SUMMER HOMEWORK

PHYSICS

YR 12 INTO YR 13

TRANSITION BOOKLET

OCR A PHYSICS A (H556)

Name: ______________________________

BEAL SIXTH FORM

ONE SIXTH FORM - TWO SITES - THREE PATHWAYS

PHYSICS

This transition work MUST be completed before your first Year 13 Physics lesson. It will be checked and used to identify the knowledge, mathematical and practical skills that need strengthening in September.

The aim is to consolidate Year 12 learning and prepare you for the increased mathematical, synoptic and practical demand of the full A Level course.

What do you do in your second year?

Exam board: OCR A Physics A (H556). The full A Level has three written papers and a separately reported Practical Endorsement.

Content Overview	Assessment Overview	
Content is split into six teaching modules: • Module 1 - Development of practical skills in physics • Module 2 - Foundations of physics • Module 3 - Forces and motion • Module 4 - Electrons, waves and photons • Module 5 - Newtonian world and astrophysics • Module 6 - Particles and medical physics All written components include synoptic assessment.	Modelling physics (01) 100 marks 2 hours 15 minutes Modules 1, 2, 3 and 5	**37%**
	Exploring physics (02) 100 marks 2 hours 15 minutes Modules 1, 2, 4 and 6	**37%**
	Unified physics (03) 70 marks 1 hour 30 minutes Modules 1 to 6	**26%**
	Practical Endorsement (04) Non-exam assessment Reported separately	**PASS**

At the end of Year 13 you will complete:

- Modelling physics: 2 hours 15 minutes, 100 marks, 37%.
- Exploring physics: 2 hours 15 minutes, 100 marks, 37%.
- Unified physics: 1 hour 30 minutes, 70 marks, 26%.
- Practical Endorsement: reported separately; your PAG evidence must be complete.

PHYSICS

Summer Transition Work - ESSENTIAL

1. Open the current OCR A Physics A (H556) specification and read the Module 5 and Module 6 learning outcomes. Use the QR code or the official OCR link below.

OCR A Physics A specification (H556)
Current document used for this booklet: version 3.0 (March 2026).

2. Complete every First attempt box independently. Do not copy from notes before attempting the question.
3. Check each response using your Year 12 folder, textbook, formula booklet and OCR specification. Add corrections and stronger detail in the final column using a different colour.
4. For every calculation: write the equation, substitute values, show rearrangement, include SI units and give an appropriate number of significant figures.
5. Draw clear diagrams and graphs in pencil. Label axes with quantities and units, draw suitable best-fit lines and show uncertainty or error bars where appropriate.
6. Bring the completed booklet to your first Physics lesson. It may be used alongside a transition assessment in September.

Summer Transition Work - RECOMMENDED

Read around one current physics application linked to Modules 5 or 6. Suitable sources include Physics Review, New Scientist, Scientific American, CERN, NASA, ESA or a university physics-news page. Be prepared to explain the physics, evidence, uncertainties and wider implications.

Required resources

- Your complete Year 12 Physics folder and Practical Endorsement/PAG records.
- A new section or folder for Modules 5 and 6, with dividers.
- Scientific calculator, ruler, protractor, pencil and coloured pens for corrections.
- Graph paper and access to spreadsheet software for modelling and data analysis.
- Recommended textbook: OCR AS/A Level Physics A, ISBN 9781447990833, or the school-issued equivalent.

Summer Plan

OCR A PHYSICS A
YEAR 12 INTO YEAR 13

This booklet is organised into six weekly sections. Complete the tasks gradually rather than leaving the work until the end of the holiday.

For each task, write what you know in the 'First attempt' column. Then use reliable course materials to correct errors, add precise explanations and improve your working in the final column.

The final two pages focus on mathematical, practical and Unified Physics skills. These are essential because all three written papers include synoptic assessment.

Week	Task
1	Year 12 synoptic mastery: Modules 1-4, mathematics and practical skills
2	5.1-5.2: Thermal physics and circular motion
3	5.3-5.4: Oscillations and gravitational fields
4	5.5: Astrophysics and cosmology
5	6.1-6.3: Capacitors, electric fields and electromagnetism
6	6.4-6.5: Nuclear/particle physics and medical imaging

