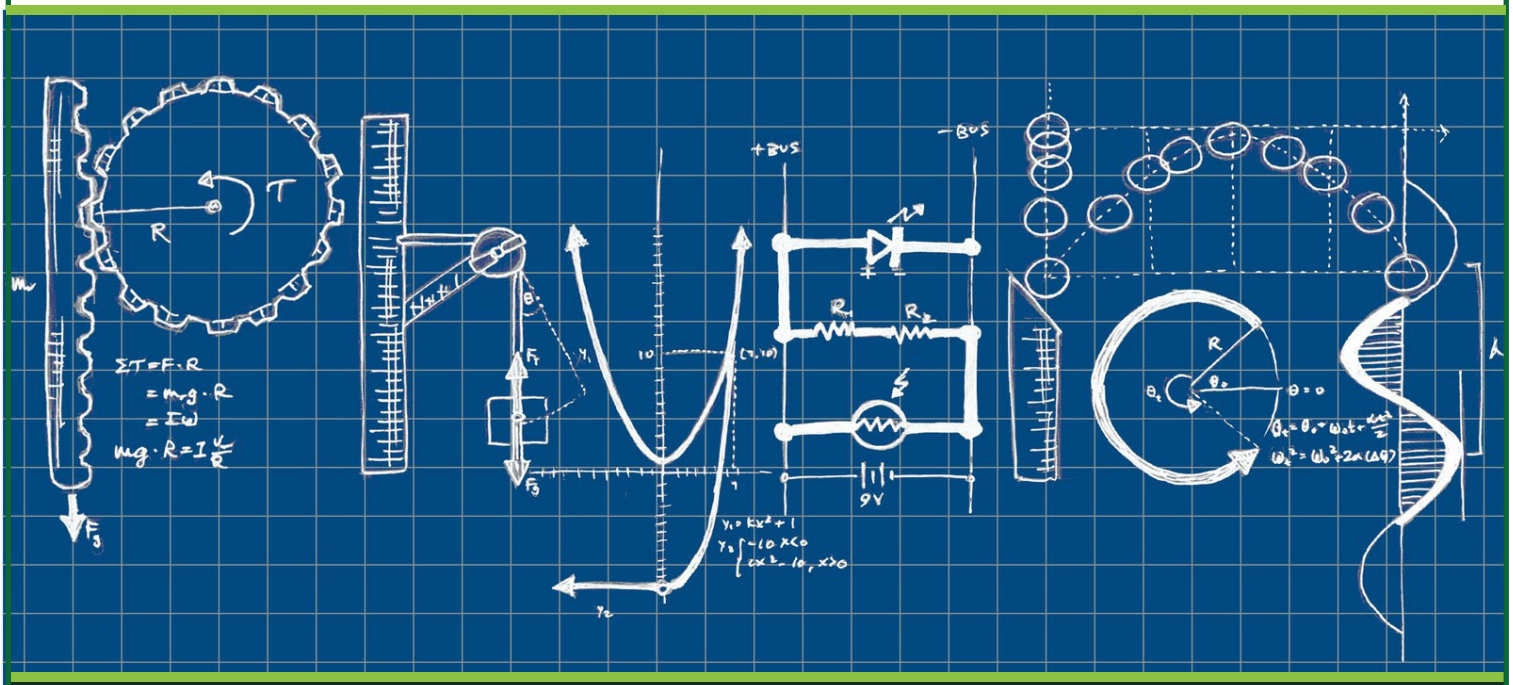
Bentley Wood
High School for Girls

Physics
GCSE to A level

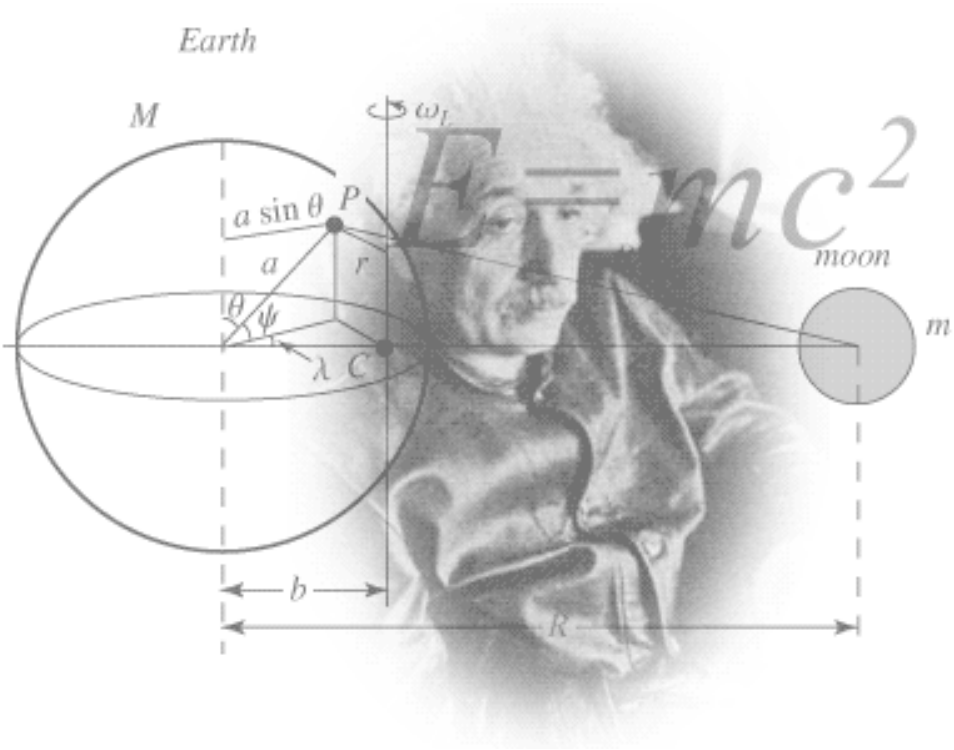
Bridging Work
Year 11 into 12 for 2023/24

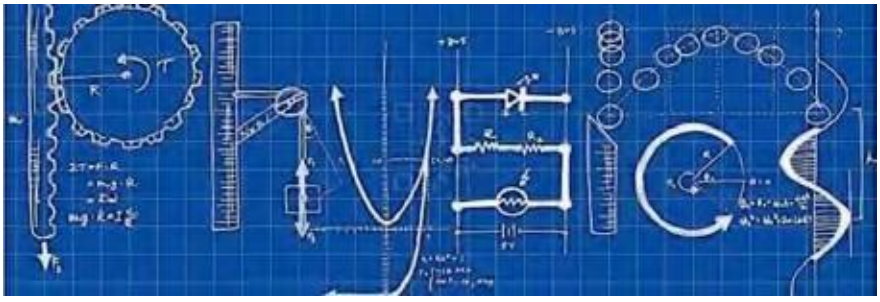


Name: _____

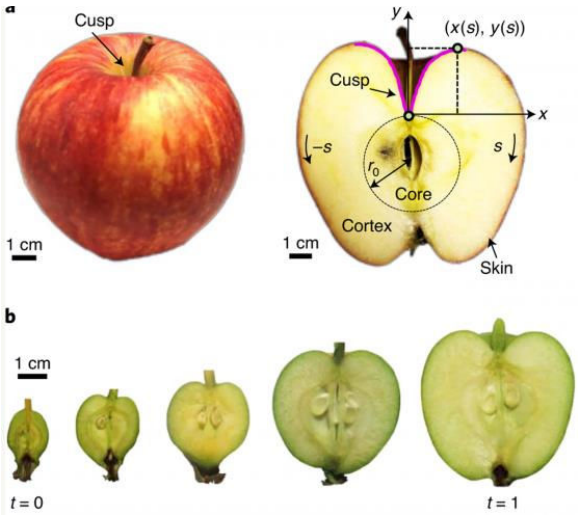
Tutor Group: _____

Teacher: _____





BRIDGING WORK 11 to 12



Bentley Wood
High School for Girls

WELCOME TO AS PHYSICS

The purpose of this booklet is to give you essential information and resources for the AS Physics course. This booklet will also help you to understand and develop the skills you will need.

Please remember the following items for **EVERY** lesson – **ESSENTIAL**:

- Pens (highlighters are useful too) and paper
- A file with your (well organised) notes in
- Calculator, ruler and pencils

We hope you enjoy learning Physics BUT sometimes even the best of students can have problems:

- **Problems with work**
- **Problems understanding concepts**
- **Problems getting your head round all the theories in physics**
- **Problems with completing homework**
- **Problems in their personal lives**

If any of this applies to you, don't feel there's nowhere to turn – **THERE IS!**

ALL the staff in the Physics Department will be happy to talk through your concerns or can advise you – so don't panic or think about giving up, **HELP IS AT HAND**.

Come and find us, or e-mail – no problem is ever so big that we can't help, honest!

A Binnion	Abinnion@bentleywood.harrow.sch.uk

Expectations

As a part of its quality approach to teaching, the Physics Department follows a common policy on the setting and marking of work. This code of practice is followed by both staff and students and is aimed to help you achieve success in Physics.

What we expect of YOU

- It is expected that your attendance will be 100% - if you are absent you MUST inform your tutor (beforehand if possible). If you do miss a lesson for medical or academic reasons it is YOUR responsibility to catch up on the work that you have missed.
- You are expected to spend **FIVE** hours a week per subject on personal study. This time may be directed by homework set by the tutor; otherwise you will be expected to use this time to read around your subject, supplement your notes and ensure that your notes are well organised and complete.
- You will be set an assessment every WEEK. If you have been unable to complete the work, you will be expected to inform your tutor prior to the lesson that the work is due in and/or find a time to catch-up.
- You are expected to manage and organise your work effectively, and to be responsible for keeping your notes, files and assessment pack up to date.
- You are expected to listen respectfully to your peers in discussions and group work

What you can expect of US

- Assessed work will be marked and handed back within TWO weeks of the handing in date.
- We will always be willing to discuss your progress and support your learning.

