = 48 g ⁄ 12 cm^3

d) Charge in coulombs, Q=I t
= 3.0 × kA × 20 s

e) Speed squared, $v^2 = (16\ m \cdot s^{-1})^2$

f) Force, F = m a = 923000g × 9.8 $m \cdot s^{-2}$

5. Rules for Significant figures (sig fig or sf)

Read from the left and start counting sig figs when you encounter the first non-zero digit

1. All non zero numbers are *significant* (meaning they count as sig figs)

- 613 has three sig figs
- 123456 has six sig figs

2. Zeros located between non-zero digits are *significant* (they count)

- 5004 has four sig figs
- 602 has three sig figs
- 6000000000000002 has 16 sig figs!

3. Trailing zeros (those at the end) are *significant* only if the number contains a decimal point; otherwise they are insignificant (they **don't** count)

- 5.640 has four sig figs
- 120000. has six sig figs
- 120000 has two sig figs – unless you're given additional information in the problem

4. Zeros to left of the first nonzero digit are *insignificant* (they **don't** count); they are only placeholders!

- 0.000456 has three sig figs
- 0.052 has two sig figs
- 0.0000000000000000000000000000000052 also has two sig figs!

Rules for calculations

When you perform a calculation the answer should be given to the same number of significant figures as the weakest piece of data that was used in the calculation. For example if a piece of card is 11.3 cm long and 2.4 cm wide then the area = 27.12 cm^2 (on the calculator), but should be written as **27 cm^2** (i.e. 2 sig fig) because the width (2.4) was only given to 2 sig fig.

C. Practice Questions

1. State the number of sig figs in each of the following numbers:

(a) 0.0000055 g ……………… (c) 1.6402 g ……………… (b) 3.40×10^3 mL ………………

2. Compare the following numbers:

370 000 v 3.70×10^6 (standard form)

Explain the advantage of giving an answer in standard form

……

……

4. Complete each of the following calculations using your calculator, giving your answer in standard form with the correct number of significant figures, with your answer in the units indicated.

(a) $\rho = m / V = 0.542\ g / 0.027\ cm^3$ = …………………………………………….$g{\cdot}cm^{-3}$

(b) $E = m c^2 = 231.5 \times 10^{-3} \times (3.00 \times 10^8)^2$ = ……………………………………………J

(c) Mean time = (23 + 20 + 21 + 22 + 25) / 5 = …………………………………………s

(d) Height difference = 2.32m – 2.07m = ……………………………….m

5. Complete the following calculations using a calculator, showing your working and giving an answer in standard form to the correct number of significant figures, in appropriate units:

a) $\frac{2.3 \times 6.5}{3.7 \times (9.1)^2}$

b) $(314)^3 / (9.9^2)$

c) $(12 \times 45\text{g}) / 12\ \text{cm}^3$

d) $1.2 \times 10^{-6} \times 1.5 \times 10^{-4}$

e) $(16\ \text{m}\cdot\text{s}^{-1})^2$

f) $923\text{Kg} \times 9.8\ \text{m}\cdot\text{s}^{-2}$

6. REARRANGING EQUATIONS

Rearrange these equations to express them in the terms that follow:

1. $v = x / t$ **a.** $x = ?$ **b.** $t = ?$

2. $F = m\,a$ **a.** $m = ?$ **b.** $a = ?$

3. $a = (v - u) / t$ **a.** $t = ?$ **b.** $v = ?$ **c.** $u = ?$

4. $v^2 = u^2 + 2as$ **a.** $v = ?$ **b.** $a = ?$ **c.** $u = ?$

5. $s = ut + \frac{1}{2} a t^2$ **a.** $u = ?$ **b.** $a = ?$ **c.** $t = ?$

6. $\frac{1}{R_{tot}} = \frac{1}{R_1} + \frac{1}{R_2}$ **a.** $R_{tot} = ?$ **a.** $R_1 = ?$

7. Showing your working clearly

When answering physics questions you need to lay out your working clearly showing all the steps, working left to right and top to bottom. Your final answer should be found to the bottom right of your working and should be underlined. Below is an example for you to base your own answer style on.

<u>Ch6, Q4</u>

A white snooker ball with a kinetic energy of 15J collides with a red ball. On impact the white ball stops, transferring all of its KE to the red ball. The mass of the red ball is 120 g. What would be the velocity of the red ball immediately following the collision?