Year 12 Synoptic Mastery

Modules 1-3: measurements, mechanics and materials

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 1

Question	First attempt	Any additional detail?
Convert 72 km h^-1 to m s^-1 and 3.6 × 10^-4 mm^2 to m^2. Explain the difference between a systematic error and a random error.		
A velocity-time graph rises uniformly from 4.0 to 22.0 m s^-1 in 6.0 s, remains constant for 5.0 s and then falls to zero in 4.0 s. Calculate acceleration and total displacement.		
Resolve forces on a 6.0 kg block on a 25° slope with coefficient of friction 0.18. Determine its acceleration and state the assumptions in your model.		
Explain stress, strain, Young modulus, elastic limit and ultimate tensile strength. Sketch and annotate a stress-strain curve for a ductile metal.		
A 0.18 kg ball travelling at 14 m s^-1 rebounds at 9.0 m s^-1. Calculate impulse and mean force if contact lasts 7.5 ms. State your sign convention.		
Plan a practical to determine Young modulus of a wire. Include apparatus, measurements, graph, uncertainties, repeats and safety.		

Year 12 Synoptic Mastery

Modules 1, 2 and 4: circuits, waves and quantum physics

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 1

Question	First attempt	Any additional detail?
A cell of emf 12.0 V and internal resistance 0.60 Ω supplies 3.0 Ω and 6.0 Ω resistors in parallel. Calculate total current, terminal p.d. and power dissipated in the 3.0 Ω resistor.		
Explain how resistivity is determined from a wire experiment. State how temperature, length, diameter measurement and contact resistance affect the result.		
Compare stationary and progressive waves. Explain nodes, antinodes, phase difference and how resonance forms a stationary wave on a string.		
Light of wavelength 420 nm illuminates a metal of work function 2.10 eV. Calculate photon energy and maximum electron kinetic energy. State the threshold condition.		
Electrons have momentum 3.0 × 10^-24 kg m s^-1. Calculate their de Broglie wavelength and explain why diffraction provides evidence for wave-particle duality.		
Design an experiment using a diffraction grating to determine laser wavelength. Include measurements, graph or averaging, uncertainty and safety.		

Thermal Physics

5.1: temperature, materials and ideal gases

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 2

Question	First attempt	Any additional detail?
Distinguish temperature, internal energy and thermal energy transfer. Explain thermal equilibrium and why kelvin is an absolute scale.		
Use the kinetic model to compare solids, liquids and gases. Explain Brownian motion and what it demonstrates about molecules.		
A 0.65 kg aluminium block receives 31 kJ and warms from 19°C to 63°C. Calculate specific heat capacity and discuss two likely energy losses.		
Explain why temperature remains constant during melting or boiling even though energy is transferred. Define specific latent heat.		
State the assumptions of the ideal-gas model. Use $pV = nRT$ to calculate the pressure of 0.42 mol gas at 310 K in 7.5×10^{-3} m^3.		
Derive the link between $pV = (1/3)Nmc_{rms}^2$ and $pV = NkT$. Calculate the rms speed of nitrogen molecules at 300 K using $m = 4.65 \times 10^{-26}$ kg.		

Circular Motion

5.2: radians, angular velocity and centripetal force

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 2

Question	First attempt	Any additional detail?
Define one radian. Convert 135° to radians and 4.8 rad to degrees. Explain why radians are required in v = omega r.		
A centrifuge rotates at 3600 rev min^-1 with radius 0.085 m. Calculate frequency, angular velocity, speed and centripetal acceleration.		
Explain why an object moving at constant speed in a circle is accelerating. Draw velocity, acceleration and resultant-force vectors at one point.		
Derive F = mv^2/r from a = v^2/r and apply it to a 950 kg car travelling at 18 m s^-1 around a bend of radius 42 m.		
A conical pendulum has length 0.72 m and makes 28° to the vertical. Determine the speed and period of the bob.		
Evaluate a whirling-bung investigation of centripetal force. Explain how to control radius, determine frequency, reduce reaction-time error and test proportionality.		

Oscillations

5.3: simple harmonic motion, energy and resonance

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 3

Question	First attempt	Any additional detail?
Define amplitude, period, frequency, angular frequency and phase difference. State the defining equation for simple harmonic motion.		
For x = A cos(omega t), explain how displacement, velocity and acceleration vary through one cycle. Identify where each is maximum and zero.		
An oscillator has amplitude 0.060 m and frequency 2.5 Hz. Calculate angular frequency, maximum speed and acceleration at x = 0.030 m.		
Sketch kinetic, potential and total-energy graphs against displacement for SHM. Explain energy changes at equilibrium and at the extremes.		
Compare light, critical and heavy damping. Explain forced oscillations, natural frequency, resonance and the shape of an amplitude-frequency graph.		
Plan how to determine the period of a mass-spring system and test whether period is independent of amplitude. Include repeats and uncertainty.		