Useful websites

The following Internet resources are useful and will help with your AS Physics course:

Exam board website:

- https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/physics-2015.html: contains past papers, exam dates and most importantly EXAMINERS' REPORTS which will tell you where students commonly go wrong/suggest how to improve.
- https://www.pearsonactivelearn.com/app/Home Once you have a login you can practice questions

Revision and consolidation of knowledge:

- https://getrevising.co.uk/resources/level/a_ib/subjects/physics
- https://senecalearning.com/en-GB/
- https://www.savemyexams.co.uk/a-level-physics-aqa/revision-notes/
- https://studywise.co.uk/a-level-revision/physics/
- https://digestiblenotes.com/physics/circles/circular_measure.php
- https://www.revisely.co.uk/alevel/physics/aqa/

Leaning towards questioning

- https://snaprevise.co.uk/
- https://www.physicsandmathstutor.com/
- https://www.alevelphysicsonline.com/
- https://mathsmadeeasy.co.uk/a-level-physics-revision/

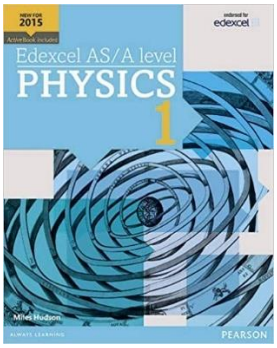
You are encouraged to keep an eye on the news as many reports and articles will be relevant to the materials you are studying in class.

Textbooks

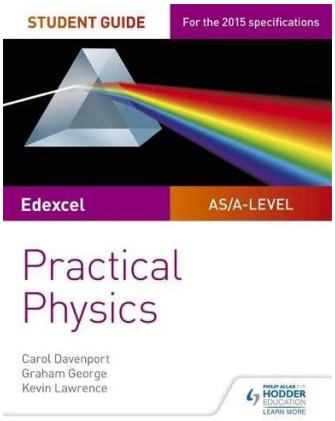
The school will provide the below text books for a small deposit. This deposit will be returned at the end of the year in return for the books.

School provided textbooks

Edexcel AS/A level Physics Student Book 1 + ActiveBook (Edexcel GCE Science 2015)



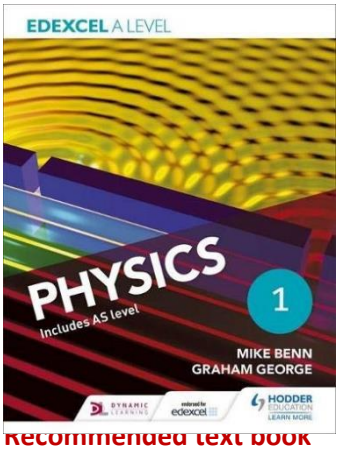
Edexcel A-level Physics Student Guide: Practical Physics by Carol Davenport



The below are text books the school recommends (the more Physics books you have the better your grade will be). A good website to use is https://www.wob.com/en-gb which tends to be cheaper than amazon. Ebay is also a good place to look. If you need financial help purchasing books please see your teacher or head of department.

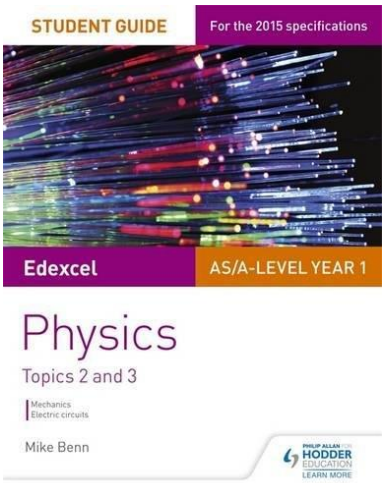
Very highly recommended text book

Edexcel A Level Physics Student Book 1 by Mike Benn

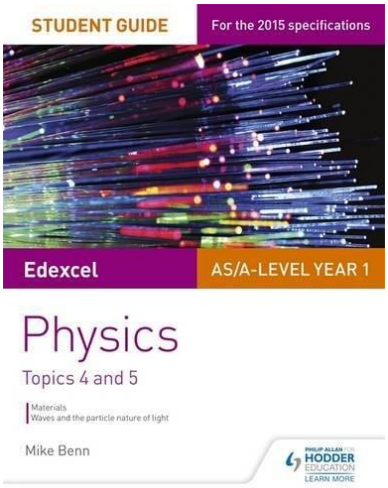


Recommended text book

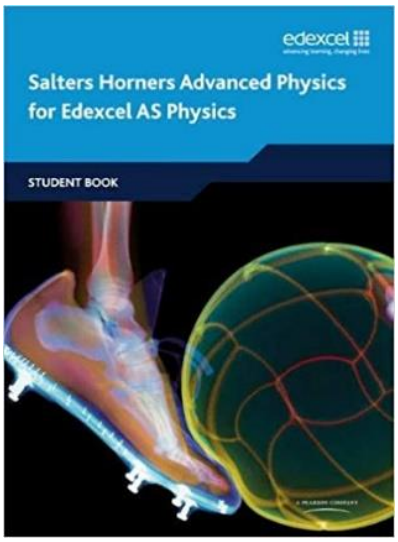
Edexcel AS/A Level Physics Student Guide: Topics 2 and 3by Mike Benn



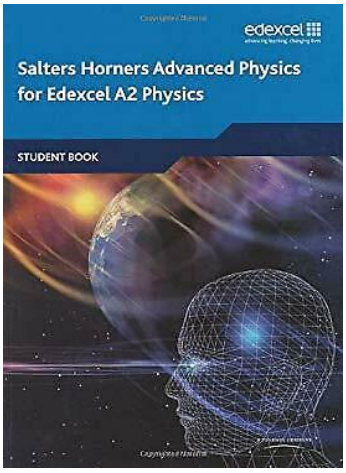
Edexcel AS/A Level Physics Student Guide: Topics 4 and 5 by Mike Benn



Salters Horners Advanced Physics AS Student Book (Salters Horners Advanced Physics 08)

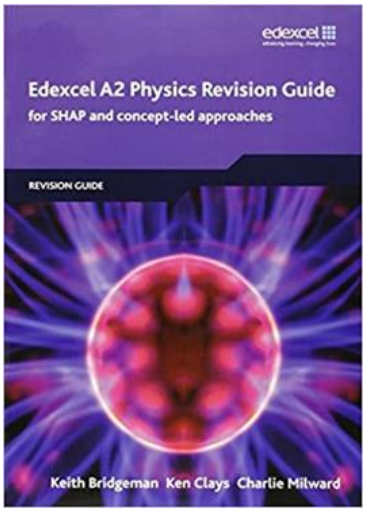


Salters Horners Advanced Physics for Edexcel A2 Physics Paperback

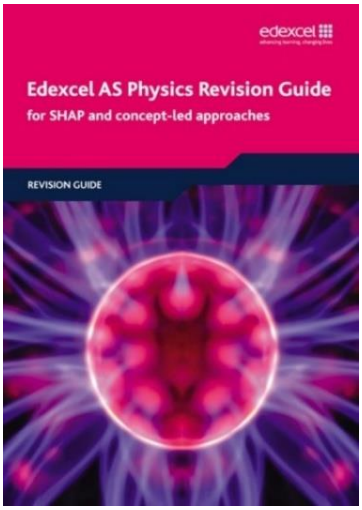


Recommended revision guides

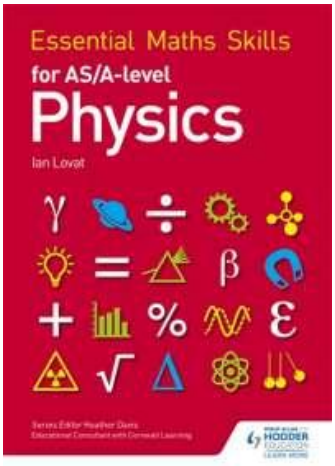
Edexcel A2 Physics Revision Guide 2008: For SHAP and Concept-Led Approaches (Edexcel GCE Physics 2008) by Mr Ken Clays (2009-08-26)



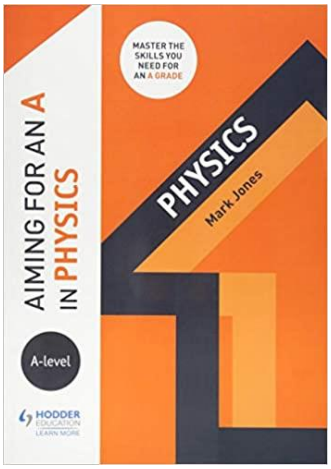
EDEXCEL AS PHYSICS REVISION GUIDE Author(s): Bridgeman, Keith



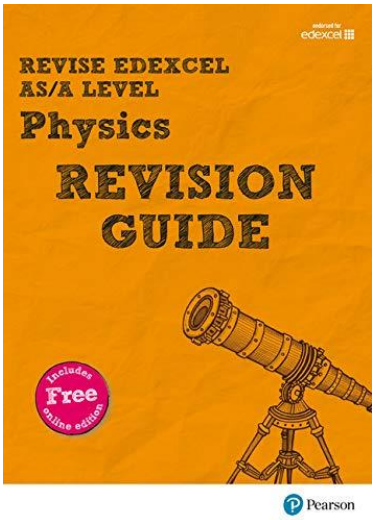
Essential math skills for Alevel physics



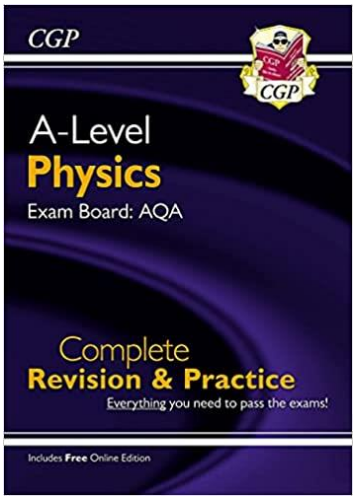
Aiming for an A in A-level Physics Paperback – 31 Aug. 2018



Revise Edexcel AS/A Level Physics Revision Guide by Steve Adams



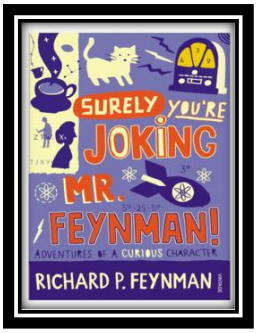
A-Level Physics: AQA Year 1 & 2 Complete Revision & Practice with Online Edition: perfect for catch-up and the 2022 and 2023 exams (CGP A-Level Physics)


CGP
A-Level
Physics
Exam Board: AQA
Complete
Revision & Practice
Everything you need to pass the exams!
Includes Free Online Edition

Reading Recommendations

Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Physics

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

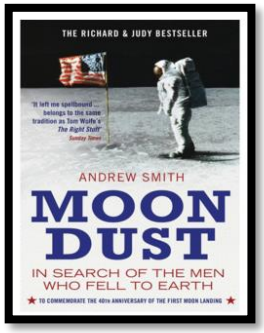


ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle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

(Also available on Audio book).

