



Transition Pack for A Level Physics

Get ready for A-level!

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



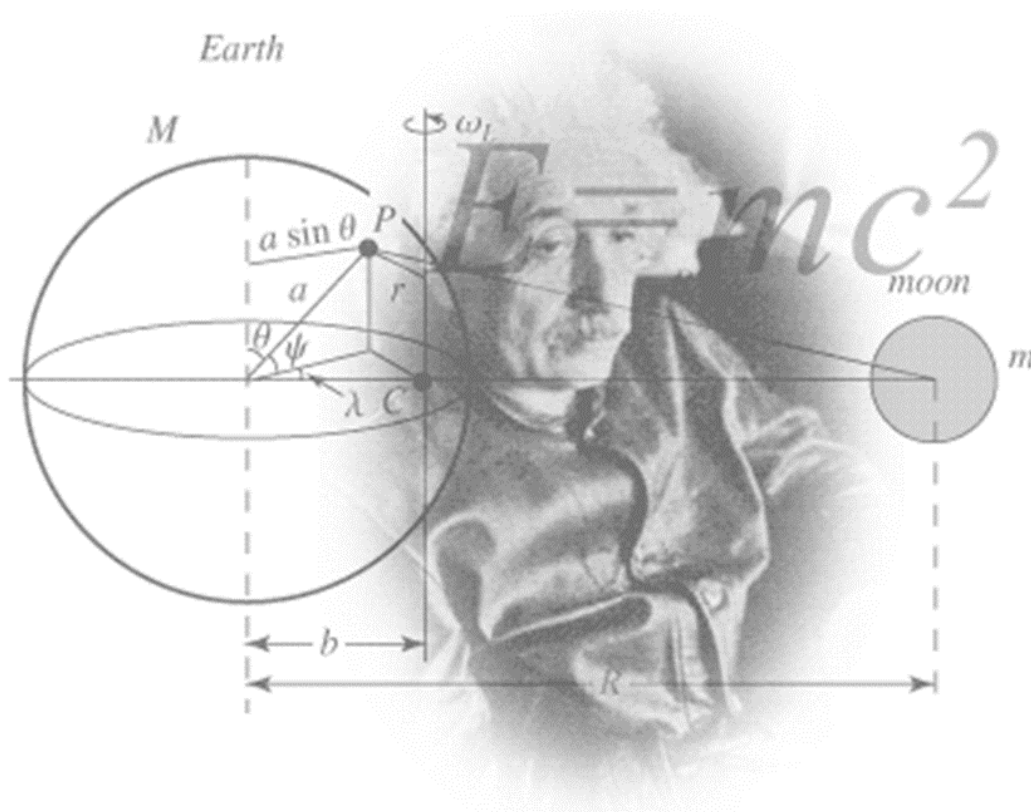
You do not have to complete everything in here, but it should give you more than enough to explore any area of physics interest and also help you practice a few key areas in advance of starting A level.

Feel free to contact me, or any of the physics team, if you want help or information.

Mr. E.J. Pattison

So you are considering A level Physics?

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



Careers

It is important to start thinking about, and looking into, possible careers. You don't need to choose but there are loads of careers you've heard of that might inspire you.

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This Summer.....

- Research
 - Careers
 - Physics
- Read
 - Books
 - Articles
- Watch
 - Online lectures, videos and animations
 - Science TV programs
- Do
 - Visit science related places (if open)
 - Online courses or a project

Careers

Over a lifetime, only graduates in medicine or law earn more than those with a **Physics Degree**.

Physics, **Chemistry** and **Engineering** graduates earn nearly **20% more** than other graduates

Discover the meaning of life, the universe and everything
as a **Physicist**.

Develop, analyse, process and produce music and sound
as a **Music technician**.

Design Aeroplanes
as an **Aeronautical engineer**.

Solve the World's problems and lead cutting edge technology combining the biological and engineering world
as a **Bioengineer**

Design bridges, buildings and roads etc
as a **Civil engineer**.

Design computers, TVs and electrical machines
as an **Electrical engineer**.

Study the stars
as an **Astronomer**.

Study the past
as an **Archaeological technician**.

Be at the cutting edge of medicine solving problems and creating new cures etc
as a **Medical physicist**.

Cure cancer
as a **Radiologist**.

Solve pollution, the ozone layer and global warming
as an **Environmental scientist**.

Create fun alternative worlds
As a **Games Designer**

Solve crime and catch criminals
as a **Forensic Scientist**.

Find out the how everything began
As a **Cosmologist**

Discover oil, earthquakes and things hidden underground
as a **Geophysicist**.

Run International business and systems as
a **Logistics expert**.

Design rivers, harbours and canals
as a **Marine engineer**.

Design new plastics, metals and ceramics
as a **Materials engineer**.

Design stylish new buildings
as an **Architect**.

Discover insides of an atom and solve world energy problems
as a **Nuclear Physicist**.

Cure people's vision
as an **Optician**.

Investigate the subatomic world
As a **Laser Physicist**

Predict the weather
As a **Metreologist**

Troubleshoot, problem solve and increase the economy
as a **City Analyst**.

Example New Career: Bioengineering



Where engineering meets medicine. Working with doctors, clinicians and researchers, bioengineers use traditional engineering principles and techniques and apply them to real-world biological and medical problems.



Rapid expansion

It's a new, evolving, technology-driven subject, with many different facets - from tissue engineering and medical devices, to biomaterials and biomanufacturing. Its rapid expansion has come about largely to address the problems arising from an ever-increasing, ageing global population.

It is predicted that the number of joint replacements being implanted every year will increase fivefold by 2030 (Institute of Mechanical Engineers), for example.

Bioengineers are working to find better materials which can be produced more quickly in a more cost-effective way and will last in the body longer.

The great interest in wearable technology is also driving the field forward. People are demanding faster, smarter, cheaper solutions and bioengineers are helping to find them.

The popularity of wearable technology is only set to grow, with 411m smart devices set to be sold in 2020 alone (Forbes).

- Artificial organs and limbs
- Assistive technology
- Biomaterials
- Computer simulation for surgery
- Critical care medicine
- Image-guided robot surgery
- Independent living
- Kidney dialysis and transplantation
- Mathematical modelling of human physiology
- Medical imaging, such as X-ray CT, MRI and PET scanners
- Neurotechnology
- Orthopaedic implants
- Rehabilitation
- Sports and physiological monitoring
- Sports technology
- Telemanipulators
- Tissue engineering
- Regenerative medicine
- Wearable technology



Or Just Finding the answers to Fundamental Questions

Where do we come from? Where will we end up? Where are we? What are we? Are we alone? What is out there? What's the point? What's the answer?

Slow time---Bend light---Know everything---Control everything---Solve everything---Win arguments---Save on buying a Stairmaster---Impress people---Walk into any job Earn stacks of cash---Have something named after you---Become a cool Physics teacher---Win game shows and pub quizzes---Be remembered for the rest of time.