Gravitational Fields

5.4: fields, orbits, potential and escape

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 3

Question	First attempt	Any additional detail?
Define gravitational field strength and gravitational potential. Explain why one is a vector and the other a scalar, and why potential is negative.		
Two masses of 6.0×10^{24} kg and 7.3×10^{22} kg are 3.84×10^{8} m apart. Calculate gravitational force and field strength at the smaller mass.		
Derive $T^2 = 4\pi^2 r^3/(GM)$ for a circular orbit. Explain how it leads to Kepler's third law.		
State the conditions for a geostationary satellite. Explain two uses and calculate its orbital radius from $T = 24.0$ h and $M_E = 5.97 \times 10^{24}$ kg.		
Sketch gravitational field strength and potential against distance from a spherical planet. Explain how area under a force-distance graph gives work done.		
Derive the escape-speed expression from energy conservation and calculate escape speed from a planet with $M = 6.4 \times 10^{23}$ kg and $R = 3.4 \times 10^{6}$ m.		

Astrophysics and Cosmology

5.5: stars, spectra and the expanding universe

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 4

Question	First attempt	Any additional detail?
Describe the formation and evolution of a low-mass star and a high-mass star. Include red giant/supergiant, white dwarf, supernova, neutron star and black hole.		
Explain electron degeneracy pressure, the Chandrasekhar limit and why a sufficiently massive stellar core collapses.		
Interpret an HR diagram. State the locations of main-sequence stars, red giants, supergiants and white dwarfs and explain the axes.		
A star has peak wavelength 480 nm and luminosity 6.0 × 10^28 W. Use Wien's and Stefan's laws to estimate its surface temperature and radius.		
Explain continuous, emission and absorption spectra. Describe how a diffraction grating identifies elements in a star.		
A galaxy is 145 Mpc away and recedes at 10 200 km s^-1. Calculate H0, convert it approximately to s^-1 and estimate the age of the universe. State limitations.		

Capacitors

6.1: capacitance, stored energy and exponential change

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 5

Question	First attempt	Any additional detail?
Define capacitance and the farad. Explain electron flow when a capacitor charges and discharges through a resistor.		
Calculate the equivalent capacitance of 4.0 μF and 6.0 μF capacitors in series, then in parallel. Explain why the rules differ from resistors.		
A 2200 μF capacitor is charged to 18 V. Calculate charge and stored energy using two suitable equations.		
Explain why capacitor energy is the area under a p.d.-charge graph and derive W = 1/2 QV.		
A 470 μF capacitor discharges through 12 kΩ. Calculate the time constant and p.d. after 8.0 s from an initial 9.0 V.		
Describe how a data logger can investigate capacitor discharge. Explain how V-t and ln(V)-t graphs determine the time constant.		

Electric Fields

6.2: Coulomb force, uniform fields and potential

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 5

Question	First attempt	Any additional detail?
Draw electric-field patterns for an isolated positive charge, two opposite charges and parallel plates. Explain field-line spacing and direction.		
Two charges +3.0 nC and -5.0 nC are 0.080 m apart. Calculate the force magnitude and state its direction.		
Compare gravitational and electric fields around point objects. Include source, force direction, field strength, potential and shielding.		
Parallel plates are 12 mm apart with p.d. 3.6 kV. Calculate field strength and the force/acceleration on an electron. Ignore gravity.		
Define electric potential. Calculate potential and potential energy 0.25 m from a +6.0 nC point charge for a proton.		
A charged particle enters a uniform electric field horizontally. Explain its trajectory and relate the motion to projectile motion.		

Electromagnetism

6.3: magnetic forces, induction and transformers

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 5

Question	First attempt	Any additional detail?
Draw magnetic-field patterns for a straight wire, flat coil and solenoid. Use Fleming's left-hand rule to predict force direction.		
A 0.18 m wire carrying 4.5 A is perpendicular to a 0.72 T field. Calculate force and explain how a digital balance can measure B.		
A proton enters a 0.85 T field at 3.2 × 10^6 m s^-1. Calculate magnetic force and circular-orbit radius.		
Explain how crossed electric and magnetic fields form a velocity selector. Derive v = E/B.		
Define magnetic flux and flux linkage. Apply Faraday's and Lenz's laws to a coil in which flux linkage falls from 0.80 to 0.12 Wb turns in 0.040 s.		
Explain the operation of an a.c. generator and an ideal transformer. Evaluate why transformers make national-grid transmission efficient.		

