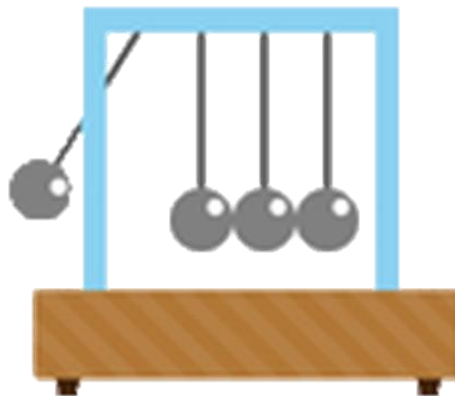




Y12 to Y13 Physics Booklet



Name _____
UCAS Grade _____
Target Grade _____
Aspirational Grade _____

Organisation

It is imperative that you are organised when you return next year, one basic requirement when undertaking this course is that you are methodical and **ALL notes are arranged in order.**

You will regularly have folder checks on your long-term folder. This should contain:

- All classwork from Y12
- Additional notes you have made from the textbook
- Your flashcards for key definitions
- All assessments carried out in Y12 with corrections
- Additional exam questions you have practiced.

Reflection

It is important you reflect on how you have done in your UCAS exam and whether this is what you want to achieve in your final exams in June. Some questions to reflect on:

- How much revision did you do for these set of exams?
- How much work had you been doing consistently throughout the year?
- Did you feel you were cramming to learn the night before the exam?
- Is your revision strategy working for you?

Use your exam paper to colour code your PLC (at the end of this document) at the start of the summer holidays. Remember this should now be your starting point. Over summer, you should re-examine the PLC and improve on your red and orange areas.

Electric Fields Personal Learning Checklist (A-Level only)

Learning Objectives:	Confidence		
Calculate the force between 2 point charges in a vacuum using the formula: $F = 1/(4\pi \epsilon_0) Q_1 Q_2 / r^2$	■		
State that air can be treated as a vacuum when calculating force between charges.	■		
Draw an electric field around a point charge (positive or negative).	■		
Draw an electric field around 2 point charges of equal magnitude.	■		
Define electric field strength.	■		
Calculate electric field strength using both $E = F/Q$ and $E = Q/4\pi \epsilon_0 r^2$			
Draw a uniform electric field.			
Calculate the electric field in a uniform using $E = V/d$.			
Compare the size of gravitational and electrostatic forces between subatomic particles.			
Derive a formula for work done in moving a charge between 2 plates: $W = Q\Delta V$			
Draw the trajectory of a moving charged particle entering a uniform electric field; both parallel and initially at right angles.			
Describe the motion of a moving charged particle in a uniform electric field.			
Define electric potential.			
State the electric potential value at infinity.			

Identify

Colour coding your PLC should help you identify which topics/areas need the most work. Make a list of these topics and put them here, prioritising your weakest topic.

1. _____
2. _____
3. _____
4. _____
5. _____

Make it a priority that you improve on these topics over the summer break. I would suggest spending 1 or 2 hours on each topic a week.

Revise

You have all been given a CGP workbook. This should be completed by September, especially for the topics you identified as your weakest topics.

There are plenty of revision websites that will help you learn this content. This is how I would suggest you use them:

- Kerboodle
 - Use the textbook to read the chapter and make notes as you go. If unsure, flag and use the next website to help you understand better.
 - Complete summary questions and practice questions.
- ALevelPhysicsOnline.com
 - Watch the videos for the topics and make notes as you watch.
 - After this, put your notes away and try to make a mind map of everything you learnt.
- PhysicsAndMathstutor.com
 - Use the key points or detailed notes to add to your mind map you made in a different colour.
 - Close and repeat mind map again.
 - Upload the definitions page to quizlet.com
- Quizlet.com
 - Add the definitions from physics and maths tutor here.
 - Continually test yourself until you are able to give all of them correctly.
- Seneca Learning
 - Subscribe to a course and try to complete the chapters you are finding difficult.

After reviewing the content using the above websites, practice exam questions from physics and maths tutor.

Reflection (again)

After revising the content, go through your PLC again and reflect on whether you have improved and understood the learning objectives. You should fill in the second column on your PLC to display your progress.