• Teachers:

- 4+ Physics teachers
- Probably the most experienced (and successful) team in south London
 - Mr Pattison (Head of Physics) epattison@royalrussell.co.uk
 - Miss Ballie-Whyte: (ex Head of A level Physics)
 - Miss Clarke (Ex Head of Physics)
 - Mr Endersby (Ex Head of Physics & Science)
- All A level classes have 2 teachers:

• Results 2018/19:

- 2 Oxford & Cambridge offers and most others heading for Russell Group universities for Sciences and engineering.



UNIVERSITY OF
CAMBRIDGE

• Lessons

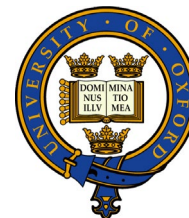
- 6 hours a week: 2 teachers

• Support

- 1 CIE Course textbook provided and other textbooks available.
- 4 Help sessions a week.
- Mentoring: both peer and teacher mentoring for those that need help.
- Resources for any club you want to run (this year rockets & magazine)
- Coming soon (by Easter): 1 new lab; 3 refurbished labs and new sixth form science work area.

• Guidance

- Weekly **Oxbridge, Imperial** etc preparation timetabled **classes** from highly experienced, trained and successful teacher.
- Success every year with Oxbridge Candidates.
- 3 students got into Oxbridge, 3 Imperial & 3 Medicine from the school this year.



• Extra curricula

- Support to run any club society you want eg engineering, astronomy, magazine, Physics, science films, Lego Mindstorms, Electrical/electronics etc
- Last year our sixth form STEM team beat all the other state and independent schools in winning the Surrey Sastro Problem solving competition and our Natural Sciences Society website/magazine is nominated for the National Schools Media Awards.
- Trips to where you want (NASA/ESA and/or CERN available this year). Universities, JET Fusion reactor, Diamond Synchrotron particle accelerator, Rutherford Appleton Laboratory or other.
- Oxford University Olympiad in y12 & 13
- A stock of physics and science books you may borrow.



Imperial College
London



BPhO
British Physics Olympiad



Get Involved: Royal Russell Science Website & Magazine

Some of you are already involved in the award winning school science magazine. It's editors are off to university and we need people to help run, write and design both parts. Check it out and get involved.



<https://russellsteapot.co.uk/>



Specification:

Cambridge International Examinations (CIE) International A level Physics 9702

[https://www.cambridgeinternational.org/
Images/554625-2022-2024-syllabus.pdf](https://www.cambridgeinternational.org/Images/554625-2022-2024-syllabus.pdf)

- | | |
|---------------------------------|----------------------------|
| 1 Physical quantities and units | 14 Temperature |
| 2 Kinematics | 15 Ideal gases |
| 3 Dynamics | 16 Thermodynamics |
| 4 Forces, density and pressure | 17 Oscillations |
| 5 Work, energy and power | 18 Electric fields |
| 6 Deformation of solids | 19 Capacitance |
| 7 Waves | 20 Magnetic fields |
| 8 Superposition | 21 Alternating currents |
| 9 Electricity | 22 Quantum physics |
| 10 D.C. circuits | 23 Nuclear physics |
| 11 Particle physics | 24 Medical physics |
| 12 <i>Motion in a circle</i> | 25 Astronomy and cosmology |
| 13 <i>Gravitational fields</i> | |

Exams:

There is no coursework on the A level

- *Paper 1: 1h15 15% of total*
 - *Multiple choice of y12 material*
- *Paper 2 1h15 23%*
 - *Structured questions on y12*
- *Paper 3 2h 12%*
 - *Practical skills exam*
- *Paper 4 2h 38%*
 - *Structured Questions: whole course*
- *Paper 5 1h15 12%*
 - *Practical planning, analysis & evaluation.* ⁸

- **To be on the course:**
 - **Physics/Science level 7; Maths level 7**
- **Assessment**
 - Weekly assessments tracked in a spreadsheet
 - All your assessments to be kept in your folder.
 - All assessments must be reviewed and a Test Review Sheet completed showing where to improve.
- **Expectations**
 - 100% **attendance & punctuality**
 - Minimum 1 hour at **work in folder done at home** for every 1 hour in lesson.
 - Before each lesson, all **textbook questions** completed at home from section covered by previous lesson.
 - Each lesson will have **extra notes** from reading textbooks, other sources or from online videos.
 - **Folder** brought to lessons, in order for regular checks.
 - Kept in order: work in sections as directed by the teachers.
 - Every sheet with **Name, date and title** on it
 - All work and extra work in them
 - **Checklist of weaknesses and mistakes** at the front
 - **TO DO** task list at the front
 - Compulsory attendance at **help clubs** if significantly underperforming.
 - Weekly **mentoring/Subject report** if persistent or excessive underperformance
 - Completion of **online assessments** and tasks that have been set.
 - **Ask** whenever there is a problem, issue or query (at least once a lesson).
 - **Seek out teacher** to resolve issue(s) (at least once a week).
 - Following of advice and direction given.
 - Increasing independence of work (necessary for higher grade).
 - To think and problem solve answers without been given answer (necessary for exam success)

Mathematical Course Content

- Many people worry about the Maths in A level Physics. Physics is mathematical and it has increased the last few years. A grades at Physics are regularly achieved by students without A level maths but it helps.
- A level Maths is almost always required if you wish to study Physics or Engineering at uni and it may be difficult to get into the top universities without further math but not impossible (further maths should only really be taken as a fourth A level NOT a third if you want to get into the best universities).
- The maths at A level is basically level 8/9 GCSE maths.

Reading etc

- To impress at interview, to inspire yourself and to help enjoy the subject reading articles in journals or online or books helps a lot.
- Choose the aspects of physics that interest you and reading around those rather than forcing yourself to read particular things because someone says you should is best.
- Anything by Feynman, Hawking, Greene, Rovelli, DeGrasse Tyson, Kaku, Singh or even Brian Cox. Articles in Scientific American, New Scientist or Focus magazine are also very good though.
- Join the Institute of Physics as a student for free and get loads of info etc on physics and events.

• Physics Online:

- Before starting the course we suggest you start using the following online resources.

- On course

- **Isaac Physics:**

- Cambridge University online, quiz, support, tutorials etc.
- **Join the Royal Russell Isaac Physics year 12 group for practice, problem solving & thinking skills**
- **I group I have created is called ... RR A level 2020-22**
 - To join ...
- **Option 1: click link**
- <https://isaacphysics.org/account?authToken=BJY24U>
- **Option 2: Enter the following code into their Teacher Connections tab on their My Account page: BGY24U**



Physics. You work it out.

