<table>
<tr><th>Week 1</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. The importance of units
2. Sample units
3. Unit prefixes
4. Scalars and vectors
5. Adding vectors – vector triangles
6. Adding vectors – resolving</td><td rowspan="3">Students should be able to:
1.1.1 Physical quantities and units
• Explain that some physical quantities consist of a numerical magnitude and a unit.
• Use correctly the named units listed in the specification as appropriate.
• Use correctly the following prefixes and their symbols to indicate decimal sub-multiples or multiples of units: pico (p); nano (n); micro (μ); milli (m); centi (c); kilo (k); mega (M); giga (G); and tera (T).
• Make suitable estimates of physical quantities.
1.1.2 Scalars and vectors
• Define scalar and vector quantities and give examples.
• Draw and use a vector triangle to determine the resultant of two coplanar vectors such as displacement, velocity and force.
• Calculate the resultant of two perpendicular vectors such as displacement, velocity and force.
• Resolve a vector such as displacement, velocity and force into two perpendicular components.</td><td>• 1.1.1–5</td><td></td></tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G481 Mechanics
1.1.1 Physical Quantities and Units – Magnitude and Unit, and SI prefixes
1.1.2 Scalars and vectors – Introduction, resultant vectors, and resolving vectors</td></tr>
</table>

Week 2	Weekly learning outcomes	Student book links	Practical activity links
1. Displacement and distance 2. Velocity and speed 3. Instantaneous and average speed 4. Acceleration 5. Displacement–time graphs 6. Velocity–time graphs	Students should be able to: **1.1.3 Kinematics** • Define *displacement*, *instantaneous speed*, *average speed*, *velocity* and *acceleration*. • Select and use the relationships: average speed = distance/time; and acceleration = change in velocity/time to solve problems. • Apply graphical methods to represent displacement, speed, velocity and acceleration. • Determine velocity from the gradient of a displacement against time graph. • Determine displacement from the area under a velocity against time graph. • Determine acceleration from the gradient of a velocity against time graph.	• 1.1.6 • 1.1.7	

OCR Scheme of Work topic outlines
G481 Mechanics 1.1.3 Kinematics (definitions), and kinematics (Graphs)

<table>
<tr><th>Week 3</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr>
<td rowspan="3">1. Equations of motion for constant acceleration taken from definitions and from velocity–time graphs
2. Examples of using the equations
3. Falling under gravity
4. Measuring g
5. Independence of horizontal and vertical motion</td>
<td rowspan="3">Students should be able to:
1.1.4 Linear motion
• Derive the equations of motion for constant acceleration in a straight line from a velocity against time graph.
• Select and use the equations of motion for constant acceleration in a straight line.
• Apply the equations for constant acceleration in a straight line, including the motion of bodies falling in the Earth’s uniform gravitational field without air resistance.
• Explain how experiments carried out by Galileo overturned Aristotle’s ideas of motion.
• Describe an experiment to determine the acceleration of free fall, g, using a falling body.
• Apply the equations of constant acceleration to describe and explain the motion of an object due to a uniform velocity in one direction and a constant acceleration in a perpendicular direction.</td>
<td>• 1.1.8
• 1.1.9
• 1.1.10</td>
<td>• Practical 1: Projectile motion down ramp
• Practical 2: The speed of a water jet
• Practical 3: Measuring acceleration due to gravity</td>
</tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G481 Mechanics
1.1.4 Linear motion</td></tr>
</table>

Week 4	Weekly learning outcomes	Student book links	Practical activity links
1. Revision of the effect of forces – balanced and unbalanced – and examples of forces 2. Newton's second law: *F* = *ma* 3. Definition of the newton 4. Limitations of *F* = *ma*	Students should be able to: **1.2.1 Force** • Solve problems using the relationship: net force = mass x acceleration (*F* = *ma*). • Appreciate that acceleration and the net force are always in the same direction. • Define the *newton*. • Apply the equations for constant acceleration and *F* = *ma* to analyse the motion of objects. • Recall that according to the special theory of relativity, *F* = *ma* cannot be used for a particle travelling at very high speeds because its mass increases.	• 1.2.1	• Practical 4: Measuring acceleration • Practical 5: Verifying *F* = *ma*
		OCR Scheme of Work topic outlines	
		G481 Mechanics 1.2.1 Force (*F* = *ma*), and using *F* = *ma*	