STEPS: Equation being used rearrange values inserted
calculated answer units sig fig

$$KE = \frac{1}{2}mv^2 \qquad \frac{2KE}{m} = v^2 \qquad v$$

$$= 15.8\ \mathrm{ms^{-1}} \quad \underline{= 16\ \mathrm{ms^{-1}}(2sf)}$$

EIGHT STEPS TO IMPROVE THE QUALITY OF YOUR WORKING

- ☐ Show all steps
- ☐ Work left to right and top to bottom
- ☐ Rearrange equations before substituting values
- ☐ If a calculation is two step, underline the answer to the first step before proceeding as this may get marks
- ☐ Your writing should be small and neat. Don’t scrawl.
- ☐ You should be able to easily check over your working to find mistakes
- ☐ Plan to use the available answer space wisely
- ☐ Try to leave space for correcting mistakes if you go wrong

8. Bringing it all together

Brain-gym for the physics-muscle in your head (It hurts to start with, but gets easier with practise)

These problems will challenge you to work with powers and units, rearrange equations and use your calculator carefully. Helpful formulae for volume and surface area are given on the last page, as are the answers.

Lay out your working clearly, work step by step, and check your answers. If you get one wrong, go back and try again. Do not be disheartened if they seem difficult to start with, persevere and seek help – you will improve. Importantly, have fun!

1. How many mm^2 are there in

   (a) $1cm^2$?
   ....

   (b) 1 m^2 ?
   ....

   (c) 1 km^2 ?
   ....

2. How many cm^3 are there in

   (a) $1mm^3$?
   ....

   (b) 1 m^3?
   ....

3. A piece of A4 paper is 210 × 297 mm. All measurements are to the nearest mm. Calculate its area in (a) mm^2, (b) cm^2, (c) m^2. Give answers to the correct number of significant figures.

....

....

a) Area = ... mm^2

b) Area = ... cm^2

c) Area = ... m^2

4. A plastic toy is supplied in a cubic box, 4.0 cm each side. How many of them pack into a carton 80 × 52 × 70 cm? (Students often get the wrong answer and can't see why. Visualise the actual problem don't just rely on maths!)

5. A copper atom has a diameter of 217 pm (pico-meters). How many of them would fit inside $1 mm^3$ of copper to 3 sig. fig? (Tip: for simplicity, treat them as cubes of side 217 pm)

6. Water has a density of 1.0 g cm^{-3}. Express this in (a) kg cm^{-3}, (b) kg m^{-3}, (c) kg mm^{-3}

....

....

a) Density = ...kg cm^{-3}

b) Density = ...c kg m^{-3}

c) Density = ... kg mm^{-3}

7. A regular block of metal has sides 12.2 × 3.7 × 0.95 cm, and a mass of 107g.
Find its density in Kg m^{-3} to a suitable number of significant figures.

8. A measuring cylinder is filled with 1.00 litres of water. The column of water inside forms a regular cylinder 32.0 cm high. What is (a) the area of the surface of the water (in mm^2)? (b) the internal diameter of the cylinder (in mm)?
(TIP: Visualise the problem clearly. Draw a diagram if it helps. Use the equation or the volume of a cylinder)

9. The diameter of the sun is 1.4×10^6 km. Its average density is 1.4 g cm^{-3}. What is its mass in kg?
(TIP: The trick here is to convert the units carefully before you start)

10. The total energy arriving in the Earth's upper atmosphere from the sun is 174×10^{15} Watts. Given that the Earth's diameter is 12.8×10^3 km, what is the average intensity of this radiation in W m^{-2}?
(TIP: Think about the units carefully. What does W m^{-2} mean?)

Answers:

1. a) 10^2 (100)
   b) 10^6 (1,000,000)
   c) 10^{12}
2. a) 10^{-3} (1/1000)
   b) 10^6 (1,000,000)
3. a) 6.237×10^4 mm^2 (62,370 mm^2)
   b) 6.237×10^2 cm^2 (623.7 cm^2)
   c) 6.237×10^{-2} m^2 (0.06237 m^2)
4. 4420
5. 9.79×10^{19}
6. a) 1×10^{-3} kg cm^{-3}
   b) 1×10^6 kg m^{-3}
   c) 1×10^{-6} kg mm^{-3}
7. 2.50×10^3 kg m^{-3}
8. a) 3125 mm^2
   b) 63.1 mm
9. 2.0×10^{30} kg
10. 338 W m^{-3}