- **Educake:** Before starting A level practice your weaknesses at GCSE to prepare for A level
- **Furry Elephant:** Login to develop your understanding of Electricity and radioactivity which is vital for success at A level. This site has lessons to understanding NOT just knowledge. Username: rrs Password: letmein
- **Absorb Physics:** This will be used once you are on the course to help support your learning.
- **Crash Course:** Explanatory tutorials on all GCSE and A level areas. Review your weaknesses and check out some new A level ones.

- **PhET.** Excellent online simulations of the physics of key areas, perfect to play around with to develop and understanding of how things work (Before and during the course).



- Guidance

- **Institute of Physics:** Join the Institute of physics as a student for **free**, to get information and updates on useful opportunities.
- **Smallpeice engineering:** If you are interested in a career in any sort of engineering, this is the most important website to find out information and find taster courses to try out the engineering you are interested in.
- **Futuremorph:** Physics related careers search site

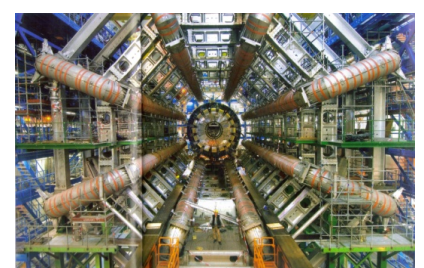
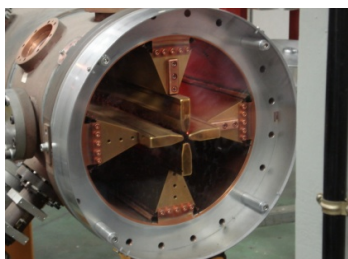
IOP Institute of Physics



- Interest

- **Minute physics:** If you are interested in advanced physics these short animation videos explain loads of really advanced and interesting questions in 2 or 3 minutes.
- **Sixty symbols:** Similar to but a little longer than minute physics but loads explained in 5 to 20 minutes.
- **Gresham College lectures:** Loads of Lectures from the best people in science online and. For now, free to watch.

<https://www.gresham.ac.uk/watch/?subject=science>



More Science websites

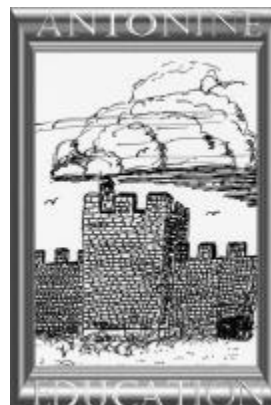
These websites all offer an amazing collection of resources that you should use again and again throughout your course.



At CERN, the European Organization for Nuclear Research, physicists and engineers are probing the fundamental structure of the universe. They use the world's largest and most complex scientific instruments to study the basic constituents of matter – the fundamental particles.
<https://home.cern/>



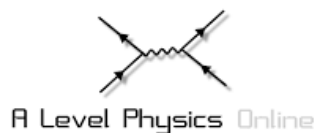
physics.org is brought to you by the Physics in Society team at the Institute of Physics. Their aim is to inspire people of all ages about physics. Let them be your guide and show you the best physics places on the web.
<http://www.physics.org/aboutus.asp>



A website written by James Irvine, a retired teacher from Sheffield. Although the website is primarily written to support AQA, the material is also easily transferable to other exam boards.
<http://www.antonine-education.co.uk/>



A website written by a practicing physics and maths tutor in London.
@physicsandmathstutor is an Oxford physics graduate with a PGCE from Kings College London.
<http://www.physicsandmathstutor.com/>



Ok, so not a website, but a YouTube channel you definitely want to watch. Y12 or AS Physics content is free to view, you will find hundreds of videos made to help you in your A Level physics studies.
<https://www.youtube.com/c/AlevelPhysicsOnline>

Science communication is essential in the modern world and all the big scientific companies, researchers and institutions have their own social media accounts. Here are some of our top tips to keep up to date with developing news or interesting stories:

Follow on Twitter:

Commander Chris Hadfield – former resident aboard the International Space Station
@cmdrhadfield

NASA's Voyager 2 – a satellite launched nearly 40 years ago that is now travelling beyond our solar system
@NSFVoyager2

Neil deGrasse Tyson – Director of the Hayden Planetarium in New York
@neiltyson

The SETI Institute – The Search for Extra Terrestrial Intelligence, be the first to know what they find!
@setiinstitute

Phil Plait – tweets about astronomy and bad science
@badastronomer

Institute of Physics – The leading scientific membership society for physics
@PhysicsNews

Scientific America – Journal sharing discoveries and insights into science that develops the world
@sciam

SN Students – Science news for students
@SNStudents



Find on Facebook:

National Geographic - since 1888, National Geographic has travelled the Earth, sharing its amazing stories in pictures and words.

Science News Magazine - Science covers important and emerging research in all fields of science.

BBC Science News - The latest BBC Science and Environment News: breaking news, analysis and debate on science and nature around the world.

Institute of Physics - The Institute of Physics is a leading scientific membership society working to advance physics for the benefit of all.

Chandra X-ray Observatory - NASA's Chandra X-ray Observatory is a telescope specially designed to detect X-ray emission from very hot regions of the Universe such as exploded stars, clusters of galaxies, and matter around black holes.

Interesting Engineering - Interesting Engineering is a cutting edge, leading community designed for all lovers of engineering, technology and science.



A few more Lecture Recommendations:

If you have more time to spare, here are some great presentations (and free!) from world leading scientists and researchers on a variety of topics. They provide some interesting answers and ask some thought-provoking questions. Use the link or scan the QR code to view:

From mach-20 glider to hummingbird drone

Available at:

https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_humming_bird_drone/up-next?language=en

"What would you attempt to do if you knew you could not fail?" asks Regina Dugan, then director of DARPA, the Defense Advanced Research Projects Agency. In this talk, she describes some of the extraordinary projects that her agency has created.



Is our universe the only universe?

Available at:

https://www.ted.com/talks/brian_greene_why_is_our_universe_fine_tuned_for_life?language=en

Brian Greene shows how the unanswered questions of physics (starting with a big one: What caused the Big Bang?) have led to the theory that our own universe is just one of many in the "multiverse."

The fascinating physics of everyday life

Available at :

https://www.ted.com/talks/helen_czerski_fun_home_experiments_that_teach_you_physics?language=en

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



We need nuclear power to solve climate change

Available at :

https://www.ted.com/talks/joe_lassiter_we_need_nuclear_power_to_solve_climate_change?language=en

Joe Lassiter is focused on developing clean, secure and carbon-neutral supplies of reliable, low-cost energy. His analysis of the world's energy realities puts a powerful lens on the touchy issue of nuclear power.

A few more research ideas

Physics provides daily online-only news and commentary about a selection of papers from the APS journal collection. The website is aimed at the reader who wants to keep up with highlights of physics research with explanations that don't rely on jargon and technical detail.