<table>
<tr><th>Week 5</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. Movement through fluids and drag
2. The causes of drag and the factors affecting it
3. Mass and weight
4. Terminal velocity</td><td rowspan="3">Students should be able to:
1.2.2 Non-linear motion
• Explain that an object travelling in a fluid experiences a resistive or a frictional force known as drag.
• State the factors that affect the magnitude of the drag force.
• Determine the acceleration of an object in the presence of drag.
• State that the weight of an object is the gravitational force acting on the object.
• Select and use the relationship: weight = mass x acceleration of free fall (W = mg).
• Describe the motion of bodies falling in a uniform gravitational field with drag.
• Use and explain the term terminal velocity.</td><td>• 1.2.2</td><td></td></tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G481 Mechanics
1.2.2 Non-linear motion – effects of resistive forces</td></tr>
</table>

<table>
<tr><th rowspan="1">Week 6</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. Balanced forces – triangle
2. Defining and finding centre of gravity
3. Couples and torque
4. Moments and the principle of moments
5. Requirements for equilibrium</td><td rowspan="3">Students should be able to:
1.2.3 Equilibrium
• Draw and use a triangle of forces to represent the equilibrium of three forces acting at a point on an object.
• State that the centre of gravity of an object is a point where the entire weight of an object appears to act.
• Describe a simple experiment to determine the centre of gravity of an object.
• Explain that a couple is a pair of forces that tends to produce rotation only.
• Define and apply the torque of a couple.
• Define and apply the moment of force.
• Explain that both the net force and net moment on an extended object in equilibrium is zero.
• Apply the principle of moments to solve problems including the example of the human forearm.</td><td>• 1.2.3
• 1.2.4
• 1.2.5</td><td>• Practical 6: To investigate the conditions for the equilibrium of three forces acting through a point
• Practical 7: Centre of gravity experiments</td></tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">1.2.3 Equilibrium (Triangle of forces), Equilibrium (Centre of gravity), and Equilibrium (Moments, couple and torque)</td></tr>
</table>

Week 7	Weekly learning outcomes	Student book links	Practical activity links
1. Definition of density and use of the equation 2. Examples of density and methods for measuring it 3. Definition of pressure and use of the equation 4. Applications of pressure	Students should be able to: **1.2.3 Equilibrium** • Select and use the equation for density $\rho = m/V$. • Select and use the equation for pressure – $p = F/A$ where F is the force normal to the area A.	• 1.2.6 • 1.2.7	
		OCR Scheme of Work topic outlines	
		G481 Mechanics 1.2.2 Equilibrium (Triangle of forces), and Equilibrium (Density and pressure)	

<table>
<tr><th>Week 8</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. Stopping distances – components
2. Factors affecting stopping distances
3. Car safety features – airbags and crumple zones
4. Use of GPS</td><td rowspan="3">Students should be able to:
1.2.4 Car safety
• Define thinking distance, braking distance and stopping distance.
• Analyse and solve problems using the terms thinking distance, braking distance and stopping distance.
• Describe the factors that affect thinking distance and braking distance.
• Describe and explain how airbags, seat belts and crumple zones in cars reduce impact forces in accidents.
• Describe how airbags work – including the triggering mechanism.
• Describe how the trilateration technique is used in the global positioning system (GPS) for cars.</td><td>• 1.2.8
• 1.2.9</td><td></td></tr>
<tr><td colspan="2">OCR Scheme of Work topic outlines</td></tr>
<tr><td colspan="2">G481 Mechanics
1.2.4 Car safety</td></tr>
</table>

Week 9	Weekly learning outcomes	Student book links	Practical activity links
1. Forms of energy and the joule 2. Energy transfers and transformations 3. Work done by a force	Students should be able to: **1.3.1 Work and conservation of energy** • Define *work done* by a force. • Define the *joule*. • Calculate the work done by a force using $W = Fx$ and $W = Fx \cos \theta$. • State the principle of conservation of energy. • Describe examples of energy in different forms, its conversion and conservation, and apply the principle of energy conservation to simple examples. • Apply the idea that work done is equal to the transfer of energy to solve problems.	• 1.3.1 • 1.3.2	
		OCR Scheme of Work topic outlines	
		G481 Mechanics 1.3.1 Work and Conservation of energy	