GEOMETRICAL EQUATIONS

arc length $= r\theta$

circumference of circle $= 2\pi r$

area of circle $= \pi r^2$

surface area of cylinder $= 2\pi rh$

volume of cylinder $= \pi r^2 h$

area of sphere $= 4\pi r^2$

volume of sphere $= \frac{4}{3}\pi r^3$

KS4 Revision & Extension

9. Energy and Power

Look up definitions for each of the following quantities and write down the equations and any notes you think are helpful

Work

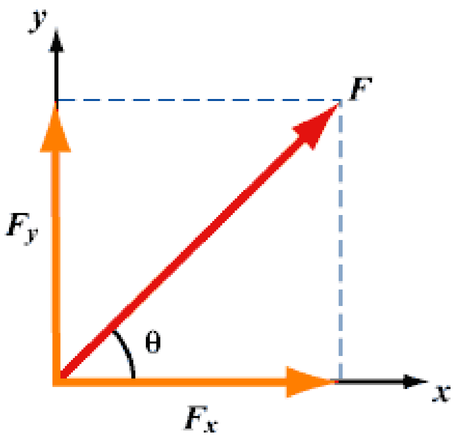
Kinetic Energy

Gravitational Energy

Elastic Potential Energy

Efficiency

Power (including electrical power)



Resolving vectors

In A level Physics you will need to work with vectors that act at odd angles. Often the easiest way to deal with this is to convert the diagonal vector into horizontal and vertical components.

For example, in the case of a force F acting at an angle ϴ, can be treated as two forces acting horizontally (F_x) and vertically (F_y). These can be calculated with trigonometry:

$$\mathbf{F_y = F\ Sin\ (\Theta)} \quad \textit{and} \quad \mathbf{F_x = F\ Cos\ (\Theta)}$$

You may need to use this in the following questions

Work

What is the definition of work?

……

……

(2)

In the following calculations take g = 9.8 N kg^{-1}

1) Calculate the work done in each of the following situations, stating the final form of the transferred
energy.

i) A box is pushed 3m along the floor by a horizontal force of 500N

……

……

Work = ……………………………… J Energy is transferred

into…………………………………………(2)

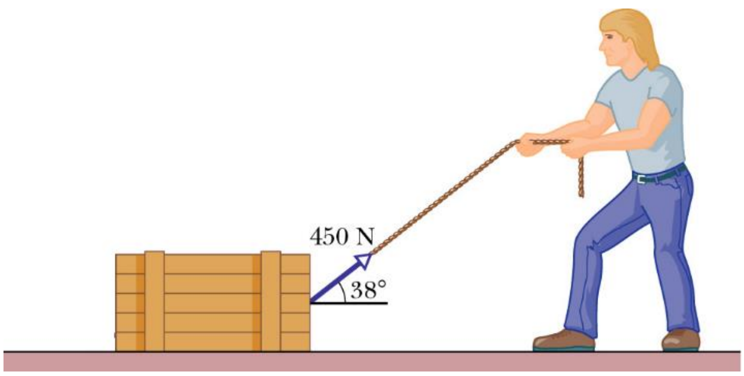
ii) An electric lift raises 540 kg load through a height of 18.3 metres

……

……

Work = ……………………………… J Energy is transferred

into…………………………………………(3)



iii) A man uses a rope to pull a box along a floor, as shown above. He drags the box 3.0 km.

....

....

....

Work done = ……………………………… J Energy is transferred

into………………………………………… (4)

iv) A student adds three 100g slotted masses to a spring of spring constant, k = 6.0 Nm^{-1}. It extends by 14.0 cm.

....

....

....

Work done = ……………………………… J Energy is transferred

into………………………………………… (4)

Power

What is the definition of power?

....

....

(1)

2) Which of the following are units of power? (circle all of the correct units)

joule second watt joule second $^{-1}$ newton metre second^{-1}

amp volt

(2)

Explain why power is equal to force × velocity

....

....

....

(2)

Explain why power is equal to current × potential difference

....

....

....

(2)

3) In two minutes a rocket gained 370 MJ of kinetic energy and 1300 MJ of gravitational potential energy.

i) Find the useful power produced by the rocket engines.

....

....

.... Power = ... W (2)

ii) In the following 30 seconds the rocket travels at a steady speed of 320 ms^{-1}. Assuming the power of the engines to be constant, calculate the thrust force produced by the engines.

....

....

Force = ... N (2)

4) A 12V electric motor is used to lift a 50g mass through 1.0m. The overall efficiency of this system is 10%.

Whilst in operation it draws a current of 0.25A.

i) Find the useful power output of the electric motor.

....

....

.... Power = ... W (2)

ii) How long does it take the motor to raise the mass 1.0m?