For each of the following topics, you are going to use the resources to produce one page of Cornell style notes.

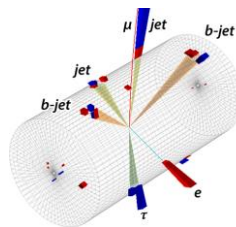
Use the links or scan the QR code to take you to the resources.



Topic 1: Sizing up the top quarks interaction with the Higgs

Available at: <https://physics.aps.org/articles/v11/56>

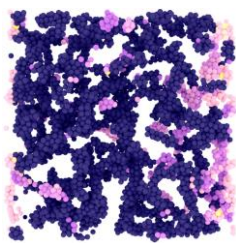
A proton collision experiment at CERN provides a new handle on the Higgs boson's interaction with the heaviest of the quarks.



Topic 2: Why soft solids get softer

Available at: <https://physics.aps.org/articles/v11/50>

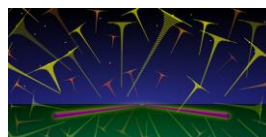
Soft materials like gels and creams exhibit fatigue resulting from the stretching of their constituent fibres, according to experiments and simulations.



Topic 3: Listening for the cosmic hum of black holes

Available at: <https://physics.aps.org/articles/v11/36>

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

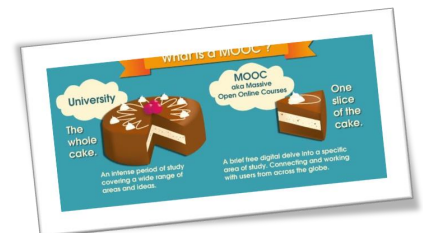


Courses & Things to do! MOOC

Day 4 of the holidays and boredom has set in? There are loads of citizen science projects you can take part in either from the comfort of your bedroom, out and about, or when on holiday. Wikipedia does a comprehensive list of all the current projects taking place. Google 'citizen science project'



Want to stand above the rest for UCAS? Now is the time to act. MOOCs are online courses run by nearly all universities. They are short FREE courses that you take part in. They are usually quite specialist, but aimed at the public, not the genius! There are lots of websites that help you find a course, such as edX and Future learn and the Open University. You can take part in any course, but there are usually start and finish dates. They mostly involve taking part in web chats, watching videos & interactives.



OpenLearn

The home of free learning from The Open University

<https://www.open.edu/openlearn/free-courses/full-catalogue>

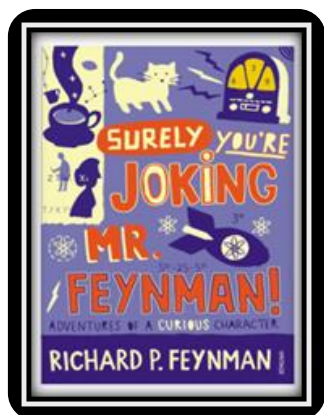
Completing a MOOC will look great on your Personal statement and they are dead easy to take part in!



FUTURELEARN

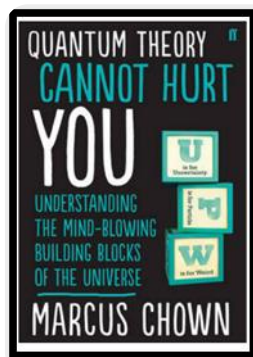


Book Recommendations



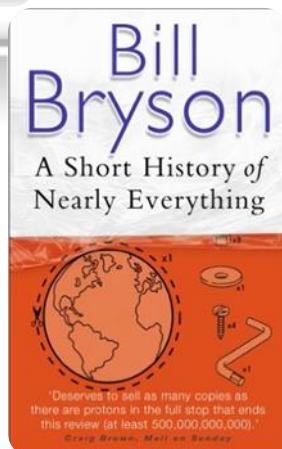
Surely You're Joking Mr Feynman: Adventures of a Curious Character

By reading this book you will get insight into his life's work including the creation of the first atomic bomb and his work in the field of particle physics.



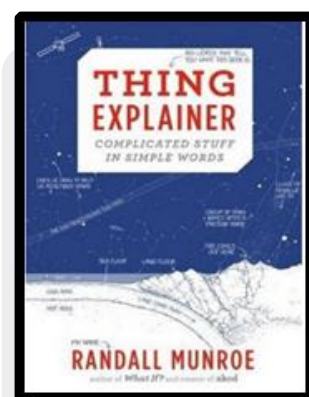
Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe

Any physics book by Marcus Chown is an excellent insight into some of the more exotic areas of physics that require no prior knowledge.



A Short History of Nearly Everything

A whistle-stop tour through many aspects of history from the Big Bang to now. This is a really accessible read that will re-familiarise you with common concepts and introduce you to some of the more colourful characters from the history of science.



Thing Explainer: Complicated Stuff in Simple Words

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.

More Extension Reading ideas

- o Introducing Quantum Theory by Joseph Patrick McEvoy and Oscar Zárate
- o Introducing Relativity by Bruce Bassett
- o Introducing particle Physics by Tom Whyntie
- o The Elegant Universe by Brian Greene (from relativity to string theory)
- o QED: The Strange Theory of Light and Matter Book by Richard Feynman
- o Seven Brief Lessons on Physics Book by Carlo Rovelli
- o The Road to Reality Book by Roger Penrose (Very advanced)
- o Physics of the Impossible: by Michio Kaku
- o Astrophysics for People in a Hurry Book by Neil deGrasse Tyson
- o Six easy pieces by Feynman (The most famous introduction to Physics)
- o Six not so easy pieces by Feynman
- o Character of physical law by Feynman
- o The Universe in a Nutshell Book by Stephen Hawking
- o A Brief History of Time Book by Stephen Hawking
- o The Fabric of the Cosmos Book by Brian Greene
- o How to Teach Quantum Physics to Your Dog Book by Chad Orzel
- o Quantum: A Guide For The Perplexed by Jim Al-Khalili
- o Mad About Modern Physics: by Christopher Jargocki and Frank Potter
- o Why $E=mc^2$ by Brian Cox
- o Our Mathematical Universe: by Max Tegmark
- o How to build a time machine..... 16

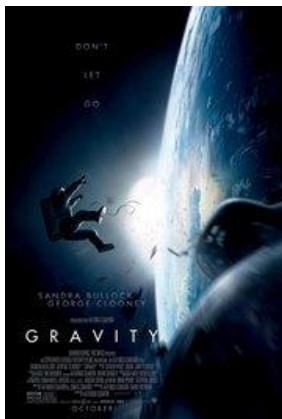
Movie Recommendations

Everyone loves a good story and everyone loves some great science. Here are some picks of the best films based on real life scientists and discoveries. You won't find Jurassic Park on this list! We've looked back over the last 30 years to give you our top 5 films you might not have seen before. Great watching for a rainy day.



