Physics Transition Pack - 2021

Getting Ready For A-level Physics

This booklet will guide you through the three stages to help you prepare for A-level physics. The 3 stages are:

Stage 1 - Solidify GCSE Understanding

Stage 2 - Develop skills to underpin your Physics

Stage 3 - Research and wider reading

Stage 1 - Solidify GCSE Understanding - A lot of the content of year 12 physics will seem familiar as it is introduced in GCSE. Before you start A level it is important to make sure your understanding of GCSE physics is secure. In particular the mechanics and electrical circuits units from GCSE will be a fundamental foundation for the work you will do in the first couple of terms.

State 2 - Develop skills to underpin your Physics There are a range of maths skills that are needed in order to progress with Physics. If you are not doing A level Maths don't worry as we will support you with these. These activities will help to support you in developing these skills.

Stage 3 - Research task and wider reading—In physics, we often focus on the fundamentals of the subject and have little time to consider more recent developments. It is important to try to take an interest in the wider subject and see how the Physics that you are studying enables a huge range of scientific innovation. Some example topics are provided to get you started.

Mindset

You are completing this work for you, not for your teachers. Don't complete the work just to get it done (that would be pointless) or to avoid trouble. Complete the work with the aim of **learning** from it. If you don't understand something, spend extra time working on it. Don't rush the work. If you are interested in something, research it further by watching a video about it or listening to a podcast. Your effort will pay off and developing this more independent learning style will really help during the course.

A-level isn't about learning facts. It is about developing critical thinking skills and deep understanding around the subject. When you are completing these tasks, think carefully and critically about your work and the questions being asked. Ensure that the answers you give are fully explained and use scientific language.

Stage 1— Solidify GCSE Understanding

Two topics studied early in Y12 are Mechanics and Electric Circuits. Read the objectives from the specification below. You will see that all the sections that you have already studied at GCSE are in green, ones you might have touched on are in yellow and new content is highlighted in red. As you see much of these early units is the same Physics but applied into harder, and often more mathematical, contexts. While you are reading through these topic outlines it would be worth RAG rating each of the green statements – any that you currently think you might struggle with would be worth you researching and getting up to speed with. Try to do this independently using online resources that you find. Once you have done this work through the separate "Mechanics Questions" and "Electricity Questions" documents. Please bring these in at the start of the Autumn term and hand over to your Physics teacher so we can discuss your understanding of the GCSE content.

Mechanics

Mechanics – Topic 2 – A Level Physics.

9	use the equations for uniformly accelerated motion in one dimension: $s = (u+v)t/2$ $v = u + at$ $s = ut + ½ at^2$ $v^2 = u^2 + 2as$			
10	draw and interpret displacement-time, velocity-time and acceleration-time graphs			
11	know the physical quantities derived from the slopes and areas of s-t, v-t and a-t graphs, including cases of non-uniform acceleration and understand how to use the quantities			
12	understand scalar and vector quantities and know examples of each type of quantity and recognise vector notation			
13	resolve a vector into two components at right angles to each other by drawing and by calculation			
14	find the resultant of two coplanar vectors at any angle to each other by drawing, and at right angles to each other by calculation.			
15	understand how to make use of the independence of vertical and horizontal motion of a projectile moving freely under gravity			
16	draw and interpret free-body diagrams to represent forces on a particle or on an extended but rigid body			
17	use the equation $\Sigma F = ma$, including where m is constant (Newton's 2nd law of motion), including Newton's 1st law of motion where $a = 0$, objects at rest or travelling at constant velocity *Use of the term terminal velocity is expected*			
18	use the equations for gravitational field strength $g = F/m$ and weight $W = mg$			
19	**CORE PRACTICAL 1: Determine the acceleration of a freely-falling object.**			
20	know and understand Newton's third law of motion and know the properties of pairs of forces in an interaction between two bodies			
21	understand that momentum is defined as $p = mv$			
22	know the principle of conservation of linear momentum, understand how to relate this to Newton's laws of motion and understand how to apply this to problems in one dimension			
23	use the equation for the moment of a force, moment of force = Fx where x is the perpendicular distance between the line of action of the force and the axis of rotation			