Week 10	Weekly learning outcomes	Student book links	Practical activity links
1. Work done and gravitational potential energy 2. The kinetic energy equation 3. Conversions from gravitational potential energy to kinetic energy and vice versa	Students should be able to: **1.3.2 Kinetic and potential energies** • Select and apply the equation for kinetic energy. • Apply the definition of work done to derive the equation for the change in gravitational potential energy. • Select and apply the equation for the change in gravitational potential energy near the Earth's surface $E_p = mgh$. • Analyse problems where there is an exchange between gravitational potential energy and kinetic energy. • Apply the principle of conservation of energy to determine the speed of an object falling in the Earth's gravitational field.	• 1.3.3	• Practical 8: Investigating the transfer of energy

OCR Scheme of Work topic outlines
G481 Mechanics 1.3.2 Kinetic and potential energies

Week 11	Weekly learning outcomes	Student book links	Practical activity links
1. Power and the watt 2. Conservation of energy and Sankey diagrams 3. Energy efficiency	Students should be able to: **1.3.3 Power** • Define *power* as the rate of work done. • Define the *watt*. • Calculate power when solving problems. • State that the efficiency of a device is always less than 100% because of heat losses. • Select and apply the relationship for efficiency. Efficiency = (useful output energy/ total input energy) x 100%. • Interpret and construct Sankey diagrams.	• 1.3.4 • 1.3.5	• Practical 9: An investigation of personal power
		OCR Scheme of Work topic outlines	
		G481 Mechanics 1.3.3 Power, and Power and efficiency	

<table>
<tr><th>Week 12</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. Pairs of forces acting on objects
2. Stretching springs and Hooke's law
3. The force constant k
4. Energy stored in a stretched spring</td><td rowspan="3">Students should be able to:
1.3.4 Behaviour of springs and materials
• Describe how deformation is caused by a force in one dimension and can be tensile or compressive.
• Describe the behaviour of springs and wires in terms of force, extension, elastic limit, Hooke's law and the force constant – i.e. force per unit extension or compression.
• Select and apply the equation $F = kx$, where k is the force constant of the spring or the wire.
• Determine the area under a force against extension (or compression) graph to find the work done by the force.
• Select and use the equations for elastic potential energy. $E = ½ Fx$ and $½ kx^2$.</td><td>• 1.3.6
• 1.3.7</td><td>• Practical 8: Investigating the transfer of energy
• Practical 10: Investigating spring behaviour</td></tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G481 Mechanics
1.3.4 Behaviour of Springs and materials (Hooke's law), and Behaviour of springs and materials (energy stored)</td></tr>
</table>

Week 13	Weekly learning outcomes	Student book links	Practical activity links
1. Stress and strain 2. The Young modulus – definition and methods for determining it experimentally 3. Plastic and elastic deformation 4. Ultimate tensile strength 5. Stretching different materials	Students should be able to: **1.3.4 Behaviour of springs and materials** • Define and use the terms *stress*, *strain, the Young modulus* and *ultimate tensile strength* (*breaking stress*). • Describe an experiment to determine the Young modulus of a metal in the form of a wire. • Define the terms *elastic deformation* and *plastic deformation* of a material. • Describe the shapes of the stress against strain graphs for typical ductile, brittle and polymeric materials.	• 1.3.8 • 1.3.9	• Practical 11: The Young modulus of copper • Practical 12: Stretching a rubber band

OCR Scheme of Work topic outlines

G481 Mechanics

1.3.4 Behaviour of Springs and materials (Hooke's law), and Behaviour of springs and materials (Young modulus)

<table>
<tr><th>Week 14</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr>
<td rowspan="3">1. Charge and the electron
2. Conductors, semiconductors and insulators
3. Electric current and electron flow
4. Kirchhoff’s first law
5. I = Anev
6. The effect of changing the material on n and v</td>
<td rowspan="3">Students should be able to:
2.1.1 Charge and current
• Explain that electric current is a net flow of charged particles.
• Explain that electric current in a metal is due to the movement of electrons, whereas in an electrolyte the current is due to the movement of ions.
• Explain what is meant by conventional current and electron flow.
• Select and use the equation $Q = I \times t$.
• Define the coulomb.
• Describe how an ammeter may be used to measure the current in a circuit.
• Recall and use the elementary charge $e = 1.6 \times 10^{-19}$ C.
• Describe Kirchhoff’s first law and appreciate that this is a consequence of conservation of charge.
• State what is meant by the term mean drift velocity of charge carriers.
• Select and use the equation $I = Anev$.
• Describe the difference between conductors, semiconductors and insulators in terms of the number density n.</td>
<td>• 2.1.1
• 2.1.2
• 2.1.3</td>
<td></td>
</tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G482 Electrons, Waves and Photons
2.1.1 Current and Charge</td></tr>
</table>

