GCSE PHYSICS - AQA AND PEARSON EDEXCEL

GCSE Physics revision handbook

Six connected chapters covering models, equations, practical evidence and original exam-style calculations.

Use the confirmed course

This handbook covers core ideas shared by AQA and Pearson Edexcel. Topic order, required practicals, tier content and equation sheets can differ. Always use the learner's current specification and teacher guidance as the final authority.

Inside this handbook

Each chapter gives the essential knowledge, a worked example and original exam-style practice. Complete the questions before using the answer section.

CHAPTER 1

Energy and efficiency

Energy is stored and transferred. Calculations must identify the system, the pathway and the units.

Coverage map

Energy stores and pathways; work; kinetic, gravitational and elastic energy; power; efficiency; conduction and radiation; specific heat capacity; energy resources.

Essential knowledge

- Energy stores include kinetic, thermal, chemical, gravitational, elastic, magnetic, electrostatic and nuclear.
- Work done transfers energy: work = force × distance moved in the force direction.
- Kinetic energy = $\frac{1}{2}mv^2$; gravitational energy change = mgh.
- Power = energy transferred ÷ time.
- Efficiency = useful output ÷ total input, expressed as a decimal or percentage.

Worked example	A 2 kg object moves at 5 m/s. Kinetic energy = $\frac{1}{2} \times 2 \times 5^2 = 25$ J.

Exam focus	Define the system, identify the starting and finishing stores and show units at each calculation stage.

Common mistake to avoid	Energy is conserved but may be dissipated to less useful stores; it is not 'used up'.

CHAPTER 1 PRACTICE

Exam-style practice

1. Calculate the gravitational energy gained by a 12 kg box lifted 2.5 m. Use g = 9.8 N/kg.

2. A motor transfers 18,000 J in 45 s. Calculate its power.

3. A device receives 500 J and transfers 360 J usefully. Calculate efficiency.

CHAPTER 2

Electricity and circuits

Circuit behaviour follows conservation of charge and energy. Connect each equation to a measurable quantity.

Coverage map

Charge and current; potential difference; resistance; component characteristics; series and parallel circuits; power and energy; mains electricity; safety and the National Grid.

Essential knowledge

- Current = charge ÷ time; potential difference = energy ÷ charge.

- Resistance = potential difference ÷ current.

- Current is the same in series; potential differences add. In parallel, branch currents add and potential difference is shared.

- Electrical power = potential difference × current and energy = power × time.

- Domestic electricity uses alternating current; protective devices reduce shock and fire risk.

Worked example	A 12 V component carries 0.5 A. Resistance = 12 ÷ 0.5 = 24 ohms and power = 12 × 0.5 = 6 W.

Exam focus	Use circuit rules before substituting into an equation and check whether the required value applies to a component, branch or whole circuit.

Common mistake to avoid	Current is not 'used up' by a component; charge is conserved around the circuit.

CHAPTER 2 PRACTICE

Exam-style practice

1. Calculate the charge passing when a current of 2.4 A flows for 75 s.

2. Two resistors of 4 ohms and 7 ohms are connected in series to 22 V. Find current.

3. Explain why adding another branch in parallel reduces total circuit resistance.

CHAPTER 3

Particles, matter and atomic physics

Particle models explain density, changes of state, gas pressure and radiation from unstable nuclei.

Coverage map

Density; changes of state; internal energy; specific latent heat; gas pressure; atomic structure; nuclear radiation; half-life; fission and fusion.

Essential knowledge

- Density = mass ÷ volume.

- Internal energy is the total kinetic and potential energy of particles.

- Specific heat capacity links energy, mass and temperature change; latent heat changes state without changing temperature.

- Gas pressure results from particle collisions with container walls.

- Alpha, beta and gamma differ in nature, ionising power and penetration; half-life describes random decay statistically.

Worked example	A 0.4 kg block receives 7,200 J and warms by 30 degrees C. Specific heat capacity = 7,200 ÷ (0.4 × 30) = 600 J/kg degrees C.
Exam focus	Use particle explanations for state changes and distinguish count rate, activity, dose and half-life.
Common mistake to avoid	Temperature stays constant during a change of state because transferred energy changes potential rather than kinetic energy.

CHAPTER 3 PRACTICE

Exam-style practice

1. A metal has mass 390 g and volume 50 cm3. Calculate density in g/cm3.

2. Calculate energy to melt 0.75 kg of a substance with specific latent heat 240,000 J/kg.

3. A sample has count rate 960 counts/min and half-life 8 hours. Find count rate after 24 hours, ignoring background.

CHAPTER 4

Forces, motion and momentum

Forces change motion or shape. Diagrams, signs and vector direction are essential.

Coverage map

Scalars and vectors; resultant force; moments; speed, velocity and acceleration; motion graphs; Newton's laws; stopping distance; momentum; elasticity and pressure.

Essential knowledge

- Resultant force is the vector sum of forces.
- Acceleration = change in velocity ÷ time; force = mass × acceleration.
- Weight = mass × gravitational field strength.
- Momentum = mass × velocity and is conserved in a closed system.
- Stopping distance combines thinking and braking distances and depends on several conditions.

Worked example	A 1,200 kg car accelerates at 2.5 m/s2. Resultant force = 1,200 × 2.5 = 3,000 N.

Exam focus	Choose a positive direction, resolve vectors consistently and read the gradient or area of a graph with its unit.

Common mistake to avoid	A moving object does not need a resultant force to keep moving at constant velocity; a resultant force changes velocity.