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

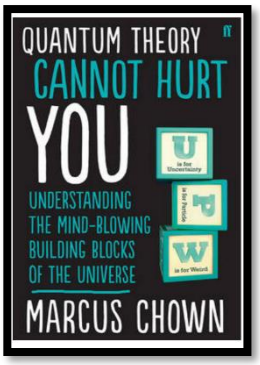
2. **Moondust: In Search of the Men Who Fell to Earth**



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

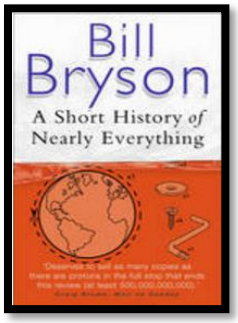
3. **Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe**



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

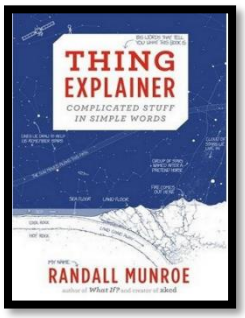
4. A Short History of Nearly Everything



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

Summer tasks

1. **Read the specification from the Edexcel Pearson website:**

https://qualifications.pearson.com/content/dam/pdf/A%20Level/Physics/2015/Specification%20and%20sample%20assessments/PearsonEdexcel-AS-Physics-Spec.pdf

2. **Purchase a folder with dividers.**

   A note on folder etiquette, for each lesson taught you will be expected to have;
   - Class notes
   - Your own notes
   - Exam questions completed and green penned

3. **You should produce 3 pages of notes on the topic of uncertainties, standard international and base units.**
   You should produce 2 pages of GCSE notes on current, voltage, resistance and component characteristics.
   You should produce 2 pages of GCSE notes on distance, displacement, speed, velocity, acceleration and motion graphs.

   The first topics/lessons we will be covering are shown below to help you plan your notes. You can choose the format in which to produce these notes.

1. Working as a physicist	Sig Fig, Standard form and Prefixes		**2. Electric Circuits**	Current & Voltage
	Uncertainties			Resistance, Ohm's law and V/I relationships
	SI and Base Units			Resistivity, Conduction and Drift Velocity
3. Mechanics	Distance, displacement, speed, velocity, accn *			**CORE PRACTICAL 2 - Resistivity**
	Motion graphs			Series & parallel circuits and Kirchhoff's law
	Vectors and vector notation, Addition of vectors			Resistor combinations
	Resolving vectors			Potential dividers *
	Resolving vectors part 2			EMF & Internal Resistance
	Kinematics Equations			**CORE PRACTICAL 3 - EMF and internal resistance**
	Projectiles			

4. Complete the below exam questions

Q1.

A student investigated how the current in a series circuit varied with the resistance of a variable resistor.

Figure 1 shows the circuit used.

Figure 1

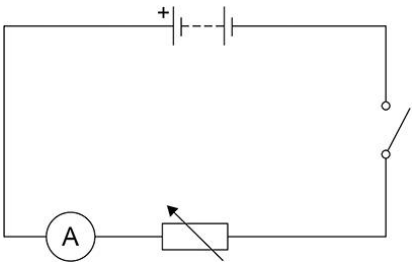
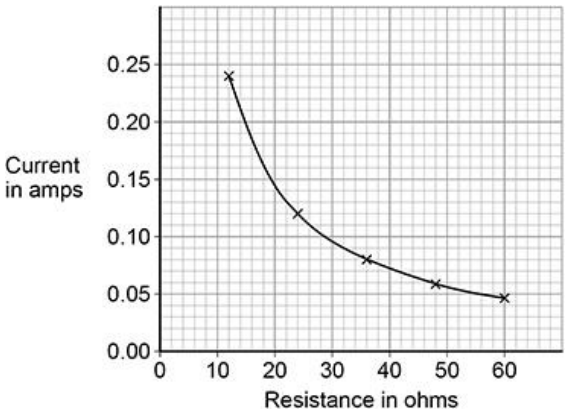


Figure 2 shows the results.

Figure 2



(a) The battery had a power output of 230 mW when the resistance of the variable resistor was 36 Ω.

Determine the potential difference across the battery.

_____

_____

_____

_____

_____

_____

Potential difference = _____ V

(4)

(b) The student concluded:

'the current in the circuit was inversely proportional to the resistance of the variable resistor.'

Explain how **Figure 2** shows that the student is correct.

_____

_____

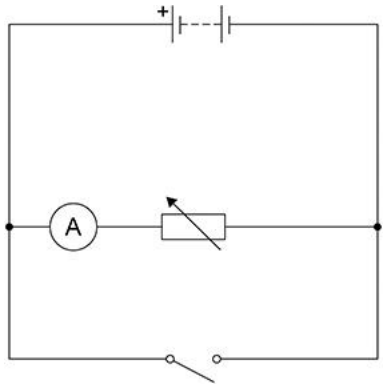
_____

_____

(2)

(c) **Figure 3** shows a circuit with a switch connected incorrectly.

Figure 3



Explain how closing the switch would affect the current in the variable resistor.

_____

_____

_____

_____

_____

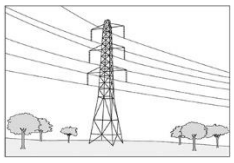
(2)

(Total 8 marks)

Q2.

Figure 1 shows some overhead power cables in the National Grid.

Figure 1



(a) Explain the advantage of transmitting electricity at a very high potential difference.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) It is dangerous for a person to fly a kite near an overhead power cable.

Figure 2 shows a person flying a kite.

Figure 2

The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

Explain why.

_____

_____

_____

_____

_____

_____

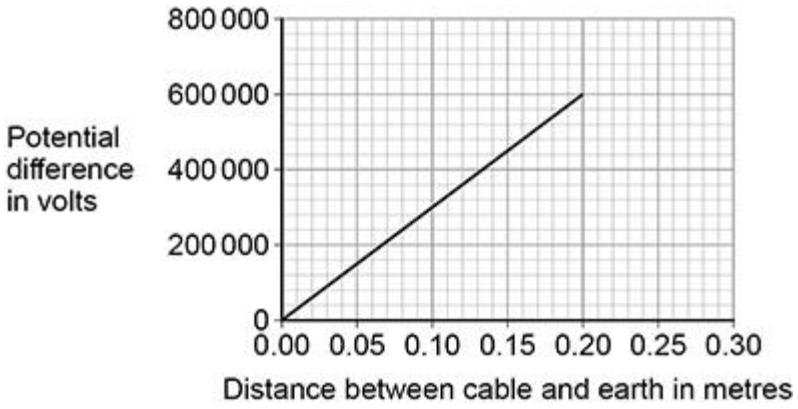
_____

(3)

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 3 shows the results.

Figure 3



(c) The data in **Figure 3** gives the relationship between potential difference and distance when the air is dry.

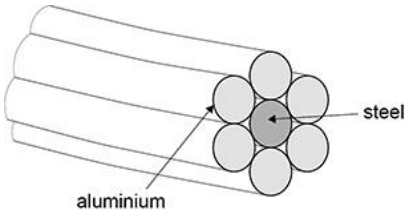
When the humidity of air increases the air becomes a better conductor of electricity.

Draw a line on **Figure 3** to show how the potential difference changes with distance if the humidity of the air increases.

(2)

(d) **Figure 4** shows a cross-section through a power cable.

Figure 4



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

_____

_____

_____

_____

(2)

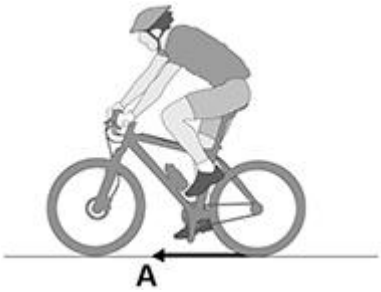
(Total 10 marks)

Q3.

Figure 1 shows a cyclist riding a bicycle.

Force **A** causes the bicycle to accelerate forwards.

Figure 1



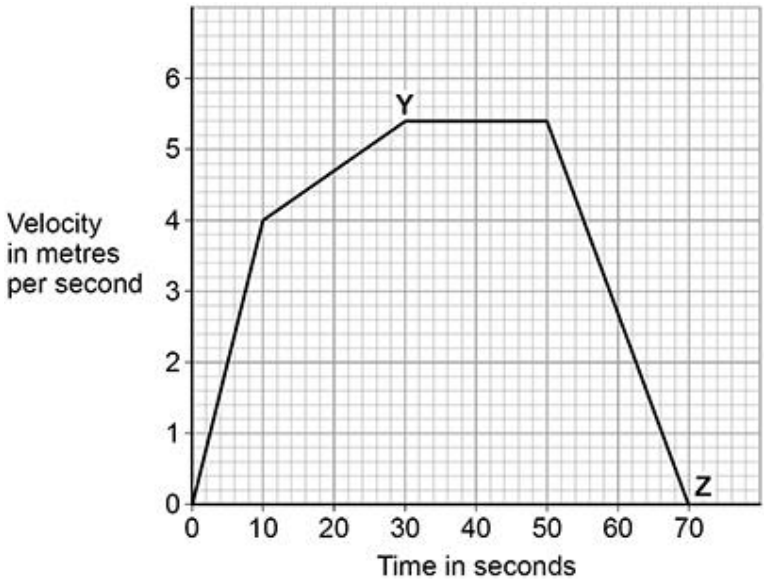
(a) What name is given to force **A**?

_____

(1)

Figure 2 shows how the velocity of the cyclist changes during a short journey.