Week 15	Weekly learning outcomes	Student book links	Practical activity links
1. Components and symbols 2. Simple circuits 3. Voltage – the volt 4. Voltage – e.m.f. and p.d. 5. Measuring e.m.f. and p.d. in circuits	Students should be able to: **2.2.1 Circuit symbols** • Recall and use appropriate circuit symbols as set out in: SI Units; Signs, Symbols and Abbreviations (ASE, 1981); and Signs, Symbols and Systematics (ASE, 1995). • Interpret and draw circuit diagrams using these symbols. **2.2.2 E.m.f. and p.d.** • Define *potential difference* (p.d.). • Select and use the equation $W = VQ$. • Define the *volt*. • Describe how a voltmeter may be used to determine the p.d. across a component. • Define *electromotive force* (e.m.f.) of a source such as a cell or a power supply. • Describe the difference between e.m.f. and p.d. in terms of energy transfer.	• 2.2.1 • 2.2.2	• Practical 13: Energy in electrical circuits

OCR Scheme of Work topic outlines
G482 Electrons, Waves and Photons 2.2.1 Circuit symbols, and 2.2.2 E.m.f. and p.d.

Week 16	Weekly learning outcomes	Student book links	Practical activity links
1. Resistance and the ohm 2. Ohm's law 3. *I–V* characteristics – ohmic conductors (fixed resistor) 4. *I–V* characteristics – non-ohmic conductors (filament lamp, diode) and the uses of diodes 5. Defining resistivity and the resistivity equation 6. Effect of temperature on resistivity – metals 7. Effect of temperature on resistivity – semiconductors including thermistors	Students should be able to: **2.2.3 Resistance** • Define resistance. • Select and use the equation for resistance $R = V/I$. • Define the ohm. • State and use Ohm's law. • Describe the *I–V* characteristics of a resistor at constant temperature; a filament lamp; and a light-emitting diode (LED). • Describe an experiment to obtain the *I–V* characteristics of a resistor at constant temperature; a filament lamp; and an LED. • Describe the uses and benefits of using LEDs. **2.2.4 Resistivity** • Define resistivity of a material. • Select and use the equation $R = \rho L/A$. • Describe how the resistivities of metals and semiconductors are affected by temperature. • Describe how the resistance of a pure metal wire and of a negative temperature coefficient (NTC) thermistor is affected by temperature.	• 2.2.3 • 2.2.4 • 2.2.5 • 2.2.6	• Practical 14: Investigations using a metal resistor • Practical 15: Current voltage characteristics of electrical components • Practical 16: Estimation of the thickness of a pencil line

OCR Scheme of Work topic outlines

G482 Electrons, Waves and Photons

2.2.3 Resistance, and

2.2.4 Resistivity

Week 17	Weekly learning outcomes	Student book links	Practical activity links
1. Electrical work and power 2. Electricity in the home and fuses 3. Paying for electrical energy	Students should be able to: **2.2.5 Power** • Describe power as the rate of energy transfer. • Select and use power equations $P = VI$, $P = I^2R$ and $P = V^2/R$. • Explain how a fuse works as a safety device; see HSW 6a. • Determine the correct fuse for an electrical device. • Select and use the equation $W = IVt$. • Define the kilowatt-hour (kWh) as a unit of energy. • Calculate energy in kWh and the cost of this energy when solving problems; see HSW 6a.	• 2.2.7 • 2.2.8 • 2.2.9	
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.2.5 Power	