Electric Fields Personal Learning Checklist (A-Level only)

Learning Objectives:	Confidence		
Calculate the force between 2 point charges in a vacuum using the formula: $F = 1/(4\pi \epsilon_0) Q_1 Q_2 / r^2$	■	■	
State that air can be treated as a vacuum when calculating force between charges.	■	■	
Draw an electric field around a point charge (positive or negative).	■	■	
Draw an electric field around 2 point charges of equal magnitude.	■	■	
Define electric field strength.	■	■	
Calculate electric field strength using both $E = F/Q$ and $E = Q/4\pi \epsilon_0 r^2$			
Draw a uniform electric field.			
Calculate the electric field in a uniform using $E = V/d$.			
Compare the size of gravitational and electrostatic forces between subatomic particles.			
Derive a formula for work done in moving a charge between 2 plates: $Ed = Q\Delta V$			
Draw the trajectory of a moving charged particle entering a uniform electric field; both parallel and initially at right angles.			
Describe the motion of a moving charged particle in a uniform electric field.			
Define electric potential.			
State the electric potential value at infinity.			

Retest

Whilst there will be another assessment in September/October in class, it is important that you test yourself to see if you improve on your percentage. This will be a good indication of whether the work you have done has helped you improve.

Complete the test that found here: <https://JODAYEC.exampro.net>

Do this in exam conditions. You have 2 hours.

Enrichment

Reading list:

- Physics of the Impossible and Parallel Worlds (Kaku)
- Hyperspace (Khan)
- Smashing Physics: inside the World's Biggest Experiment (Butterworth)
- Seven Brief Lessons on Physics (Rovelli)
- Chaos (Gleich)
- Quantum (Kumar)
- How to Teach Quantum Physics to your Dog (Orzel)
- 50 Physics Ideas You Really Need To Know (Baker)
- The Ele.g.ant Universe (Greene)
- Just Six Numbers (Rees)
- About Time (Frank)
- The Wonders of the Solar System (Brian Cox - anything by him is good)
- An Astronaut's Guide to Life on Earth (Hadfield)
- A Space Traveller's Guide to the Solar System (Thompson)
- Ripples in Spacetime (Schilling)
- Calculating the Cosmos (Stewart)
- The Ascent of Gravity (Chown)

Links to TED Talks/Articles/Documentaries/Books/Journals:

- TED talk – [Inside the black hole image that made history.](#)
- TED talk – [Why do hospitals have particle accelerators?](#)
- BBC Sounds – [Will Artificial Intelligence kill development?](#)
- BBC Sounds – [Tech tent- the promise of smart cities.](#)
- Article in Nature – [A closer look at lightning](#)
- Careers – [Institute of Physics – Next Steps with Physics](#)

A-Level Paper 1 Personal Learning Checklist

Measurements and Errors

Learning Objectives:	Confidence		
Recall the fundamental (base) units for: mass, length, time, amount of substance, temperature and electric current.			
Derive the SI units for other quantities.			
Recall and use the prefixes: T, G, M, k, c, m, μ , n, p and f.			
Convert between units of the same quantity for example J, eV and kW h.			
Identify random and systematic errors in a practical.			
Suggest ways to reduce random and systematic errors in a practical.			
<i>Understand and use the following terms correctly:</i>			
<ul style="list-style-type: none"> • precision 			
<ul style="list-style-type: none"> • repeatability 			
<ul style="list-style-type: none"> • reproducibility 			
<ul style="list-style-type: none"> • resolution 			
<ul style="list-style-type: none"> • accuracy 			
State a quantity to the appropriate number of significant figures based on the value and it's associated uncertainty.			
<i>Calculate the following:</i>			
<ul style="list-style-type: none"> • absolute uncertainty 			
<ul style="list-style-type: none"> • fractional uncertainty 			
<ul style="list-style-type: none"> • percentage uncertainty 			
<ul style="list-style-type: none"> • combination of absolute and percentage uncertainties 			
<ul style="list-style-type: none"> • combining uncertainties in cases where the measurements have been added, subtracted, multiplied, divided, or raised to powers. 			
Draw error bars on a graph relating to the uncertainty in a data point.			
Calculate the uncertainty in the gradient of a straight-line graph.			
Calculate the uncertainty in the y-intercept of a straight-line graph.			