Figure 2



(b) Determine the distance travelled by the cyclist between **Y** and **Z**.

_____

_____

_____

_____

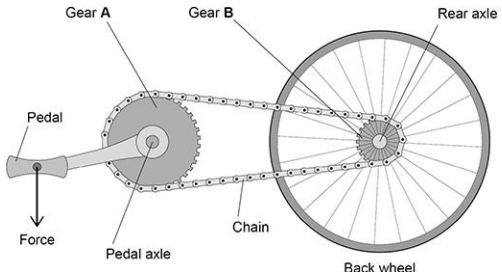
_____

Distance travelled by the cyclist between **Y** and **Z** = _____ m

(3)

(c) **Figure 3** shows the gears on the bicycle.

Figure 3



Describe how the force on the pedal causes a moment about the rear axle.

_____

_____

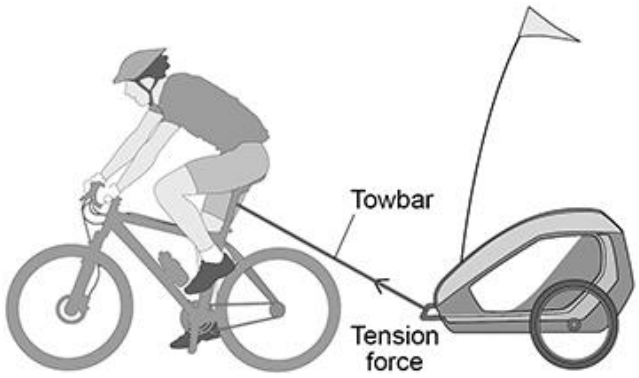
_____

_____

(2)

Figure 4 shows a different cyclist towing a trailer.

Figure 4



(d) The speed of the cyclist and trailer increased uniformly from 0 m/s to 2.4 m/s.

The cyclist travelled 0.018 km while accelerating.

Calculate the initial acceleration of the cyclist.

_____

_____

_____

_____

_____

Acceleration = _____ m/s^2

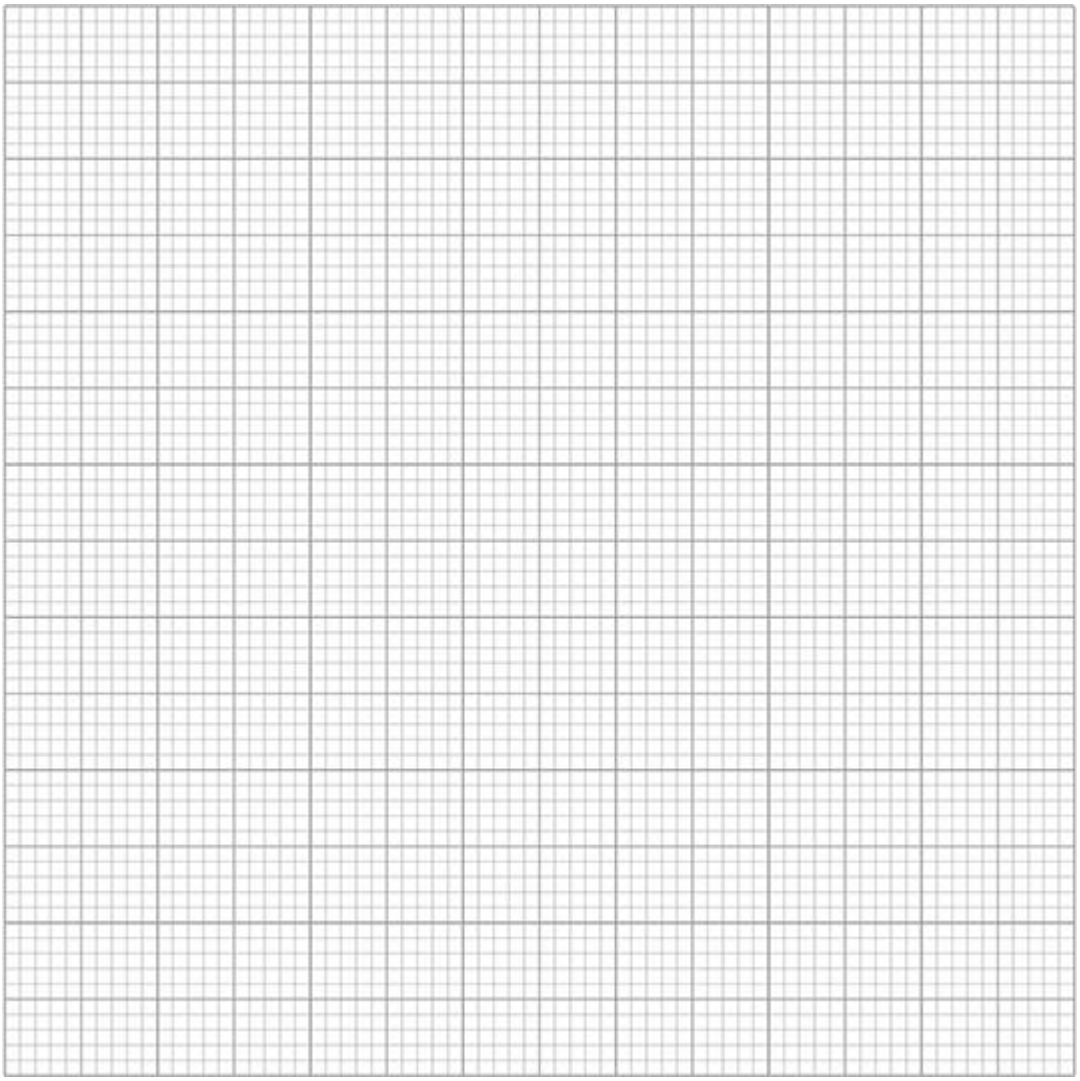
(3)

(e) The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

horizontal force = 200 N

vertical force = 75 N

Determine the magnitude and direction of the resultant force of the towbar on the trailer by drawing a vector diagram.



Magnitude of force = _____ N

Direction of force = _____ degrees

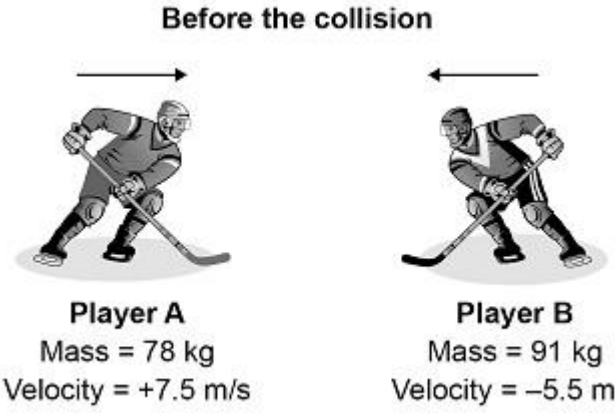
(4)

(Total 13 marks)

Q4.

The image below shows two ice hockey players moving towards each other.

They collide and then move off together.



During the collision, the total momentum of the players is conserved.

(a) What is meant by 'momentum is conserved'?

_____

_____

(1)

(b) Immediately after the collision the two players move together to the right.

Calculate the velocity of the two players immediately after the collision.

_____

_____

_____

_____

_____

_____

_____

_____

Velocity = _____ m/s

(4)

(c) The ice hockey players wear protective pads filled with foam.

Explain how the protective pads help to reduce injury when the players collide.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q5.

The thinking distance and braking distance for a car vary with the speed of the car.

(a) Explain the effect of **two** other factors on the **braking** distance of a car.

Do **not** refer to speed in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Which equation links acceleration (*a*), mass (*m*) and resultant force (*F*).

Tick (✓) **one** box.

resultant force = mass × acceleration ☐

resultant force = mass × acceleration^2 ☐

$$\text{resultant force} = \frac{\text{mass}}{\text{acceleration}^2}$$ ☐

$$\text{resultant force} = \frac{\text{mass}}{\text{acceleration}}$$ ☐

(1)

(c) The mean braking force on a car is 7200 N.

The car has a mass of 1600 kg.

Calculate the deceleration of the car.

_____

_____

_____

_____

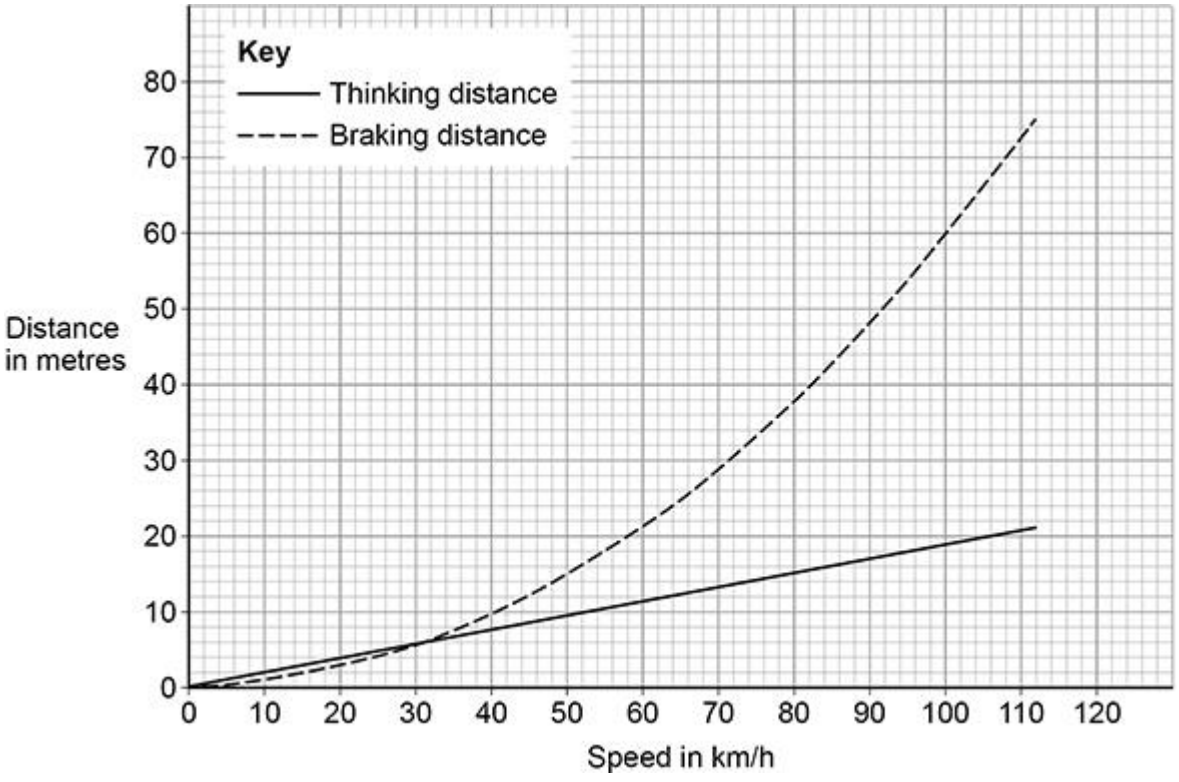
_____

Deceleration = _____ m/s^2

(3)

(d) **Figure 1** below shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 1



Determine the stopping distance when the car is travelling at 80 km/h.