24	use the concept of centre of gravity of an extended body and apply the principle of moments to an extended body in equilibrium			
25	use the equation for work $\Delta W = F\Delta s$, including when the force is not along the line of motion			
26	use the equation $E_k = \frac{1}{2} mv^2$ for the kinetic energy of a body			
27	use the equation $\Delta E_{grav} = mg\Delta h$ for the difference in GPE near the Earth's surface			
28	know, and understand how to apply, the principle of conservation of energy including use of work done, gravitational potential energy and kinetic energy			
29	use the equations relating power, time and energy transferred or work done: P = E/t and P = W/t			
30	use efficiency = useful energy output / total energy input and = useful power output / total power input			

Electric Circuits

31. understand that electric current is the rate of flow of charged particles and be able to use the equation: $I = \Delta Q / \Delta t$
32. understand how to use the equation $V = W/Q$
33. understand that resistance is defined by $R = V/I$ and that Ohm's law is a special case when $I \propto V$ for constant temperature
34. understand how the distribution of current in a circuit is a consequence of charge conservation
35. understand how the distribution of potential differences in a circuit is a consequence of energy conservation
36. be able to derive the equations for combining resistances in series and parallel using the principles of charge and energy conservation, and be able to use these equations
37. be able to use the equations $P = VI$, $W = VIt$ and be able to derive and use related equations, e.g. $P = I^2R$ and $P = V^2/R$
38. understand how to sketch, recognise and interpret current-potential difference graphs for components, including ohmic conductors, filament bulbs, thermistors and diodes
39. be able to use the equation $R = \rho\, l/A$
40. **CORE PRACTICAL 2: Determine the electrical resistivity of a material.**
41. be able to use $I = nqvA$ to explain the large range of resistivities of different materials
42. understand how the potential along a uniform current-carrying wire varies with the distance along it
43. understand the principles of a potential divider circuit and understand how to calculate potential differences and resistances in such a circuit
44. be able to analyse potential divider circuits where one resistance is variable including thermistors and light dependent resistors (LDRs)
45. know the definition of *electromotive force (e.m.f.)* and understand what is meant by *internal resistance* and know how to distinguish between e.m.f. and *terminal potential difference*
46. **CORE PRACTICAL 3: Determine the e.m.f. and internal resistance of an electrical cell.**
47. understand how changes of resistance with temperature may be modelled in terms of lattice vibrations and number of conduction electrons and understand how to apply this model to metallic conductors and negative temperature coefficient thermistors
48. understand how changes of resistance with illumination may be modelled in terms of the number of conduction electrons and understand how to apply this model to LDRs.

Stage 2 - Develop skills to underpin your Physics

Maths skills

To prepare for this please complete the assignments that I have put online on Isaacphysics.org You will need to create an account if you don't have one, then click on My accounts and the teacher connections tab. Enter the code 72K444. This should link you to some assignments, please complete before the start of the Autumn term.

Isaacphysics.org is a really good website. It was funded by the government when they realised that there were not enough students nationally getting the top grades at GCSE and A level. So they funded Cambridge University to write a website to support students. It is good as there are loads of question banks, support videos, as well as workshops and teacher led seminars. All to help you to get the best grade possible. You can access all parts of the website so, as well as doing the assignments I have set, you can set yourself challenges and targets to complete game boards. The top students each year get invited to Cambridge University to take part in some workshops – a very prestigious prize that opens doors!

Stage 3 – Research and wider reading

To get the best grades in A-level physics, you will have to complete independent research and make your own notes about challenging topics. Below are links to four websites which cover some interesting concepts from the world of physics.

Instructions

Make 1 page of notes covering a topic of your choice. You can choose from any of the sites below, but should use other sources if necessary.

For a suggestion of how to go about producing your notes, have a look at this site about the Cornell notes system: http://coe.jmu.edu/learningtoolbox/cornellnotes.html

Topics

a) http://home.cern/about
CERN encompasses the Large Hadron Collider (LHC) and is the largest collaborative science experiment ever undertaken. Find out about it here and make a page of suitable notes on the accelerator.

b) http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html
The solar system is massive and its scale is hard to comprehend. Have a look at this award winning website and make a page of suitable notes.