Explain why individual points on a graph may or may not have associated error bars.			
Estimate approximate values of physical quantities to the nearest order of magnitude.			
Use common estimates and knowledge of physics to produce further derived estimates to the nearest order of magnitude.			

Particles

Learning Objectives:	Confidence		
Recall the model of the atom, including the proton, neutron and electron.			
Recall the charge and mass of the proton, neutron and electron in SI units and relative units.			
Understand what is meant by the atomic mass unit (amu).			
Calculate the specific charge of the proton and the electron, and of nuclei and ions.			
Use nuclide notation, and understand what Z and A stand for in this notation.			
Define isotope.			
Use isotopic data in calculations.			
Describe the strong nuclear force.			
Explain the role of the strong nuclear force in keeping the nucleus stable.			
Describe alpha and beta decay.			
Write equations for alpha and beta decay.			
Explain the need for the neutrino in beta decay.			
Describe what is meant by the term 'antiparticle'.			
Compare particles and antiparticles in terms of their mass, charge and rest energy in MeV.			
State the antiparticles of the electron, proton, neutron and neutrino.			
State what is meant by a 'photon'.			
Understand how energy of a photon is related to the frequency of radiation.			
Use the following equation: $E = hf = hc / \lambda$			
Describe the process of annihilation.			
Describe the process of pair production.			
Describe and calculate the energies involved in annihilation and pair production.			
State the four fundamental interactions.			
Describe the four fundamental interactions and their exchange particles.			
State what is meant by exchange particles.			
Draw Feynman diagrams for the following interactions:			
<ul style="list-style-type: none"> • β^- decay. 			

• β^+ decay.			
• electron capture.			
• electron – proton collision			
• neutron – neutrino.			
Describe how we can classify particles into two groups: hadrons and leptons.			
Describe the two classes of hadrons: baryons and mesons.			
Conserve baryon number.			
Describe what kaons are.			
Describe what kaons can decay into.			
Conserve lepton number.			
State when strange particles are produced.			
State when strangeness is conserved and not conserved.			
Apply all the conservation rules (charge, baryon number, lepton number and strangeness, if necessary) to be able to predict products of interactions.			
Appreciate that particle physics relies on the collaborative efforts of large teams of scientists and engineers to validate new knowledge.			
Understand what quarks are.			
Describe the properties of quarks and antiquarks.			
State how many quarks are needed in a baryon and how many needed in a meson.			
Be able to identify the quark make up of particles in terms of the following quarks: up (u), down (d) and strange (s).			
State what a neutron decays into.			
Describe the change in quark character in β^- and in β^+ decay.			
State that energy and momentum are conserved in all interactions.			

Quantum

Learning Objectives:	Confidence		
Describe the photoelectric effect.			
State what is meant by the threshold frequency.			
Explain how the presence of a threshold frequency was evidence for photon theory.			
State what is meant by the work function, ϕ .			
Explain what a stopping potential is.			
Understand and use the photoelectric equation: $hf = \phi + E_{k(max)}$			
Explain why the kinetic energy in the photoelectric equation is a maximum.			
State what is meant by the following words:			
• ionisation			

• excitation			
• ground state			
• de-excitation			
• electron volt			
Describe how electrons can be ionised or excited.			
Describe what happens when an electron is de-excited.			
Describe what happens in a fluorescent tube.			
Convert from eV to joules and vice versa.			
Describe what a line spectra shows.			
Explain how a line spectra is evidence for transitions between discrete energy levels.			
Understand and use the following equation: $hf = E_1 - E_2$			
Explain what electron diffraction is and how it suggests that particles possess wave properties.			
Calculate de Broglie wavelength using the equation $\lambda = h / (mv)$			
Explain how and why the amount of diffraction changes when the momentum of the particle is changed.			
Appreciate knowledge and understanding of the nature of matter changes over time.			
Appreciate that such changes need to be evaluated through peer review and validated by the scientific community.			