_____

_____

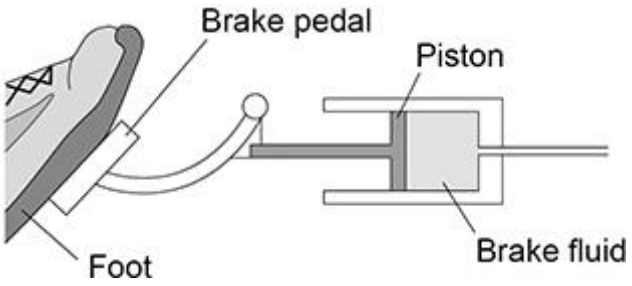
_____

Stopping distance = _____ m

(2)

Figure 2 below shows part of the braking system for a car.

Figure 2



(e) Which equation links area of a surface (A), the force normal to that surface (F) and pressure (p)?

Tick (✓) **one** box.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☐

$p = \frac{A}{F}$ ☐

(1)

(f) When the brake pedal is pressed, a force of 60 N is applied to the piston.

The pressure in the brake fluid is 120 000 Pa.

Calculate the surface area of the piston.

Give your answer in standard form.

Give the unit.

_____

_____

_____

_____

_____

_____

Surface area (in standard form) = _____ Unit _____

(5)

(Total 16 marks)

5. Read through the below and fill in the blanks where required.

1. Prefixes and units

In Physics we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	Name	What it means		How to convert	
P	peta	10^{15}	1000000000000000		↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000
k	kilo	10^{3}	1000	↑ ÷ 1000	↓ x1000
			1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ x1000
µ	micro	10^{-6}	0.000001	↑ ÷ 1000	↓ x1000
n	nano	10^{-9}	0.000000001	↑ ÷ 1000	↓ x1000
p	pico	10^{-12}	0.000000000001	↑ ÷ 1000	↓ x1000
f	femto	10^{-15}	0.000000000000001	↑ ÷ 1000	

Convert the figures into the units required.

6 km	=	6×10^{3}	m
54 MN	=		N
0.086 µV	=		V
753 GPa	=		Pa
23.87 mm/s	=		m/s

Convert these figures to suitable prefixed units.

640	GV	=	640×10^{9}	V
		=	0.5×10^{-6}	A
		=	93.09×10^{9}	m
	kN	=	32×10^{5}	N
	nm	=	0.024×10^{-7}	m

Convert the figures into the prefixes required.

s	ms	µs	ns	ps
0.00045	0.45	450	450 000 or 450×10^3	450×10^6
0.000000789				
0.000 000 000 64				

mm	m	km	µm	Mm
1287360				
295				

2. Significant Figures

1. **All non-zero numbers ARE significant.** The number 33.2 has THREE significant figures because all of the digits present are non-zero.

2. **Zeros between two non-zero digits ARE significant.** 2051 has FOUR significant figures. The zero is between 2 and 5

3. **Leading zeros are NOT significant.** They're nothing more than "place holders." The number 0.54 has only TWO significant figures. 0.0032 also has TWO significant figures. All of the zeros are leading.

4. **Trailing zeros when a decimal is shown ARE significant.** There are FOUR significant figures in 92.00 and there are FOUR significant figures in 230.0.

5. **Trailing zeros in a whole number with no decimal shown are NOT significant.** Writing just "540" indicates that the zero is NOT significant, and there are only TWO significant figures in this value.

(THIS CAN CAUSE PROBLEMS!!! WE SHOULD USE POINT 8 FOR CLARITY, BUT OFTEN DON'T - 2/3 significant figures is accepted in IAL final answers - eg 500/260 = 1.9 to 2 sf. Better $5.0 \times 10^2 / 2.6 \times 10^2 = 1.9$)

8. **For a number in scientific notation: $N \times 10^x$, all digits comprising N ARE significant by the first 5 rules; "10" and "x" are NOT significant.** 5.02×10^4 has THREE significant figures.

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.070	
2.0		82.42		2.483×10^4		69324.8	
500		750000		0.0006		0.0063	

3. Converting length, area and volume

Whenever substituting quantities into an equation, you must always do this in SI units – such as time in seconds, mass in kilograms, distance in metres…

If the question doesn't give you the quantity in the correct units, you should always convert the units **first**, rather than at the end. Sometimes the question may give you an area in mm^2 or a volume in cm^3, and you will need to convert these into m^2 and m^3 respectively before using an equation.

To do this, you first need to know your length conversions:

1m = 100 cm = 1000 mm (1 cm = 10 mm)

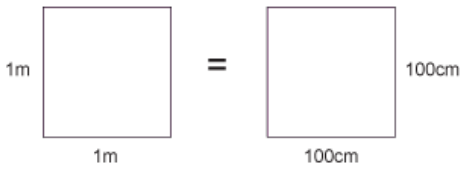
m to cm	x 100	cm to m	÷ 100
m to mm	x 1000	M to mm	÷ 1000

Always think –

"Should my number be getting larger or smaller?" This will make it easier to decide whether to multiply or divide.

Converting Areas

A 1m x 1m square is equivalent to a 100 cm x 100 cm square.



Therefore, $1\ m^2 = 10\ 000\ cm^2$

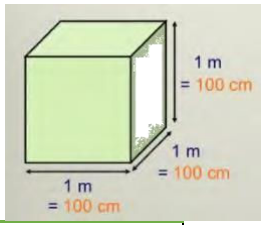
Similarly, this is equivalent to a 1000 mm x 1000 mm square;

So, $1\ m^2 = 1\ 000\ 000\ mm^2$

m^2 to cm^2	x 10 000	cm^2 to m^2	÷ 10 000
m^2 to mm^2	x 1 000 000	m^2 to mm^2	÷ 1 000 000

Converting Volumes

A 1m x 1m x 1m cube is equivalent to a 100 cm x 100 cm x 100 cm cube.



Therefore, $1\ m^3 = 1\ 000\ 000\ cm^3$

Similarly, this is equivalent to a 1000 mm x 1000 mm x 1000 mm cube;

So, $1\ m^3 = 10^9\ mm^3$

m^3 to m^3	x 1 000 000	cm^3 to m^3	÷ 1 000 000
m^3 to mm^3	x 10^9	m^3 to mm^3	÷ 10^9

6 m_2	=	cm^2
0.002 m^2	=	mm^2
24 000 cm^2	=	m^2
46 000 000 mm^3	=	m^3
0.56 m^3	=	cm^3

750 mm^2	=	m^2
5 x 10^{-4} cm^3	=	m^3
8.3 x 10^{-6} m^3	=	mm^3
3.5 x 10^2 m^2	=	cm^2
152000 mm^2	=	m^2

Now use the technique shown on the previous page to work out the following conversions:

31 x 10^8 m^2	=	km_2
59 cm^2	=	mm_2
24 dm^3	=	cm_3
4 500 mm^2	=	cm_2
5 x 10^{-4} km^3	=	m_3

(*Hint: There are 10 cm in 1 dm)*

For the following, think about whether you should be writing a smaller or a larger number down to help decide whether you multiply or divide.

Eg. To convert 5 m ms^{-1} into m s^{-1} – you will travel more metres in 1 second than in 1 millisecond, therefore you should multiply by 1000 to get 5000 m s^{-1}.

5 N cm^{-2}	=	N m^{-2}
1150 kg m^{-3}	=	g cm^{-3}
3.0 m s^{-1}	=	km h^{-1}
65 kN cm^{-2}	=	N mm^{-2}
7.86 g cm^{-3}	=	kg m^{-3}

7. Accuracy, Precision, Resolution

An ***accurate*** result is one that is judged to be close to the true value. It is influenced by random and systematic errors.

The true value is the value that would be obtained in an ideal measurement.

The true value is the value that would be obtained in an ideal measurement.

A ***precise*** measurement is described when the values 'cluster' close together. We describe measurements as precise when repeated values are close together (consistent). It is influenced by random effects.
Resolution is the smallest change in the quantity being measured that causes a perceptible change in the output of the measuring device. This is usually the smallest measuring interval. It does not mean a value is accurate.
Uncertainty is variation in measured data and is due to random and systematic effects. We usually assume the uncertainty is the same as the resolution of the measuring instrument.
example ruler, resolution +/- 1 mm so uncertainty is also +/- 1 mm

Stop watch used by a pupil, resolution +/- 0.01 s but uncertainty estimated as +/- 0.2 s due to human reaction time.

For our exam we estimate uncertainty and as long as you have a sensible justification your answer will be ok.

Eg. The true temperature of the room is 22.4 °C. One thermometer gives a reading of 22 °C *and another gives a reading of* 23.4 °*C* . Which is most accurate and estimate its uncertainty?

23.4 °*C* has the best resolution but is not close to the correct value.
22°C has less resolution but is more accurate as it is closer to the correct result.

The uncertainty in this reading is 22 +/− 1°C

Example
Isabelle is finding the mass of an insect, but the insect moves while on the electronic balance.
She records a set of readings as 5.00 mg , 5.01 mg, 4.98 mg, 5.02 mg.
The true value of the insect's mass is 4.5 mg.
Calculate an average value with estimated uncertainty for her results and compare this value with the true value using the terms above.