Moon (2009)

With only three weeks left in his three year contract, Sam Bell is getting anxious to finally return to Earth. He is the only occupant of a Moon-based manufacturing facility along with his computer and assistant, GERTY. When he has an accident however, he awakens to find that he is not alone.

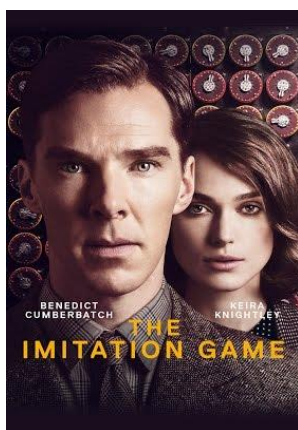
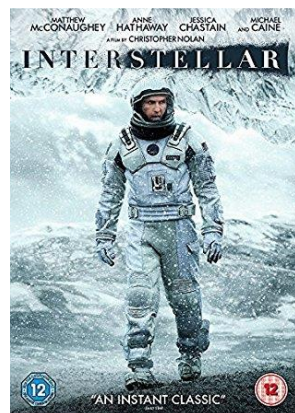


Gravity (2013)

Two astronauts work together to survive after an accident which leaves them stranded in space.

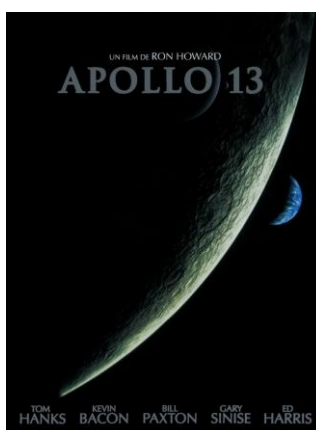
Interstellar (2014)

A team of explorers travel through a wormhole in space in an attempt to ensure humanity's survival.



The Imitation Game (2014)

Based on a true story. During World War II, the English mathematical genius Alan Turing tries to crack the German Enigma code with help from fellow mathematicians.



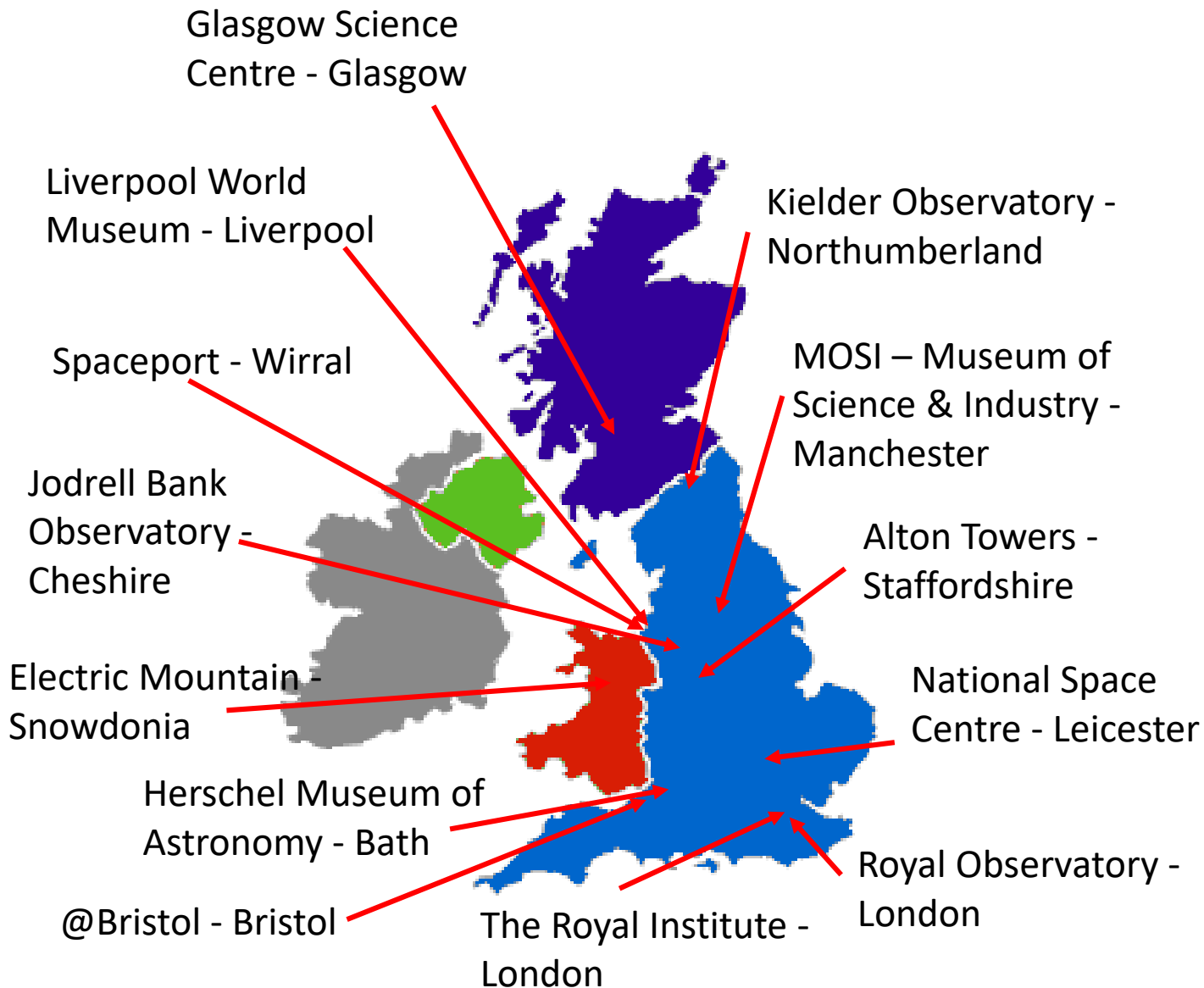
Apollo 13 (1995)

Based on a true story. NASA must devise a strategy to return Apollo 13 to Earth safely after the spacecraft undergoes massive internal damage putting the lives of the three astronauts on board in jeopardy.

There are some great TV series and box sets available too! You might want to check out: Horizon, Planets, Cosmos, Wonders of the Universe, Wonders of the Solar System, NASA TV and Shock & Awe – The Story of Electricity or radio/podcasts such as **The Infinite Monkey Cage**

Ideas for Day Trips

If you are on holiday in the UK, or on a staycation at home, why not plan a day trip to one of these :



If you are on holiday in the UK, or on a staycation at home, why not plan a day trip to one of these :

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 across 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.

My preparation

Things I will/have do/done this summer	Y/N

My areas of strength/Weakness are

My A levels

My Career/degree Ideas

My GCSE grades

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting or typing. There are no margins, text, or other markings on the page.

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting or typing. There are no margins, text, or other markings on the page.