Progressive and Stationary Waves

Learning Objectives:	Confidence		
Define what a progressive wave is.			
Define the following words and state their units:			
• amplitude			
• frequency			
• wavelength			
• speed			
• phase			
• phase difference			
• time period			
Carry out calculations using the wave equation, $c = f\lambda$.			
Carry out calculations using the time period equation, $T = 1/f$.			
Describe a transverse wave and give examples.			
Describe a longitudinal wave and give examples.			
Compare transverse waves and longitudinal waves.			

State common features of all electromagnetic waves.			
Define polarisation.			
Explain why polarisation can only happen for transverse waves.			
Describe uses of polarisers, including Polaroid material and the alignment of aerials.			
Define what a stationary wave is.			
Explain how a stationary wave is formed from two progressive waves travelling in opposite directions towards each other.			
Draw a stationary wave.			
Define nodes and antinodes.			
Label nodes and antinodes onto a graphical depiction of a standing wave.			
Explain what harmonics are.			
Calculate the first harmonic using the equation.			
Calculate further harmonics by understanding what happens to the frequency as the order of the harmonic increases.			
Describe how standing waves are formed in different scenarios including on a string and in a microwave.			
Core Practical			
Investigation into the variation of the frequency of stationary waves on a string with length, tension, and mass per unit length of the string.			

Refraction, Diffraction and Interference

Learning Objectives:	Confidence		
Define the term path difference.			
Define coherence.			
State an example of monochromatic light.			
Explain constructive and destructive interference.			
Describe diffraction.			
Describe the pattern produced when coherent light is passed through a double-slit. (Young's double slit experiment).			
Explain how the pattern is produced in a double-slit experiment.			
Describe the safety issues associated with using lasers.			
Understand and use the following equation $w = \lambda D/s$.			
Describe and explain what the pattern would look like if using white light.			
Describe the interference produced with sound and electromagnetic waves.			
Appreciate how knowledge and understanding of nature of electromagnetic radiation has changed over time.			
Describe the pattern produced when monochromatic light is shone through a single slit.			

Describe the pattern produced when white light is shone through a single slit.			
State and explain how the variation of the width of the central diffraction maximum is affected by wavelength and slit width.			
Derive and use $d\sin\theta = n\lambda$			
Describe the pattern produced by a plane transmission diffraction grating at normal incidence.			
Describe the uses of application gratings.			
Understand what refraction is and what causes refraction.			
Understand and use the equation for the refractive index of a substance: $n = c / c_s$			
State the refractive index of air.			
Understand and use Snell's law of refraction for a boundary: $n_1\sin\theta_1 = n_2\sin\theta_2$			
Describe what total internal reflection is.			
Explain when total internal reflection occurs with reference to the critical angle.			
Be able to calculate the critical angle for a medium: $\sin\theta_c = n_2 / n_1$			
Explain how simple fibre optics work.			
Explain the function of cladding in optical fibres.			
Describe what is meant by material dispersion.			
Describe what is meant by modal dispersion.			
Describe the principles of pulse broadening and absorption.			
Describe the consequences of pulse broadening and absorption.			
Core Practical			
Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating.			

Vectors, Forces and Moments

Learning Objectives:	Confidence		
State what is meant by the term scalar.			
State what the term vector means.			
Give examples of vectors and scalars.			
Calculate the resultant vector numerically or by scale drawing. (Calculations will be limited to two vectors at right angles).			
Resolve vectors into two components at right angles to each other (vertically and horizontally).			
Resolve vectors into two components that are along and perpendicular to an inclined plane.			
State what is meant by the term coplanar.			
State the conditions for equilibrium for two forces acting at a point.			

State the conditions for equilibrium for three coplanar forces acting at a point.			
Describe the motion of an object that is in equilibrium.			
State what 'moment' means.			
Calculate the moment of a force about a point.			
State what 'couple' means.			
Calculate the moment of a couple.			
State the principle of moments.			
Apply the principle of moments to a given context.			
State what is meant by centre of mass.			
Explain why the centre of mass of a uniform regular object is at its centre.			