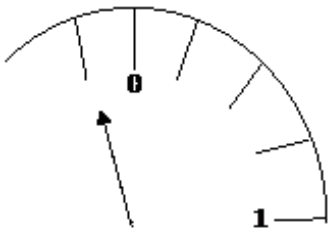
8. Identifying Errors

There are two main types of error in Science:

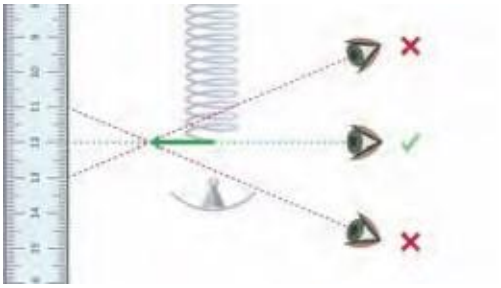
1) Random error
2) Systematic error

Random errors can be caused by changes in the environment that causes readings to alter slightly, measurements to be in between divisions on a scale or observations being perceived differently by other observers. These errors can vary in size and can give readings both smaller and larger than the true value.
The best way to reduce random error is to use as large values as possible (eg. Large distances) and repeat and average readings, as well as taking precaution when carrying out the experiment.

Systematic errors have occurred when all readings are shifted by the same amount away from the true value.
The two main types of systematic error are:
i) *Zero error* – this is where the instrument does not read zero initially and therefore will always produce a shifted result (eg. A mass balance that reads 0.01g before an object is placed on it). Always check instruments are zeroed before using. ii) *Parallax error* – this is where a measurement is not observed from eye level so the measurement is always read at an angle producing an incorrect reading. Always read from eye level to avoid parallax.



Zero Error



Parallax Error

Repeat and averaging experiments will not reduce systematic errors as correct experimental procedure is not being followed.

There are occasions where readings are just measured incorrectly or an odd result is far away from other readings – these results are called **anomalies**. Anomalies should be removed and repeated before used in any averaging.

For each of the measurements listed below identify the most likely source of error what type of error this is and one method of reducing it.

9. Improving Experiments – Accuracy, Resolution and Reliability

When improving **accuracy**, you must describe how to make sure your *method* obtains the best results possible. You should also try to *use as large quantities as possible as this reduces the percentage error in your results*. Also make your range as large as possible, with small intervals between each reading.

Resolution refers to the smallest scale division provided by your measuring instrument, or what is the smallest nonzero reading you can obtain from that instrument.

Reliability refers to how 'trustworthy' your results are. You can improve reliability by repeating and averaging your experiment, as well as removing anomalies.

Complete the table below to state how to use the measuring instruments as accurately as possible, as well as stating the precision (smallest scale division) of each instrument.

Appendix - It's all Greek

You are expected to know most of these letters.

The letters we will not use at A level are zeta, chi, psi, iota, kappa, xi, omicron.

Greek alphabet list

Upper Case Letter	Lower Case Letter	Greek Letter Name
Α	α	Alpha
Β	β	Beta
Γ	γ	Gamma
Δ	δ	Delta
Ε	ε	Epsilon
Ζ	ζ	Zeta
Η	η	Eta
Θ	θ	Theta

Upper Case Letter	Lower Case Letter	Greek Letter Name
Ρ	ρ	Rho
Σ	σ,ς *	Sigma
Τ	τ	Tau
Υ	υ	Upsilon
Φ	φ	Phi
Χ	χ	Chi
Ψ	ψ	Psi
Ω	ω	Omega

Upper Case Letter	Lower Case Letter	Greek Letter Name
Ι	ι	Iota
Κ	κ	Kappa
Λ	λ	Lambda
Μ	μ	Mu
Ν	ν	Nu
Ξ	ξ	Xi
Ο	ο	Omicron
Π	π	Pi
Ρ	ρ	Rho

Note.

The second lower case symbol for sigma is used at the end of Greek words and not in our equations.

TASK. Write out the Greek letters that you have used in physics and mathematics.

Can you find other letter you have not used yet? If so write them out.

We often use the upper and lower case letters so learn both.

Mark schemes

Q1.

(a) I = 0.08 (A)

an incorrect value of I from the graph can score all subsequent marks

1

0.230 = 0.08 × V

allow a correct substitution of an incorrectly/not converted value of P

1

$$V = \frac{0.230}{0.08}$$

allow a correct rearrangement using an incorrectly/not converted value of P

1

V = 2.875 (V)

OR

I = 0.08 (A) (1)

V = 0.08 × 36 (2)

V = 2.88 (V) (1)

OR

0.230 = I^2 × 36 (1)

I = 0.08 (A) (1)

V = 0.08 × 36 (1)

V = 2.88 (V) (1)

allow a correct calculation using an incorrectly/not converted value of P

1

(b) the product of current and resistance = a constant

1

calculation of constant (2.88) using three or more pairs of values

if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity

1

(c) current would be (almost) zero (in the variable resistor)

1

(because) the switch has (effectively) zero resistance
or
the potential difference across the variable resistor is (effectively) zero

the switch's resistance is much lower than the variable resistor

allow the switch creates a short circuit

1

[8]

Q2.

(a) (very high p.d. means) very low currents

1

which means less (thermal) energy is transferred to surroundings

allow less power loss in cables

1

which increases the efficiency of power transmission

1

(b) electric field strength is very high

1

causing the air to become ionised

allow the air breaks down

allow the air becomes a conductor

allow the air conducts charge

1

(the kite / string) conducts charge to the person / earth

ignore answers referring to the kite touching the power cables

1

(c) straight line passing through the origin

1

line drawn below existing line for all values

1

(d) the potential difference across the wires/cable is the same

1

(but) the resistance of the steel wire is greater (and so less current in the steel)

1

[10]

Q3.

(a) friction

1

(b) (area of rectangle =) 108 (m)

1

(area of triangle =) 54 (m)

1

(total area / distance =) 162 (m)

allow a correctly calculated total area / distance from an incorrectly calculated area of rectangle and / or triangle

1

(c) (the force on the pedal) causes a moment about the pedal axle

1

which causes a force on the chain (which causes a moment about the rear axle)

allow gear B for chain

1

(d) $2.4^2 (- 0^2) = 2 \times a \times 18$

1

$$a = \frac{2.4 \times 2.4}{36}$$

1

$a = 0.16$ (m/s^2)

1

alternative method

$t = 18 / 1.2$
$t = 15$ (s) (1)

$a = 2.4 / 15$ (1)

this mark may be awarded if the time is incorrectly calculated

$a = 0.16$ (m/s^2) (1)

allow a correctly calculated acceleration from an incorrectly calculated time 1

(e) horizontal (200N) **and** vertical (75N) forces drawn to the same scale

1

resultant force drawn in the correct direction

shown by an arrow head from bottom right to top left

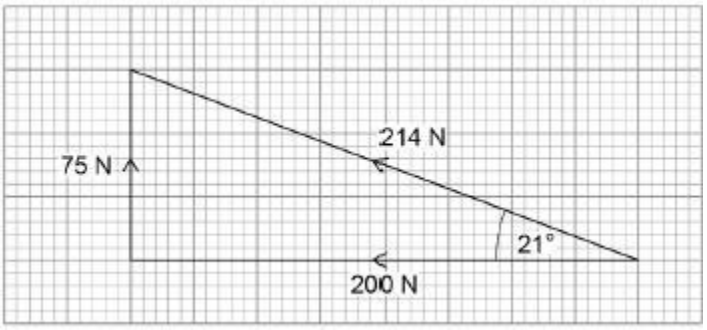
1

resultant force with a value in the range 212 to 218 (N)

allow a calculated value of 213.6 ***or*** *214 (N)*

1

direction in the range 20–22 (degrees from the horizontal)



allow 68–70 (degrees from the vertical)
allow a bearing in the range 290–292
to gain full marks a vector diagram must have been drawn

1

[13]

Q4.

(a) (total) momentum before = (total) momentum after
allow (total) momentum stays the same

1

(b) momentum of player A = 585 (kg m/s)

1

momentum of player B = –500.5 (kg m/s)

1

$$\frac{(-500.5 + 585)}{(78 + 91)}$$

OR

$$\frac{84.5}{169}$$

allow $\frac{1085.5}{169}$

1

= 0.5 (m/s)
this answer only

1

(c) (protective pads) increase the time taken to stop (during the collision)
allow increases impact / contact / collision time
*do **not** allow slows down time*

1

so the rate of change of momentum decreases
allow reduces acceleration/deceleration
*allow increases the time to reduce the momentum to zero for **2** marks*

1

reducing the force (on the ice hockey player)

allow impact for force

*do **not** allow if linked to an incorrect explanation*

1

[8]

Q5.