....

....

Time = ... s (2)

<u>SPEED QUESTIONS</u>

1. A bullet travels 300m in 2.60 seconds what is its velocity in (a) m s^{-1} (b) km h^{-1} ?

....

....

....

2. An alpha particle covers 2.0 cm travelling at 5% the speed of light (speed of light=3.0 x10^8 m s^{-1}). How long does it take to cover this distance?

....

....

....

3. A cyclist is racing on a circular track at an average speed of 8.35 m s^{-1}. She completes three laps in 2 minutes 24.36 seconds. What is the radius of the track?

....

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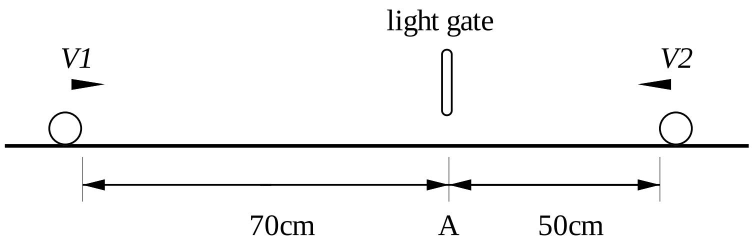
....

....

4. Two pool balls are moving towards each other as in the diagram below. At position A is a light gate.



If $V1$= 0.60 m s^{-1} and $V2$ = 0.20 m s^{-1} then (a) which ball passes through the light gate first and (b) at what time and (c) at what position do they collide and (d) at what time?

....

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5. A light-year is the distance light travels in one year. Calculate this distance in metres to 3 significant figures, given that the speed of light is 3.00×10^8 m s^{-1}.

....

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....

....

....

ACCELERATION QUESTIONS

6. A horse is cantering at 3.1 m s^{-1} and breaks into a gallop reaching a speed of 5.6 m s-1 in 3.5 seconds. Calculate its acceleration.

   ……

   ……

7. A car travelling at 16.0 m s^{-1}, brakes for 3.20 s, decelerating at a rate of 3.125 m s^{-2}. What is its final speed?

   ……

   ……

   ……

8. An Olympic diver strikes the water at a speed of 7.2 m s^{-1}, and comes to rest in 1.2 seconds. What is his acceleration?

   ……

   ……

9. A falling ball strikes a floor with a velocity of 4.2 m s^{-1} and rebounds with a velocity of -3.8 m s^{-1}. It is in contact with the floor for 0.12 seconds. What was its acceleration?

   ……

   ……

   ……

10. A Porsche is quoted as having a *"0-60 time of 4.2 seconds"*. This means it accelerates from zero to 60 miles per hour in 4.2 seconds. Given that 1 mile = 1.55 km, calculate its acceleration in ms^{-2}

    ……

    ……

    ……

    ……

11. At the University of Errors Science Tower, a brick is observed falling past the window of the physics laboratory. A quick thinking physics student records its speed as 4.59 m s^{-1}. A moment later it passes the ground floor windows of the engineering faculty and an alert engineer records its speed as 12.91 m s^{-1}.

    (a) Assuming acceleration due to gravity to be 9.81 m s^{-1} and assuming air resistance to be negligible, how long was the 'moment' between these observations?

    ....

    ....

    ....

    (b) By considering its average speed calculate the height between the Physics and the Engineering labs.

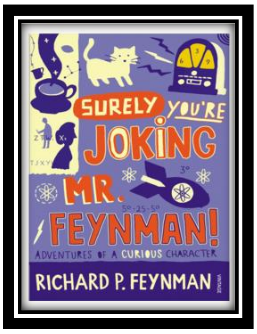
    ....

    ....

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**

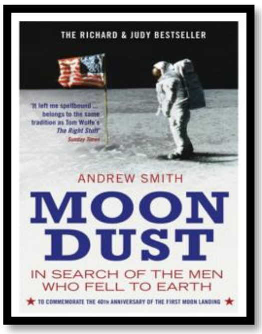


ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle physics.

(Also available on Audio book).

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

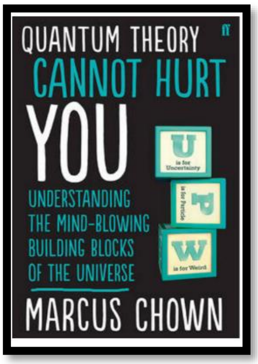
2. **Moondust: In Search of the Men Who Fell to Earth**



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

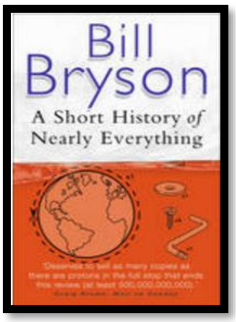
3. **Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe**



ISBN - 057131502X - Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics that 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!