Motion and Momentum

Learning Objectives:	Confidence		
Define the following words:			
• displacement			
• speed			
• velocity			
• acceleration			
Apply the equations for velocity and acceleration, including average and instantaneous speeds and velocities.			
Represent uniform and non-uniform acceleration on graphs.			
Deduce what the area under an acceleration-time graph represents.			
Draw a velocity-time graph.			
Deduce what the gradient and area under a velocity-time graph represents.			
Apply and use the equations for uniform acceleration (SUVAT) for one-dimension one-direction problems.			
Apply and use the equations for uniform acceleration (SUVAT) for one-dimension problems.			
Understand the independent effect of motion in the horizontal and vertical directions in a uniform gravitational field.			
Apply and use the equations for uniform acceleration (SUVAT) for two dimension problems.			
Describe the effect of friction.			
Describe the effect of lift and drag forces.			
Explain what is meant by terminal speed and when it occurs.			
Describe what happens to air resistance with increased speed.			
Explain what effect air resistance has on the trajectory of a projectile.			

State the factors that affect the maximum speed of a vehicle.			
State the three laws of motion			
Apply the three laws of motion to appropriate situations.			
Understand and use $F=ma$ in situations where the mass is constant.			
Define momentum as mass x velocity.			
State the conservation of linear momentum.			
Apply the conservation of linear momentum to problems in one dimension.			
State force as the rate of change of momentum and apply the equation $F = \Delta mv / \Delta t$.			
Define impulse.			
Deduce what the area under a force-time graph represents.			
Explain how impact forces are related to contact time (eg kicking a football, crumple zones, packaging).			
State what is meant by an elastic and inelastic collision.			
Carry out calculations involving elastic and inelastic collisions.			
Carry out calculations involving explosions.			
Appreciate the use of momentum conservation issues in the context of ethical transport design.			
Core Practical			
Determination of g by a free-fall method.			

Work, Energy and Power

Learning Objectives:	Confidence		
Calculate the energy transferred using the equation: $W = Fs \cos\theta$			
State what is meant by the term 'power'.			
Calculate the power using $P = \Delta W / \Delta t = Fv$			
Explain what would happen to power if the force was not constant.			
Deduce what the area under a force-displacement graph represents.			
State what is meant by the term efficiency.			
Calculate efficiency using $\text{efficiency} = \text{useful output power} / \text{input power}$.			
Express efficiency as a percentage.			
State what the principle of conservation of energy is.			
Apply the principle of conservation of energy.			
Calculate change in gravitational potential energy.			
Calculate kinetic energy.			
Describe and explain applications of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces.			

Materials

Learning Objectives:	Confidence		
State what is meant by density.			
Calculate density using $\rho = m / V$.			
State Hooke's law.			
State what is meant by elastic limit.			
Understand and apply $F = k\Delta L$ to an example.			
Define tensile strain.			
Define tensile stress.			
Calculate tensile strain.			
Calculate tensile stress.			
Calculate the elastic strain energy using the equation.			
Deduce the elastic strain energy from a force-extension graph.			
Calculate breaking stress.			
Describe the following words:			
<ul style="list-style-type: none"> plastic behaviour 			
<ul style="list-style-type: none"> fracture 			
<ul style="list-style-type: none"> brittle behaviour 			
Link the above words to force- extension graphs.			
Quantitative and qualitative application of energy conservation to examples involving elastic strain energy and energy to deform.			
Convert from elastic potential energy to kinetic and gravitational potential energy.			
Interpret stress-strain curves.			
Appreciate use of energy conservation issues in the context of ethical transport design.			
Define Young's modulus.			
Calculate Young's modulus as stress/strain.			
Use a stress-strain graph to deduce Young's modulus.			
Core practical			
Determination of the Young modulus by a simple method.			

Electrical Properties

Learning Objectives:	Confidence		
Define the following terms:			
<ul style="list-style-type: none"> Current 			
<ul style="list-style-type: none"> Charge 			