CHAPTER 4 PRACTICE

Exam-style practice

1. A runner changes velocity from 3 m/s to 9 m/s in 2.4 s. Calculate acceleration.

2. A 0.20 kg ball at 12 m/s rebounds at 8 m/s in the opposite direction. Calculate change in momentum.

3. Explain why airbags reduce injury using force, momentum and time.

CHAPTER 5

Waves and electromagnetic radiation

Waves transfer energy and information without overall transfer of matter. Use diagrams and units carefully.

Coverage map

Transverse and longitudinal waves; wave speed; reflection and refraction; sound and ultrasound; seismic waves; electromagnetic spectrum; communications; lenses and colour.

Essential knowledge

- Wave speed = frequency × wavelength.

- Transverse oscillations are perpendicular to travel; longitudinal oscillations are parallel.

- Reflection obeys angle of incidence = angle of reflection.

- Refraction occurs because wave speed changes across a boundary.

- All electromagnetic waves travel at the same speed in a vacuum but differ in frequency, wavelength, uses and hazards.

Worked example	A wave has frequency 50 Hz and wavelength 0.8 m. Speed = 50 × 0.8 = 40 m/s.

Exam focus	Identify what remains constant at a boundary and use wavelength, frequency and speed with compatible units.

Common mistake to avoid	Frequency is fixed by the source; when wave speed changes at a boundary, wavelength changes.

CHAPTER 5 PRACTICE

Exam-style practice

1. A sound wave travels at 340 m/s and has frequency 680 Hz. Find wavelength.

2. Explain why light bends towards the normal when entering glass from air.

3. Give one use and one hazard of ultraviolet radiation.

CHAPTER 6

Magnetism, electromagnetism and space

Fields explain forces at a distance, while electromagnetic induction links motion, magnetism and electricity.

Coverage map

Magnetic fields; electromagnets; motor effect; generator effect; alternating current; transformers; orbital motion; stellar life cycles; red shift and the expanding universe.

Essential knowledge

- Magnetic field direction is the direction a north pole would move.
- A current creates a magnetic field; a solenoid produces a strong, nearly uniform field.
- A current-carrying conductor in a magnetic field experiences the motor effect.
- Changing magnetic flux induces a potential difference; faster change produces a larger effect.
- Stars form from nebulae and evolve according to initial mass; red shift supports an expanding universe.

Worked example	A transformer has 500 primary turns, 50 secondary turns and 230 V input. $V_s/V_p = N_s/N_p$, so $V_s = 230 \times {}^{50}\!/_{500} = 23$ V.
Exam focus	State what changes in the field or conductor and connect that change to force, induced potential difference or energy transfer.
Common mistake to avoid	A transformer requires a changing magnetic field, so it operates with alternating rather than steady direct current.

CHAPTER 6 PRACTICE

Exam-style practice

1. A conductor of length 0.30 m carries 4 A at right angles to a 0.50 T field. Calculate force.

2. Explain how moving a magnet into a coil produces a potential difference.

3. Outline the life cycle of a star with similar mass to the Sun.

ANSWERS AND WORKED METHODS

Check the reasoning as well as the final answer

Award credit only for a method that answers the question asked. Where a response is unclear, return to the matching chapter and correct it before trying a fresh question.

Chapter 1: Energy and efficiency

1. Energy = mgh = 12 × 9.8 × 2.5 = 294 J.
2. Power = energy ÷ time = 18,$\frac{000}{45}$ = 400 W.
3. Efficiency = $\frac{360}{500}$ = 0.72 = 72%. The remaining 140 J is dissipated to other stores.

Chapter 2: Electricity and circuits

1. Charge = current × time = 2.4 × 75 = 180 C.
2. Series resistance = 4 + 7 = 11 ohms. Current = $\frac{22}{11}$ = 2 A.
3. An additional branch provides another path for charge. At the same potential difference, total current increases; since R = V/I, total resistance decreases.

Chapter 3: Particles, matter and atomic physics

1. Density = $^{390}/_{50}$ = 7.8 g/cm3.
2. Energy = mass × specific latent heat = 0.75 × 240,000 = 180,000 J.
3. 24 hours is three half-lives: 960 → 480 → 240 → 120 counts/min.

Chapter 4: Forces, motion and momentum

1. Acceleration = (9 - 3) ÷ 2.4 = 2.5 m/s2.
2. Take initial direction as positive. Initial momentum = 0.20 × 12 = 2.4 kg m/s. Final = 0.20 × -8 = -1.6 kg m/s. Change = -1.6 - 2.4 = -4.0 kg m/s, magnitude 4.0 kg m/s.
3. The passenger's momentum must change to zero. An airbag increases the time over which this change occurs, so the average force is smaller because force = change in momentum ÷ time.

Chapter 5: Waves and electromagnetic radiation

1. Wavelength = speed ÷ frequency = $^{340}/_{680}$ = 0.50 m.

2. Light slows down on entering glass. If it enters at an angle, one side of the wavefront slows first, changing direction towards the normal.

3. Uses include security marking, fluorescent lamps and tanning. Hazards include skin ageing, eye damage and increased risk of skin cancer because ultraviolet can damage cells and DNA.

Chapter 6: Magnetism, electromagnetism and space

1. Force = BIL = 0.50 × 4 × 0.30 = 0.60 N.

2. Movement changes the magnetic field through the coil. The changing flux induces a potential difference; reversing motion reverses polarity, and faster motion increases magnitude.

3. Nebula → protostar → main-sequence star → red giant → white dwarf, which gradually cools. During the main sequence, fusion pressure balances gravitational collapse.