(a) **Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

Factors
- poor condition of tyres
- poor road surface
- wet or icy road
- poor/worn brakes

Explanation
- because of decreased friction

Factors
- increased mass of car/passengers

Explanation
- increases kinetic energy of car
- more work needs to be done to stop car
- increases momentum of the car

Factor
- road slopes downhill

Explanation
- (a component of) gravity opposes the braking force
- resultant (braking) force is reduced

allow answers in terms of reducing braking distance throughout

A single factor with no related explanation is insufficient to score a mark

(b) resultant force = mass × acceleration

1

(c) $7200 = 1600 \times a$

ignore negatives throughout

1

$$a = \frac{7200}{1600}$$

1

$a = 4.5$ (m/s^2)

1

(d) 15 (m) 38 (m)

two correct values identified

1

= 53 (m)

allow the correct addition of a misread braking distance and /or a misread thinking distance taken from the graph

1

(e) $p = \frac{F}{A}$

1

(f) $120\,000 = \frac{60}{A}$

1

$A = \frac{60}{120\,000}$

1

$A = 0.0005$

1

$A = 5\ (.0) \times 10^{-4}$

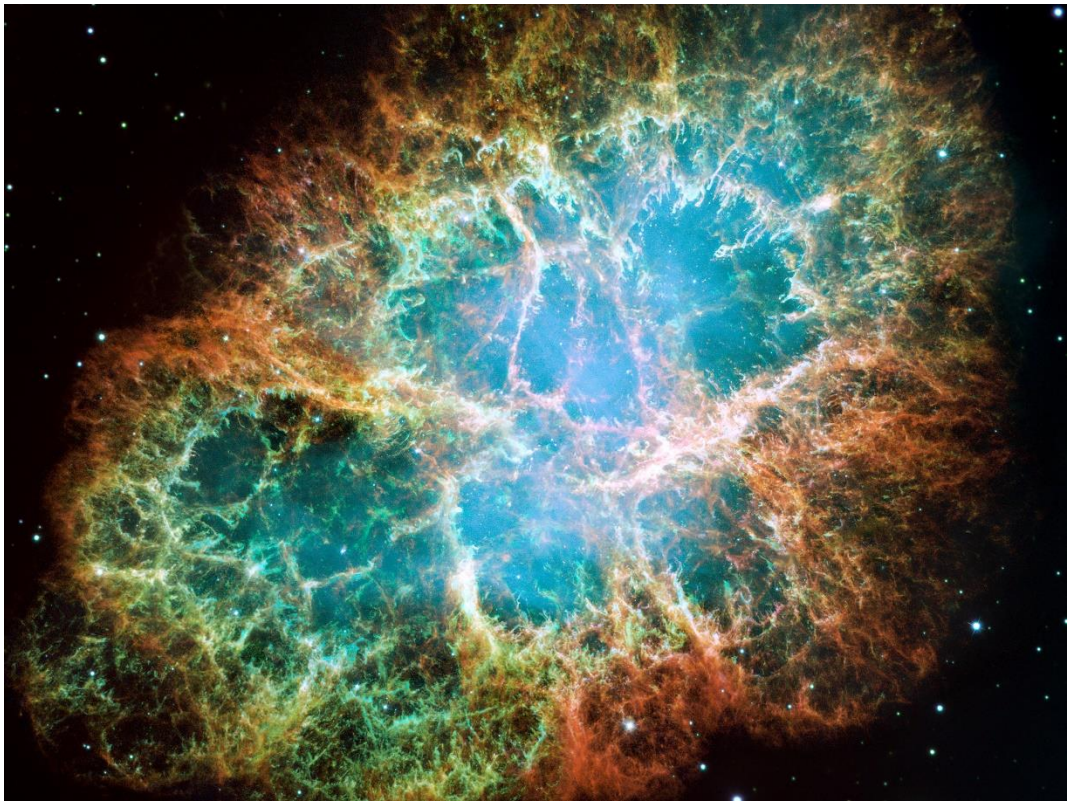
allow an answer given to 2 sig figs from an incorrect calculation using the given data

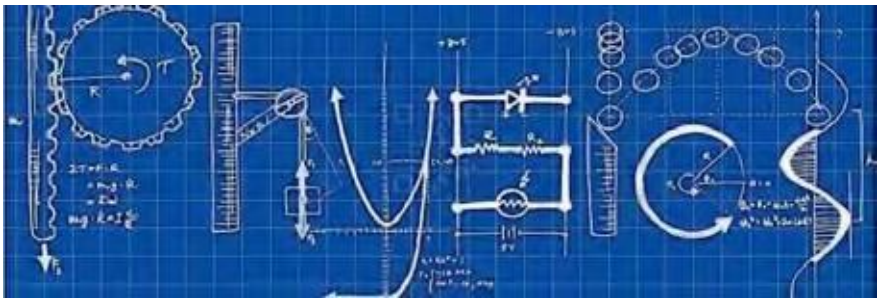
1

m^2

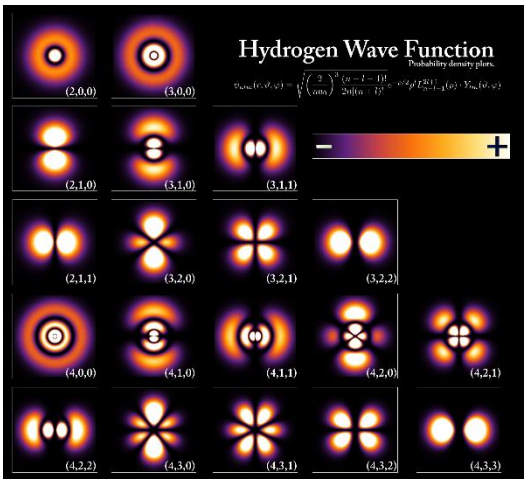
1

[16]





BRIDGING WORK 12 to 13



Bentley Wood
High School for Girls

WELCOME TO A2 PHYSICS

The purpose of this booklet is to give you essential information and resources for the A2 Physics course. This booklet will also help you to understand and develop the skills you will need.

Please remember the following items for **EVERY** lesson – **ESSENTIAL**:

- Pens (highlighters are useful too) and paper
- A file with your (well organised) notes in
- Calculator, ruler and pencils

We hope you enjoy learning Physics BUT sometimes even the best of students can have problems:

- **Problems with work**
- **Problems understanding concepts**
- **Problems getting your head round all the theories in physics**
- **Problems with completing homework**
- **Problems in their personal lives**

If any of this applies to you, don't feel there's nowhere to turn – **THERE IS!**

ALL the staff in the Physics Department will be happy to talk through your concerns or can advise you – so don't panic or think about giving up, **HELP IS AT HAND**.

Come and find us, or e-mail – no problem is ever so big that we can't help, honest!

A Binnion	Abinnion@bentleywood.harrow.sch.uk

Expectations

As a part of its quality approach to teaching, the Physics Department follows a common policy on the setting and marking of work. This code of practice is followed by both staff and students and is aimed to help you achieve success in Physics.

What we expect of YOU

- It is expected that your attendance will be 100% - if you are absent you MUST inform your tutor (beforehand if possible). If you do miss a lesson for medical or academic reasons it is YOUR responsibility to catch up on the work that you have missed.
- You are expected to spend **FIVE** hours a week per subject on personal study. This time may be directed by homework set by the tutor; otherwise you will be expected to use this time to read around your subject, supplement your notes and ensure that your notes are well organised and complete.
- You will be set an assessment every WEEK. If you have been unable to complete the work, you will be expected to inform your tutor prior to the lesson that the work is due in and/or find a time to catch-up.
- You are expected to manage and organise your work effectively, and to be responsible for keeping your notes, files and assessment pack up to date.
- You are expected to listen respectfully to your peers in discussions and group work

What you can expect of US

- Assessed work will be marked and handed back within TWO weeks of the handing in date.
- We will always be willing to discuss your progress and support your learning.

Useful websites

The following Internet resources are useful and will help with your AS Physics course:

Exam board website:

- https://qualifications.pearson.com/en/qualifications/edexcel-a-levels/physics-2015.html: contains past papers, exam dates and most importantly EXAMINERS' REPORTS which will tell you where students commonly go wrong/suggest how to improve.
- https://www.pearsonactivelearn.com/app/Home Once you have a login you can practice questions

Revision and consolidation of knowledge:

- https://getrevising.co.uk/resources/level/a_ib/subjects/physics
- https://senecalearning.com/en-GB/
- https://www.savemyexams.co.uk/a-level-physics-aqa/revision-notes/
- https://studywise.co.uk/a-level-revision/physics/
- https://digestiblenotes.com/physics/circles/circular_measure.php
- https://www.revisely.co.uk/alevel/physics/aqa/

Leaning towards questioning

- https://snaprevise.co.uk/
- https://www.physicsandmathstutor.com/
- https://www.alevelphysicsonline.com/
- https://mathsmadeeasy.co.uk/a-level-physics-revision/

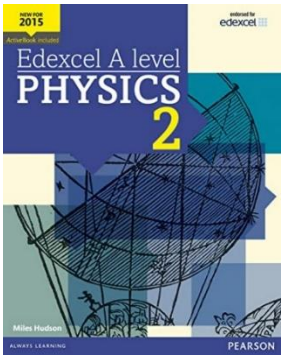
You are encouraged to keep an eye on the news as many reports and articles will be relevant to the materials you are studying in class.

Textbooks

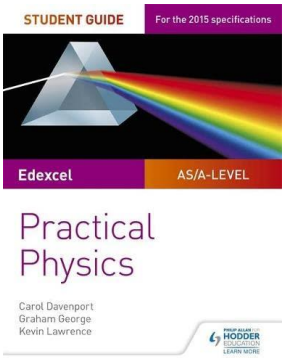
The school will provide the below text books for a small deposit. This deposit will be returned at the end of the year in return for the books.

School provided textbooks

Edexcel A level Physics Student Book 2 + ActiveBook by Miles Hudson



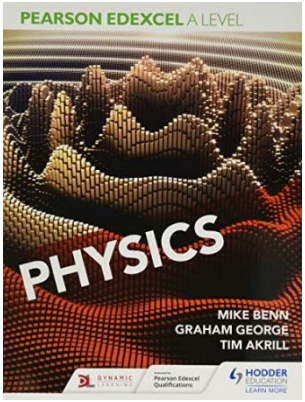
Edexcel A-level Physics Student Guide: Practical Physics by Carol Davenport



The below are text books the school recommends (the more Physics books you have the better your grade will be). A good website to use is https://www.wob.com/en-gb which tends to be cheaper than amazon. Ebay is also a good place to look. If you need financial help purchasing books please see your teacher or head of department.