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

Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	$\times 10^{-9}$
Micro	μ	$\times 10^{-6}$
Milli	m	$\times 10^{-3}$
Centi	c	$\times 10^{-2}$
Kilo	k	$\times 10^3$
Mega	M	$\times 10^6$
Giga	G	$\times 10^9$

At A level, unlike GCSE, you need to remember all symbols, units and prefixes. Below is a list of quantities you may have already come across and will be using during your A level course.

Quantity	Symbol	Unit
Velocity	v	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	S
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	kgms^{-1}
Power	P	W
Density	ρ	kgm^{-3}
Charge	Q	C

Task: 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 54 600 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, quantities will be written in standard form and it is expected that your answers will be too.

0.00000000567g

Conversion to Standard Form

0.00000000567g

9 digits from the original decimal point to the new one.

=

5.67×10^{-9}

Distance: Earth > Moon

=

384 400 000 meters

Conversion to Standard Form

384 400 000

8 digits to where the decimal point will go.

=

3.844×10^8

<http://www.ultimatemaths.com/standard-form-conversion.htm>

This means answers should be written as ...x 10ⁿ. E.g. for an answer of 1200kg we would write 1.2 x 10³kg. For more information visit: www.bbc.co.uk/education/guides/zc2hsbk/revision

Task: Complete the following problems;

1. Write 2530 in standard form.
2. Write 280 in standard form.
3. Write 0.77 in standard form.
4. Write 0.0091 in standard form.
5. Write 1 872 000 in standard form.
6. Write 12.2 in standard form.
7. Write 2.4×10^{-2} as a normal number.
8. Write 3.505×10^{-1} as a normal number.
9. Write 8.31×10^{-6} as a normal number.
10. Write 6.002×10^{-2} as a normal number.
11. Write 1.5×10^{-4} as a normal number.
12. Write 4.3×10^3 as a normal number.

Rearranging Formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

www.youtube.com/watch?v=WWgc3ABSj4

Task: Rearrange the following:

1. $E = m \times g \times h$ to find h
2. $Q = I \times t$ to find I
3. $E = \frac{1}{2} m v^2$ to find m
4. $E = \frac{1}{2} m v^2$ to find v
5. $v = u + at$ to find u
6. $v = u + at$ to find a
7. $v^2 = u^2 + 2as$ to find s
8. $v^2 = u^2 + 2as$ to find u

Significant Figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

<http://www.purplemath.com/modules/rounding2.htm>

Task: Give the following to 3 significant figures:

1. 3.4527
2. 40.691
3. 0.838991
4. 1.0247

Calculate the following to a suitable number of significant figures:

1. $63.2 \div 78.1 =$
2. $39 + 78 + 120 =$
3. $(3.4 + 3.7 + 3.2) \div 3 =$
4. $0.0256 \times 0.129 =$

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

Task: Describe the model used for the structure of an atom including details of the individual particles that make up an atom and the relative charges and masses of these particles. 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.

Task: Identify the errors the student has made.

Length/cm	Time			
	Trial 1	Trial 2	Trial 3	Mean
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

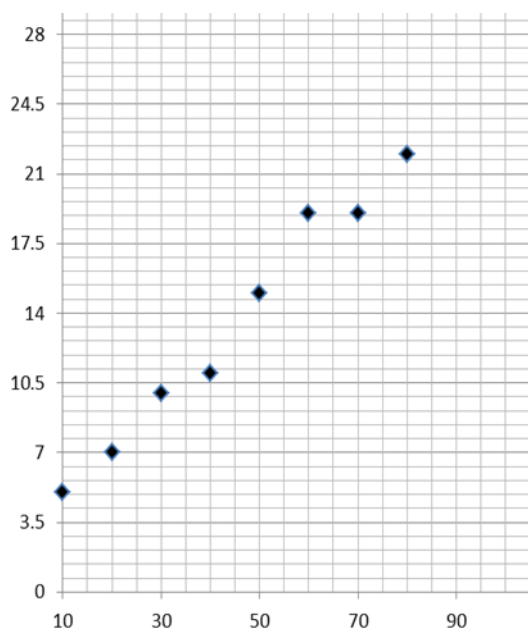
Graphs

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

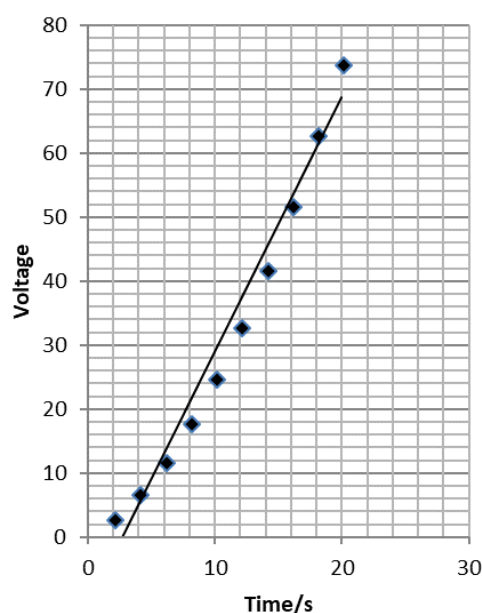
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Identify how the following graphs could be improved

Graph 1



Graph 2



Forces and Motion

At GCSE you studied forces and motion and at A level you will explore this topic in more detail so it is essential you have a good understanding of the content covered at GCSE. You will be expected to describe, explain and carry calculations concerning the motion of objects. The websites below cover Newton's laws of motion and have links to these in action.

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

<http://www.sciencechannel.com/games-and-interactives/newtons-laws-of-motion-interactive/>

Task: On graph paper sketch a velocity-time graph showing the journey of a skydiver after leaving the plane to reaching the ground. Mark on terminal velocity.

Electricity

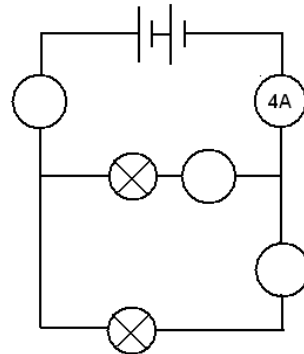
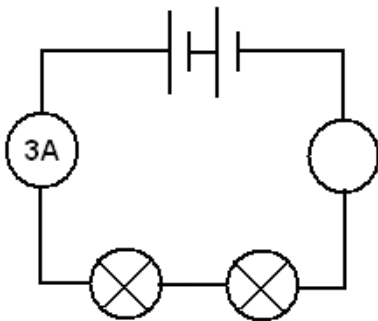
At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

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

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

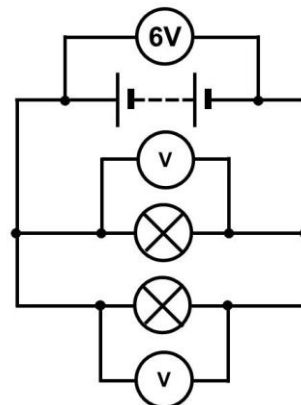
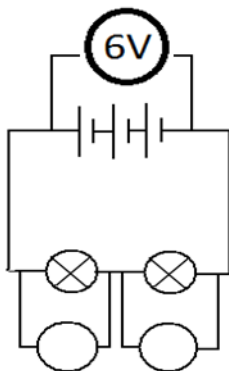
Task:

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 longitudinal and transverse waves and give an example of each.