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

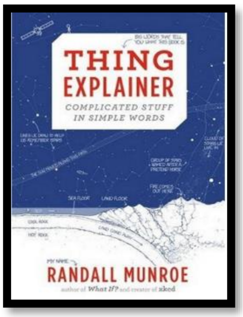
4. **A Short History of Nearly Everything**



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.

Science Fictions Films

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

Online Clips / Series

1. **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

2. **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.

3. **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

4. **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/

5. **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=LyqleIxXTpw

Research activity

To get the best grades in A Level Physics you will have to get good at completing independent research and making your own notes on difficult topics. Below are links to 5 websites that cover some interesting Physics topics.

Using the Cornell notes system: http://coe.jmu.edu/learningtoolbox/cornellnotes.html make 1 page of notes **from each site** covering a topic of your choice.

a) http://home.cern/about
   CERN encompasses the Large Hadron Collider (LHC) and is the largest collaborative science experiment ever undertaken. Find out about it here and make a page of suitable notes on the accelerator.
b) http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html
   The solar system is massive and its scale is hard to comprehend. Have a look at this award winning website and make a page of suitable notes.
c) https://phet.colorado.edu/en/simulations/category/html
   PhET create online Physics simulations when you can complete some simple experiments online. Open up the resistance of a wire html5 simulation. Conduct a simple experiment and make a one page summary of the experiment and your findings.
d) http://climate.nasa.gov/
   NASA's Jet Propulsion Laboratory has lots of information on Climate Change and Engineering Solutions to combat it. Have a look and make notes on an article of your choice.
e) http://www.livescience.com/46558-laws-of-motion.html
   Newton's Laws of Motion are fundamental laws for the motion of all the object we can see around us. Use this website and the suggested further reading links on the webpage to make your own 1 page of notes on the topics.

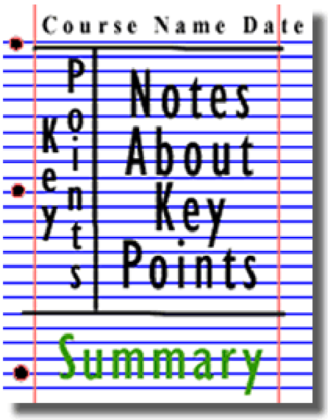


Figure 1: http://coe.jmu.edu/learningtoolbox/images/noteb4.gif

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 10^3kg. 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 = 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 = 6.75m/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:

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

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

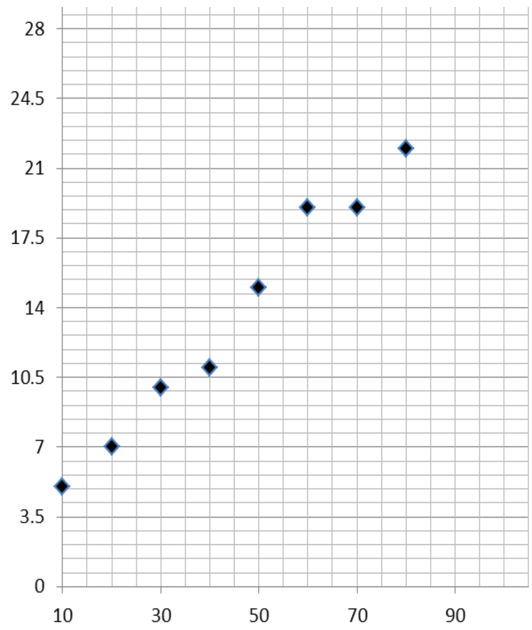
Graphs

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:

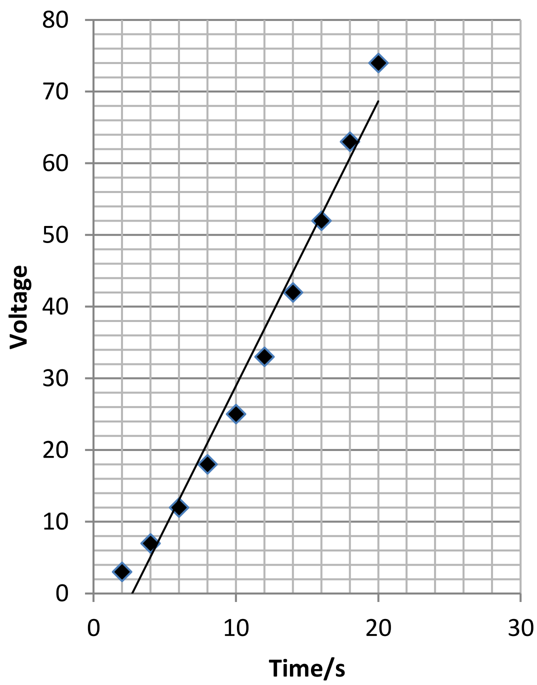
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a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