Week 18	Weekly learning outcomes	Student book links	Practical activity links
1. Energy and Kirchhoff's second law 2. Kirchhoff's laws and electrical circuits 3. Resistors in series and parallel 4. Combinations of resistors	Students should be able to: **2.3.1 Series and parallel circuits** • State Kirchhoff's second law and appreciate that this is a consequence of conservation of energy. • Apply Kirchhoff's first and second laws to circuits. • Select and use the equation for the total resistance of two or more resistors in series. • Recall and use the equation for the total resistance of two or more resistors in parallel.	• 2.3.1 • 2.3.2	
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.3.1 Series and parallel circuits – Kirchhoff's second law, and Resistors in series and parallel	

Week 19	Weekly learning outcomes	Student book links	Practical activity links
1. Circuits with more than one source of e.m.f. 2. E.m.f., terminal p.d. and internal resistance 3. *e.m.f.* = *V* + *Ir* 4. Measuring e.m.f. and *r* in circuits	Students should be able to: **2.3.1 Series and parallel circuits** • Solve circuit problems involving series and parallel circuits with one or more sources of e.m.f.. • Explain that all sources of e.m.f. have an internal resistance. • Explain the meaning of the term terminal p.d.. • Select and use the equations *e.m.f.* = *I* (*R* + *r*), and *e.m.f.* = *V* + *Ir* .	• 2.3.2 • 2.3.3 • 2.3.4	• Practical 17: The internal resistance of a cell
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.3.1 Series and parallel circuits – Kirchhoff's second law, and Series and parallel circuits – Internal resistance	

Week 20	Weekly learning outcomes	Student book links	Practical activity links
1. The basic operation of a potential divider 2. The potential divider equation 3. LDRs and thermistors in potential dividers 4. Using potential dividers in dataloggers	Students should be able to: **2.3.2 Practical circuits** • Draw a simple potential divider circuit. • Explain how a potential divider circuit can be used to produce a variable p.d. • Recall and use the potential divider equation, $V_1 = \frac{R_1}{R_1 + R_2} \times V_{in}$ (where V_1 is the p.d. across R_1). • Describe how the resistance of a light-dependent resistor (LDR) depends on the intensity of light. • Describe and explain the use of thermistors and LDRs in potential divider circuits. • Describe the advantages of using dataloggers to monitor physical changes; see HSW 3.	• 2.3.5	• Practical 18: Calibrating a thermistor or a diode as a thermometer • Practical 19: The potentiometer – potential divider experiments.
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.3.2 Practical circuits	

Week 21	Weekly learning outcomes	Student book links	Practical activity links
1. Wave types 2. Wave characteristics 3. The wave equation, $v = f\lambda$ 4. Wave experiments	Students should be able to: **2.4.1 Wave motion** • Describe and distinguish between progressive longitudinal and transverse waves. • Define and use the terms displacement, amplitude, wavelength, period, phase difference, frequency and speed of a wave. • Derive from the definitions of speed, frequency and wavelength, the wave equation $v = f\lambda$. • Select and use the wave equation $v = f\lambda$. • Explain what is meant by reflection, refraction and diffraction of waves such as sound and light.	• 2.4.1 • 2.4.2 • 2.4.3 • 2.4.4	• Practical 20: The speed of sound in air • Practical 21: Investigating some properties of electromagnetic waves using 1 GHz radio waves
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.4.1 Wave motion	

<table>
<tr><th>Week 22</th><th>Weekly learning outcomes</th><th>Student book links</th><th>Practical activity links</th></tr>
<tr><td rowspan="3">1. Electromagnetic waves and the electromagnetic spectrum
2. Uses and dangers of different parts of the spectrum
3. Polarisation
4. Malus' law</td><td rowspan="3">Students should be able to:
2.4.2 Electromagnetic waves
• State typical values for the wavelengths of the different regions of the electromagnetic spectrum from radio waves to γ-rays.
• State that all electromagnetic waves travel at the same speed in a vacuum.
• Describe differences and similarities between different regions of the electromagnetic spectrum.
• Describe some of the practical uses of electromagnetic waves.
• Describe the characteristics and dangers of UV-A, UV-B and UV-C radiation and explain the role of sunscreen, see HSW 6a.
• Explain what is meant by plane-polarised waves and understand the polarisation of electromagnetic waves.
• Explain that polarisation is a phenomenon associated with transverse waves only.
• State that light is partially polarised on reflection.
• Recall and apply Malus' law for transmitted intensity of light from a polarising filter.</td><td>• 2.4.5
• 2.4.6</td><td></td></tr>
<tr><th colspan="2">OCR Scheme of Work topic outlines</th></tr>
<tr><td colspan="2">G482 Electrons, Waves and Photons
2.4.2 Electromagnetic waves, and Polarisation</td></tr>
</table>