3) Draw a wave and label the wavelength and amplitude.

Test Yourself baseline quiz

The following 40 minute test is designed to test your recall, analysis and evaluative skills and knowledge.
Remember to use your exam technique: look at the command words and the number of marks each question is worth.
A suggested mark scheme is provided for you to check your answers.

A single piece of graph paper is required for the completion of the assessment.
You may use a calculator.

Question Number	Topic	Score
1	Symbols and Prefixes	/3
2	Standard Form	/4
3	Re-arranging Equations	/3
4	Atomic Structure	/3
5	Recording Data	/3
6	Graphing	/4
7	Forces and Motion	/10
8	Electrical Circuits	/5
9	Waves	/5
Total		/40

Want more practice?
CGP Head Start to A level physics is free on Kindle
(or kindle enabled devices)

<https://www.amazon.co.uk/Head-Start-level-Physics-Level-ebook/dp/B00VE2NII4>



Q1 Complete the following table:

Unit prefix	Meaning
k (kilo)	x 1000
	X 0.000001
M (mega)	
N (nano)	

[3]

Q2

a) Write the following numbers into standard form.

- i. 0.012
- ii. 120000
- iii. 0.00000012

[3]

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

- i. 2.1×0.15
- ii. $0.345 \div 0.114$

[4]

Q3 Re-arrange the following equations to make R the subject of the equation.

a) $Q = WERTY$

b) $Q^2 = WR^2$

c) $Q = W - RT^2$

[3]

Q4

- a) Name the 3 particles (from GCSE) that make up an atom.
- b) Which one of the above particles is not found in the nucleus of an atom?
- c) Which of the above particles will be found in varying quantities in the nuclei of isotopes of the same element?

Q5

- a) Complete the following table

Voltage (V)	_____ (A)		
	Repeat 1	Repeat 2	Average
2	0.23	0.26	0.25
4	0.46	0.53	
6	0.69	0.78	0.74
8	0.92	1.04	0.98
10	1.15	1.30	1.23

[3]

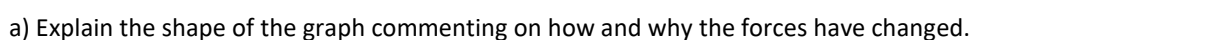
Q6

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

[4]

- b) Find the gradient of your line of best fit

[3]



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

[2]

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

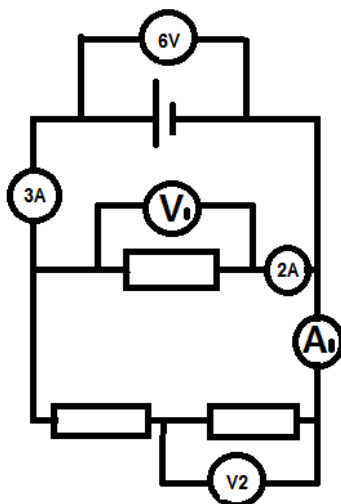
[2]

Q8

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

[2]

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

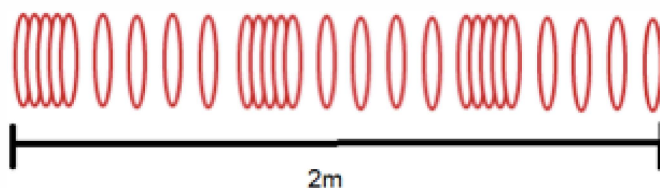


Write the missing values of current and potential difference:

- i. $V_1 =$
- ii. $V_2 =$
- iii. $A_1 =$

[3]

Q9 The image below shows a diagram of 3 complete longitudinal wave oscillations on a slinky:



- a) State the wavelength of the wave shown

..... [1]

- b) Label a complete wavelength on the diagram above with the correct symbol used for wavelength in GCSE and A Level Physics

[1]

- c) If the above wave had a frequency of 5Hz how long would it take an individual hoop to complete 1 full oscillation?

[1]

- d) Calculate the speed of the wave

$$\text{wavespeed} = \text{frequency} \times \text{wavelength}$$

Wave speed = _____ Unit _____ [2]

A Level Physics Baseline Assessment SUGGEST MARKSCHEME

Q1

a)

Unit prefix	Meaning
k (kilo)	x 1000
μ (micro)	X 0.000001
M (mega)	x 1000000
N (nano)	x 0.000000001

[3]

Q2

a) Write the following numbers into standard form

- i. 0.012 1.2×10^{-2}
- ii. 120000 1.2×10^5
- iii. 0.00000012 1.2×10^{-7}

[3]

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

- i. 2.1×0.15
a. $0.315 = 0.32(2sf)$
- ii. $0.345 \div 0.114$
a. $3.0263... = 3.03 (3sf)$

Award 1 mark for correct answer and 1 mark for correct number of s.f. [4]

Q3 Re-arrange the following equations to make R the subject of the equation.

a) $Q = WERTY$

$$R = \frac{Q}{WETY}$$

b) $Q^2 = WR^2$

$$R = \sqrt{\frac{Q^2}{W}}$$

c) $Q = W - RT^2$

$$R = \frac{W - Q}{T^2}$$

[3]

Q4

- a) Name the 3 particles (from GCSE) that make up an atom

Proton, Neutron, Electron (any order)

[1]

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

Electron

[1]

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

Neutron

[1]

Q5

- a)

Voltage (V)	Current (A)		
	Repeat 1	Repeat 2	Average
2	0.23	0.26	0.25
4	0.46	0.53	0.50
6	0.69	0.78	0.74
8	0.92	1.04	0.98
10	1.15	1.30	1.23

1 Mark for correct unit (V or volts)

1 Mark for correct heading (Current in Amps or A)

1 Mark for correct average, 1 Mark if rounded to correct number of s.f.

[3]

Q6

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

1 mark if BOTH x and y axis cover half the graph paper

1 mark for correctly labelling x and y axis including units

1 mark if data points are correctly plotted (check 3)

1 mark for correct line of best fit (with even spread of points above and below)