• Potential difference			
• Resistance			
Calculate quantities using the following equations:			
• $I = \Delta Q / \Delta t$			
• $V = W / Q$			
• $R = V / I$			
Interpret current – voltage graphs and distinguish between the characteristics for an ohmic conductor, a semiconductor diode and a filament lamp. (I or V can be on the x-axis)			
State Ohm’s law.			
Recognise that Ohm’s law is a special case where I is directly proportional to V under constant physical conditions.			
Describe why ammeters must be connected in series and voltmeters in parallel. (Ammeters and voltmeters should be treated as ideal unless specifically stated)			
Define resistivity.			
Suggest reasons why resistivity is a better quantity to state than resistance.			
Understand and use the resistivity equation: $\rho = RA / L$			
Describe and explain the effect of temperature on the resistance of metal conductors.			
Describe the effect of temperature on the resistance of thermistors. (Only negative temperature coefficient, ntc, thermistors will be considered).			
Describe application of thermistors, including in temperature sensors.			
Explain what ‘superconductor’ means.			
Describe how superconductors can be used to produce strong magnetic fields and to reduce energy losses in the transmission of electric power.			
Core Practical			
Determination of resistivity of a wire using a micrometer, ammeter, and voltmeter.			

Circuits

Learning Objectives:	Confidence		
Calculate the value for total resistance when resistors are connected in series.			
Calculate the value for total resistance when resistors are connected in parallel.			
Calculate values for resistance when components are connected in a combination of series and parallel.			
Calculate electrical energy using the equation, $E = IVt$.			
Calculate electrical power using: $P = IV = I^2R = V^2/R$.			
State Kirchhoff’s first law.			
Explain why current into a junction must equal the current exiting a junction.			
Calculate current in a series or parallel circuit.			

State Kirchhoff's second law.			
Define potential difference.			
Define electromotive force.			
Calculate the potential difference of components in series or parallel circuits.			
Explain what happens to cells that are combined in series.			
Explain what happens to cells that are combined in parallel.			
Describe what a potential divider does.			
Describe the purpose of a negative temperature coefficient (ntc) thermistor and draw the circuit symbol.			
Describe the purpose of a light dependent resistor (LDR) and draw the circuit symbol.			
Derive the equation for a potential divider.			
Explain what happens to the output voltage of a potential divider when changes are made to the circuit, including circuits with a thermistor and LDR.			
Understand what internal resistance is.			
Define terminal potential difference.			
Apply the following equations to a circuit:			
• $\epsilon = E/Q$			
• $\epsilon = I(R + r)$			
Perform calculations for circuits where the internal resistance is not negligible.			
Core Practical			
Investigation of the emf and internal resistance of electric cells and batteries by measuring the variation of the terminal pd of the cell with current in it.			

Periodic Motion (A-Level only)

Learning Objectives:	Confidence		
Describe the motion in a circular path at constant speed.			
Explain why motion in circular path requires a centripetal force.			
Estimate the acceleration and centripetal force in situations that involve rotation.			
State the centripetal force in a situation.			
Calculate the magnitude of angular speed using $\omega = v / r = 2\pi f$.			
Convert between radians and degrees.			
Calculate centripetal acceleration using $a = v^2/r = \omega^2 r$.			
Derive and use the equation for centripetal force $F = mv^2/r = m\omega^2 r$.			
Describe simple harmonic motion.			
Explain the characteristics of simple harmonic motion.			
State the conditions for simple harmonic motion.			

Define an equation for simple harmonic motion $a = -\omega^2x$ and $x = A \cos \omega t$ and $v = \pm\omega\sqrt{(A^2 - x^2)}$			
Sketch the following graphs:			
• x against t.			
• v against t.			
• a against t.			
• kinetic energy against x.			
• kinetic energy against t.			
• potential energy against x.			
• potential energy against t.			
• total energy against x.			
• total energy against t.			
Appreciate that the v-t graph is derived from the gradient of the x-t graph and that the a-t graph is derived from the gradient of the v-t graph.			
Calculate maximum speed using ωA .			
Calculate maximum acceleration using $\omega^2 A$			
Study the mass-spring system and use the equation for time period of this system.			
Study the simple pendulum and use the equation for time period of this system.			
Explain why we use the small angle approximation in the derivation of the time period formula.			
Apply simple harmonic motion to other contexts (eg liquid in a U-tube).			
Describe the effect of damping on oscillations. ,			
State what free vibrations mean.			
State what is meant by forced vibrations.			
State what resonance is.			
Describe the effect of damping on the sharpness of resonance.			
Apply knowledge of resonance to mechanical systems and situations involving stationary waves.			
Core Practical			
Investigation into simple harmonic motion using a mass-spring system and a simple pendulum.			