Nuclear and Particle Physics
6.4: nuclei, particles, decay and nuclear energy

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 6

Question	First attempt	Any additional detail?
Explain how alpha scattering supports the nuclear model. Compare atomic and nuclear sizes and calculate nuclear radius from R = r0A^(1/3).		
Describe the strong nuclear force, including range and how it changes below about 0.5 fm and up to about 3 fm.		
Classify hadrons and leptons. Give quark structures and charges for proton and neutron, then describe beta-minus decay at quark level.		
A sample has activity 960 Bq and half-life 14.0 h. Calculate decay constant and activity after 36.0 h using exponential decay.		
Explain mass defect, binding energy and binding energy per nucleon. Use the binding-energy curve to explain fission and fusion.		
Compare fission and fusion. Explain a chain reaction, the roles of fuel rods/moderator/control rods and issues associated with nuclear waste.		

Medical Imaging

6.5: X-rays, tracers, PET and ultrasound

1. Complete the 'First attempt' column without notes.
2. Use your Year 12 folder, textbook and OCR specification to correct and extend your answer.

WEEK 6

Question	First attempt	Any additional detail?
Draw and label an X-ray tube. Explain thermionic emission, electron acceleration, target interactions and why cooling is required.		
Explain simple scattering, photoelectric absorption, Compton scattering and pair production. Apply $I = I0e^{(-\mu x)}$ to attenuation through tissue.		
Compare a radiograph and CT scan. Explain contrast media, image formation, advantages and radiation-dose concerns.		
Explain how a gamma camera forms an image using a collimator, scintillator and photomultiplier tubes. State why technetium-99m is useful.		
Explain positron-electron annihilation and coincidence detection in PET. Compare PET information with CT information.		
Explain the piezoelectric effect, acoustic impedance, reflection coefficient and A-scan/B-scan ultrasound. Evaluate ultrasound safety and limitations.		

Mathematical and Practical Skills

A Level Physics challenge activity

Complete each task without notes first. Show equations, rearrangement, substitutions, units and significant figures. Then check and correct your method.

Question	First attempt	Correction / improvement
A capacitor discharges from 8.0 V to 2.1 V in 18.0 s. Use $V = V0e^{(-t/RC)}$ to calculate the time constant. Explain how a graph of ln(V) against t could determine RC.		
A pendulum has T = 1.86 s for L = 0.850 ± 0.002 m. Calculate g using $T = 2\pi\sqrt{(L/g)}$. Estimate the percentage uncertainty in g if the uncertainty in T is ±0.02 s.		
Gas data are recorded at constant volume. Explain which graph would test $p \propto T$, how absolute zero could be estimated, and two reasons why real data might not pass exactly through the origin.		
The peak wavelength of a star is (510 ± 12) nm. Use Wien's law $\lambda maxT = 2.90 \times 10^{-3}$ m K to calculate T and its approximate percentage uncertainty.		
A radioactive source gives corrected count rates of 824, 582, 411, 292 and 207 min^{-1} at equal 6.0 min intervals. Test whether the decay is exponential and estimate the half-life.		
Plan an investigation to determine magnetic flux density using a current-carrying wire and digital balance. Include variables, apparatus, measurements, graph, uncertainties, repeats and risk management.		

Unified Physics Challenge

Synoptic data analysis: producing and using fluorine-18

A hospital cyclotron accelerates protons to produce fluorine-18 for PET imaging. Use the data below and ideas from across the course.

Quantity	Value
Accelerating p.d.	4.0 MV
Magnetic flux density	1.50 T
Proton charge / mass	1.60 × 10^-19 C / 1.67 × 10^-27 kg
F-18 half-life	110 min
Activity at 08:00	1.60 GBq
Annihilation photon energy	511 keV each

Question	First attempt	Any additional detail?
Assuming non-relativistic motion, use qV = 1/2 mv^2 to calculate the proton speed after acceleration through 4.0 MV. State one limitation of this model.		
Use magnetic force as the centripetal force to derive r = mv/(qB), then calculate the proton orbit radius in the 1.50 T field.		
Calculate the F-18 activity at 10:45. State why production must be close to the hospital and why background correction is important when measuring activity.		
Explain how positron emission produces two 511 keV photons and how coincidence detection allows a PET image to be reconstructed.		
Extended response: evaluate PET, CT and ultrasound for diagnosing disease. Compare image information, ionising radiation, resolution, cost, access and patient risk.		

Completion and reflection

My strongest Year 12 area is:	
The area I most need to revisit is:	
My specific Year 13 target is:	