[4]

b) Find the gradient of your line of best fit

Working must be shown for the award of any marks

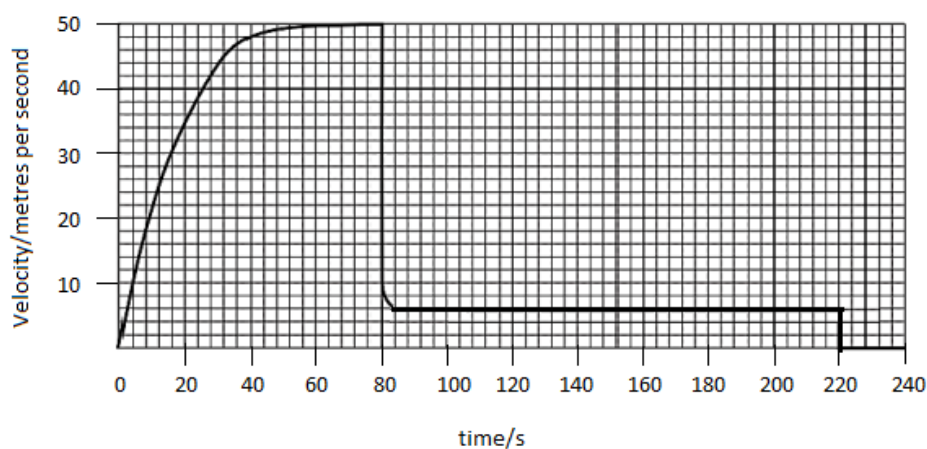
1 mark for correct y axis read offs

1 mark for correct x axis read offs

1 mark for correct calculation of their own gradient

[3]

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



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

Band 1 (1/2 Marks)	Band 2 (3/4 Marks)	Band 3 (5/6 Marks)
Correctly describes the motion of the parachutists. E.g. Acceleration (at reducing rate) Terminal velocity/constant speed, deceleration, lower terminal velocity. There may be small errors in spelling and grammar.	Correctly describes motion and links to the balancing and unbalancing of the forces of weight and drag. Almost faultless spelling and grammar.	Explains why increasing velocity produces increased drag and why opening the parachute produces increase drag, using ideas of collisions of air particles with the surface of the skydiver/parachute. Faultless spelling and grammar

[6]

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

$$(220s - 84s) \times 6ms^{-1} = 816m$$

[2]

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

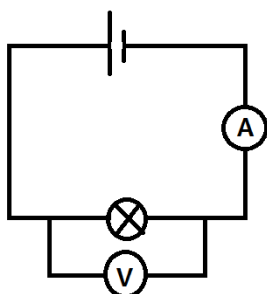
Award 1 mark for correct unit

[2]

Q8

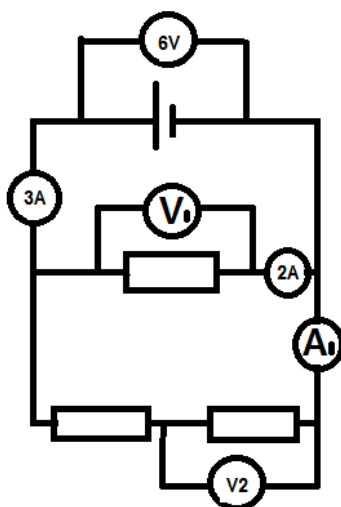
- a) Draw a circuit diagram to show how the resistance of a filament bulb could be measured using an ammeter and a voltmeter.

Award 1 mark for correctly positions ammeter [1] and voltmeter [1]



[2]

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

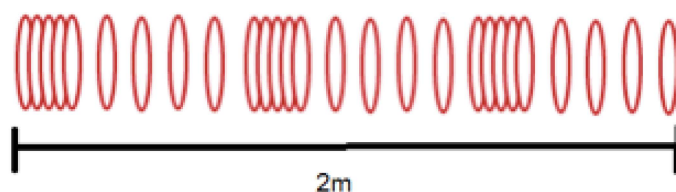


Write the missing values of current and potential difference:

- i. $V_1 = 6V$
- ii. $V_2 = 3V$
- iii. $A_1 = 1A$

[3]

Q9 The image below shows a diagram of 3 complete longitudinal wave oscillations of a slinky:



a) State the wavelength of the wave shown

$2/3\text{m} = 0.7\text{m}$ [1]

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

[1]

c) If the above wave had a frequency of 5Hz how long would it take an individual hoop to complete 1 full oscillation?

0.2s

[1]

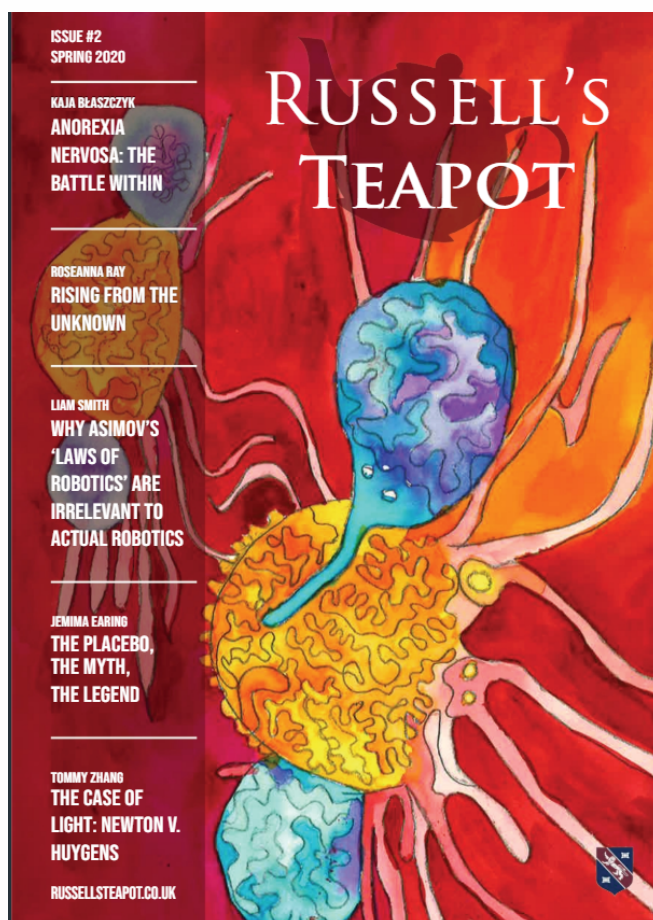
d) Calculate the speed of the wave

$$\text{wavespeed} = \text{frequency} \times \text{wavelength}$$

$$\text{wavespeed} = 5 \times \frac{2}{3} = 3\text{m/s (1sf)}$$

Wave speed = _____ Unit _____ [2]

<https://russellsteapot.co.uk/>



Physics

I hope this document has been useful.

Any questions, queries, problems or feedback on how it could be improved can be emailed to me.

This is a very strange time and we need to be adaptable to a rapidly changing world. We are here to help you through it and Physics will prepare you to be a thinker, analyser and problem solver that will make you an invaluable asset in the changing landscape.

Mr Pattison
epattison@royalrussell.co.uk