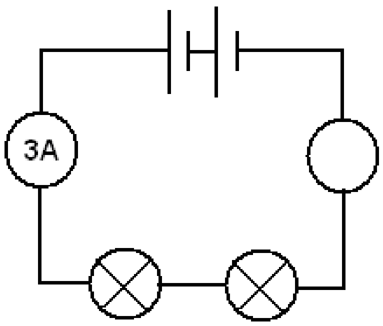
At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as

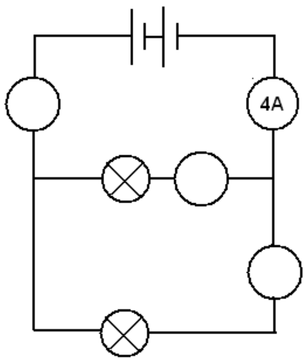
calculating the resistance of a device.

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

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

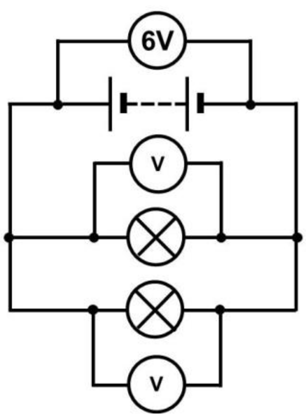
1a) Add the missing ammeter readings on the circuits below.





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

Ideas for Day Trips

Here are some suggestions for some physics-themed days out for you to enjoy over the summer break. Try and have some fun as you prepare for two tough but rewarding years ahead!

Northern England and Scotland

1. **Jodrell Bank Observatory** – Cheshire – one of the largest moveable radio telescopes in the world and the location of the filming of the BBC's Stargazing Live. The site has both indoor and outdoor activities.
2. **MOSI** – Manchester – Massive free museum showing how science helped Britain lead the way through the industrial revolution. Contains hands on exhibits and displays and often host regular travelling exhibitions.
3. **Liverpool World Museum** / **Spaceport –** Liverpool/Wirral – Start the day off at an excellent family science museum with a top floor dedicated to astronomy including a planetarium. Take the ferry cross the Mersey to another family friendly museum dedicated to spaceflight.
4. **Kielder Observatory** – Northumberland – Book ahead at this popular observatory in the midst of the darkest night skies the UK has to offer. Regular tours and opportunities to view the stars through professional telescopes take place on a nightly basis.
5. **Glasgow Science Centre** - The Centre is home to hundreds of interactive exhibits throughout the three engaging floors

The Midlands and Wales

1. **Electric Mountain** – Snowdonia – Set against a mountainous backdrop is a working pumped storage power station. Take a tour deep into the heart of the mountain and see the turbines spring into action to meet our ever increasing demand for electricity. Take a stroll up on of the UKs highest peaks in the afternoon.
2. **National Space Centre** – Leicester - With six interactive galleries, the UK's largest planetarium, unique 3D Simulator experience, the award-winning National Space Centre in Leicester is an out of this world visitor attraction
3. **Alton Towers** – Staffordshire – Treat yourself to a go on a few rollercoasters whilst discussing Newton's Laws. You may want to download and take these handy rollercoaster physics notes with you http://www.explainthatstuff.com/rollercoasters.html

Southern England

1. **Royal Observatory** – London - Visit the Royal Observatory Greenwich to stand on the historic Prime Meridian of the World, see the home of Greenwich Mean Time (GMT), and explore your place in the universe at London's only planetarium.
2. **Herschel Museum of Astronomy –** Bath – As you walk around the picturesque Roman city – take an hour or two out at the home of one of the great scientists – discoverer of Infra-red radiation and Uranus.
3. **@Bristol –** Bristol - home to the UK's only 3D Planetarium and one of the biggest science centres.
4. **The Royal Institution –** London – The birthplace of many important ideas of modern physics, including Michael Faraday's lectures on electricity. Now home to the RI Christmas lectures and many exhibits of science history.