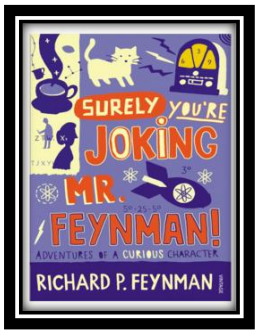
c) https://phet.colorado.edu/en/simulations/category/physics
PhET create online Physics simulations where you can complete some simple experiments online. Conduct an experiment from the many possible choices and make a one page summary of the experiment and your findings.

d) http://climate.nasa.gov/
NASA's Jet Propulsion Laboratory has lots of information on Climate Change and Engineering Solutions to combat it. Have a look and make notes on an article of your choice.

Book Recommendations

Below is a selection of books that should appeal to a physicist – someone with an enquiring mind who wants to understand the universe around us. None of the selections are textbooks full of equations (there will be plenty of time for that!) but each one provides insight to either an application of physics or a new area of study that you will meet at A Level. There are loads of other books in the popular science category that are worth a read or see your Physics teacher to see if they can lend you a book.

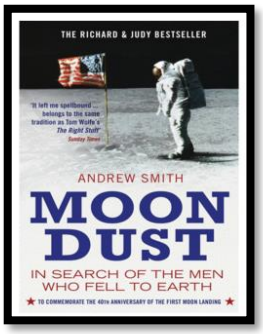
1) **Surely You're Joking Mr Feynman: Adventures of a Curious Character**



ISBN - 009917331X - Richard Feynman isn't a household name but he was a brilliant, inspirational physicist. By reading this book you will get an insight into his life's work, including the creation of the first atomic bomb, his bongo playing(!) and his ground-breaking work in the field of particle physics.

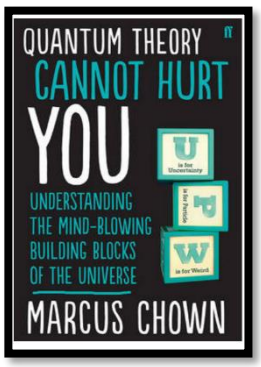
(Also available on Audio book).

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

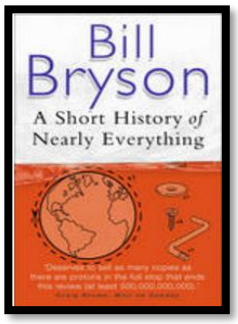


ISBN – 1408802384 - One of the greatest scientific achievements of all time was putting mankind on the surface of the moon. Only 12 men made the trip to the surface; at the time of writing, only 9 are still with us. The book uses the personal accounts of astronauts and others involved in the space programme. Hopefully a new era of space flight is about to begin as we push on to put mankind on Mars within the next few decades.

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



ISBN - 057131502X - Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics, without the need for any prior knowledge. In your first year of A-Level study you will encounter the quantum world for the first time. This book will provide you with interesting facts and handy analogies to whip out to impress your peers!



4) A Short History of Nearly Everything

ISBN – 0552997048 - A modern classic and popular science writing at its best. This is Bill Bryson's quest to find out everything that has happened from the Big Bang to the rise of civilisation - how we got from there, being nothing at all, to here, being us.

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 Fiction Films

1. **Arrival (2016)**
2. **Gravity (2013)**
3. **Interstellar (2014)**
4. **The Imitation Game (2015)**
5. **The Prestige (2006)**

Online Clips / Series

1. **Minute Physics –** A variety of Physics questions explained simply (in felt tip) in a couple of minutes.

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

2. **Wonders of the Universe / Wonders of the Solar System –** Both available on Netflix – Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

3. **Shock and Awe, The Story of Electricity –** Professor Jim Al-Kalili presents a 3-part BBC documentary. 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 (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. **Greatest Minds of all Time: Richard Feynman –** See the life's work of the "great explainer", an incredible scientist, lecturer and bongo player (!) who created mischief and enlightenment in all areas of modern Physics.

   https://www.youtube.com/watch?v=cNaEI70hT-o