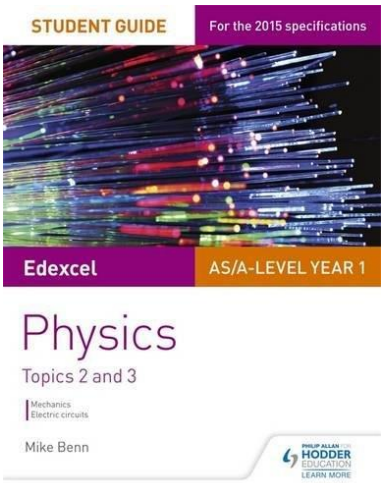
Very Highly recommended text books

Pearson Edexcel A Level Physics (Year 1 and Year 2) by Mike Benn (or separate)

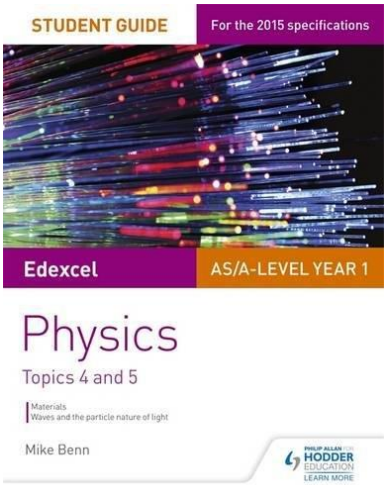


Recommended text book

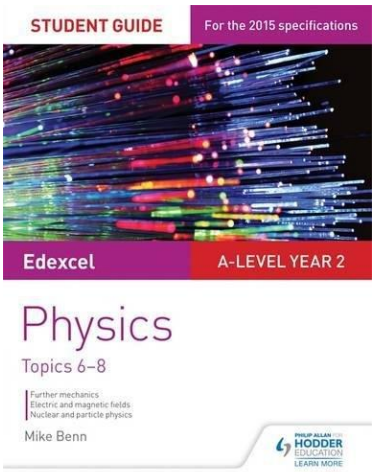
Edexcel AS/A Level Physics Student Guide: Topics 2 and 3by Mike Benn



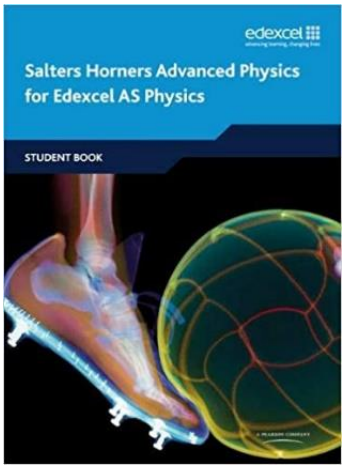
Edexcel AS/A Level Physics Student Guide: Topics 4 and 5 by Mike Benn



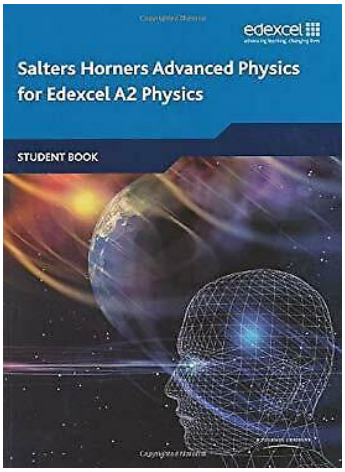
Edexcel A Level Year 2 Physics Student Guide: Topics 6-8 by Mike Benn



Salters Horners Advanced Physics AS Student Book (Salters Horners Advanced Physics 08)

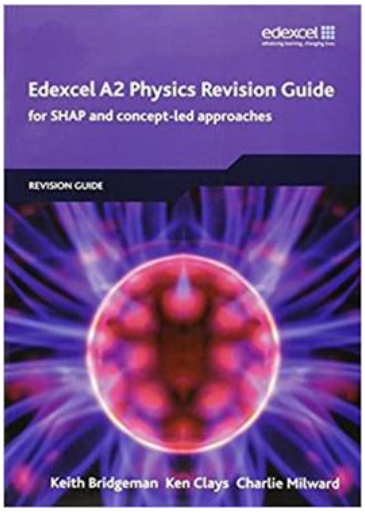


Salters Horners Advanced Physics for Edexcel A2 Physics Paperback

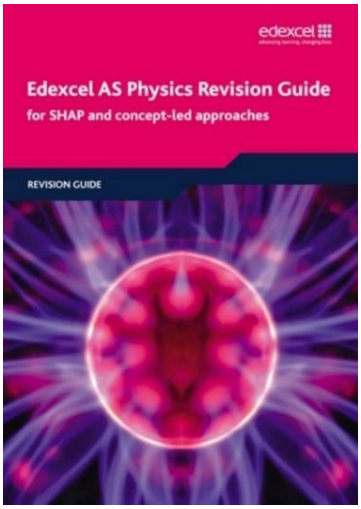


Recommended revision guides

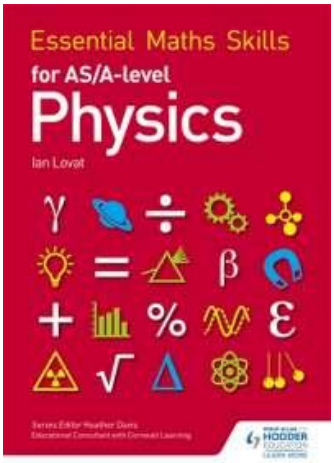
Edexcel A2 Physics Revision Guide 2008: For SHAP and Concept-Led Approaches (Edexcel GCE Physics 2008) by Mr Ken Clays (2009-08-26)



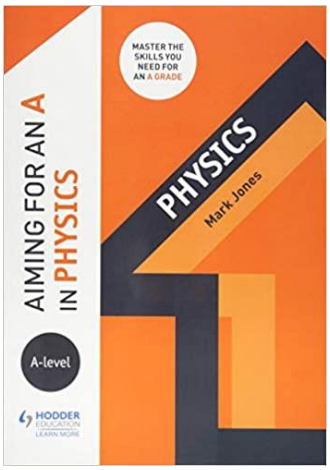
EDEXCEL AS PHYSICS REVISION GUIDE Author(s): Bridgeman, Keith



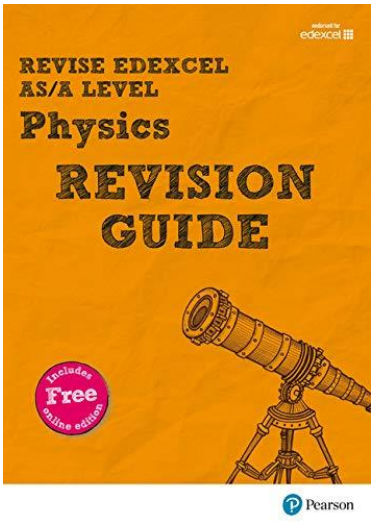
Essential math skills for Alevel physics



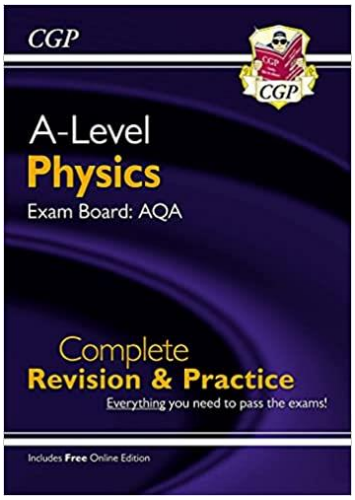
Aiming for an A in A-level Physics Paperback – 31 Aug. 2018



Revise Edexcel AS/A Level Physics Revision Guide by Steve Adams



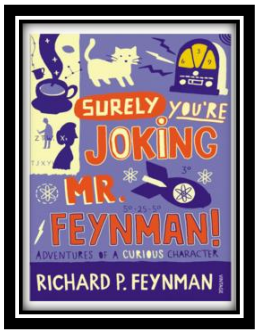
A-Level Physics: AQA Year 1 & 2 Complete Revision & Practice with Online Edition: perfect for catch-up and the 2022 and 2023 exams (CGP A-Level Physics)



Reading Recommendations

Kick back this summer with a good read. The books below are all popular science books and great for extending your understanding of Physics

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

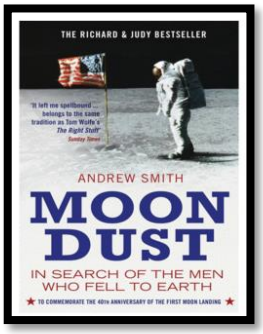


ISBN - 009917331X - Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle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

(Also available on Audio book).

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

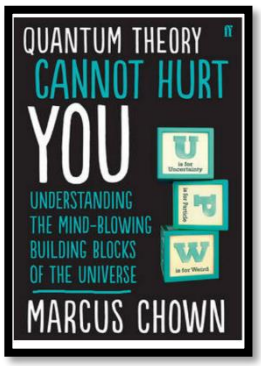
2. **Moondust: In Search of the Men Who Fell to Earth**



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

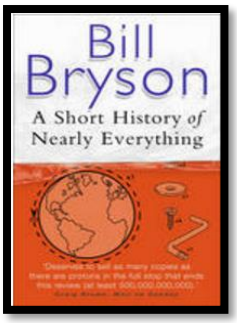
3. **Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe**



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

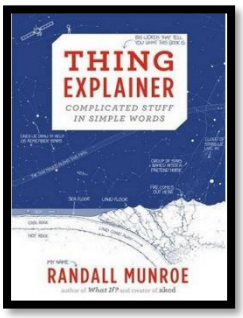
4. A Short History of Nearly Everything



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=LyqIeIxXTpw

Summer tasks

1. **Read** the specification from the Edexcel Pearson website: https://qualifications.pearson.com/content/dam/pdf/A%20Level/Physics/2015/Specification%20and%20sample%20assessments/PearsonEdexcel-Alevel-Physics-Spec.pdf

2. At the very start of next year you will be **retested** on your AS knowledge. This will include all the AS topics in addition to further mechanics and space. Make sure your knowledge is strong and that you reviewed the AS content over the summer.

3. Consolidate your notes and folders completing a structured mind map for each sub-topic from Y12.

4. Research project

One topic in year 13 is particle physics which is such an interesting topic with so much to learn. To prepare for this you must **choose one research project below and create a presentation about it.** This presentation could be in the form of a powerpoint, a poster or a written essay but you **must include the success criteria outlined below**. You will be presenting this to your class in September and you will be **assessed by your teacher**. This assessed mark will go on your first report, so you want it to be excellent.

1. The history of the atom – From Democritus to Rutherford
2. Into the nucleus – the discovery of the neutron.
3. Electrons – a truly fundamental particle – discovery and uses
4. The particle zoo – quarks and beyond
5. Particle accelerators – what are they and how do they develop our understanding of physics?
6. *Challenge question. The prediction and discovery of the Higg's Boson*

Success criteria

- Able to present for 5 minutes about your chosen topic
- Included relevant and correct physics information
- Used correct scientific vocabulary
- Included the key dates and notable scientists involved