Week 23	Weekly learning outcomes	Student book links	Practical activity links
1. Wave intensity 2. Superposition of waves 3. Interference – constructive and destructive 4. Phase and path difference causing interference patters 5. Two-source interference for sound and microwaves	Students should be able to: **2.4.3 Interference** • State and use the principle of superposition of waves. • Apply graphical methods to illustrate the principle of superposition. • Explain the terms *interference*, *coherence*, *path difference* and *phase difference*. • State what is meant by constructive interference and destructive interference. • Describe experiments that demonstrate two-source interference using sound, light and microwaves. • Describe constructive interference and destructive interference in terms of path difference and phase difference. • Use the relationships: intensity = power/cross-sectional area and intensity is proportional to amplitude^2.	• 2.4.7	• Practical 22: Wave superposition experiments 1 • Practical 23: Young's experiment to observe the interference of light

OCR Scheme of Work topic outlines
G482 Electrons, Waves and Photons 2.4.3 Interference

Week 24	Weekly learning outcomes	Student book links	Practical activity links
1. Interference patterns with light 2. Young's double-slit experiment 3. $\lambda = ax/D$ 4. Diffraction gratings	Students should be able to: **2.4.3 Interference** • Describe the Young double-slit experiment and explain how it is a classical confirmation of the wave nature of light, see HSW 1. • Select and use the equation $\lambda = ax/D$ for electromagnetic waves. • Describe an experiment to determine the wavelength of monochromatic light using a laser and a double slit. • Describe the use of a diffraction grating to determine the wavelength of light (the structure and use of a spectrometer are not required). • Select and use the equation $d\sin\theta = n\lambda$. • Explain the advantages of using multiple slits in an experiment to find the wavelength of light.	• 2.4.8 • 2.4.9	• Practical 25: Using a diffraction grating to measure the wavelength of light. • Practical 24: Investigating Young's fringes
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.4.3 Interference	

Week 25	Weekly learning outcomes	Student book links	Practical activity links
1. Forming stationary waves 2. Stationary waves and progressive waves 3. The fundamental frequency and harmonics 4. Finding the wavelength from a stationary wave 5. Stationary waves on strings 6. Stationary waves in pipes	Students should be able to: **2.4.4 Stationary waves** • Explain the formation of stationary (standing) waves using graphical methods. • Describe the similarities and differences between progressive and stationary waves. • Define the terms *nodes* and *antinodes*. • Describe experiments to demonstrate stationary waves using microwaves, stretched strings and air columns. • Determine the standing wave patterns for stretched string and air columns in closed and open pipes. • Use the equation: separation between adjacent nodes (or antinodes) = $\lambda/2$. • Define and use the terms fundamental mode of vibration and harmonics. • Determine the speed of sound in air from measurements on stationary waves in a pipe closed at one end.	• 2.4.10 • 2.4.11 • 2.4.12 **OCR Scheme of Work topic outlines** **G482 Electrons, Waves and Photons** 2.4.4 Stationary waves	• Practical 26: Investigating stationary waves on a string • Practical 27: Observing a resonance effect

Week 26	Weekly learning outcomes	Student book links	Practical activity links
1. The photon and $E = hf$ 2. The electronvolt 3. Measuring Planck's constant	Students should be able to: **2.5.1 Energy of a photon** • Describe the particulate nature (photon model) of electromagnetic radiation. • State that a photon is a quantum of energy of electromagnetic radiation. • Select and use the equations for the energy of a photon: $E = hf$ and $E = hc/\lambda$. • Define and use the electronvolt (eV) as a unit of energy. • Use the transfer equation $eV = \frac{1}{2} mv^2$ for electrons and other charged particles. • Describe an experiment using LEDs to estimate the Planck constant h using the equation $eV = hc/\lambda$ (no knowledge of semiconductor theory is expected).	• 2.5.1	• Practical 28: An estimate of the Planck constant using LEDs
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.5.1 Energy of a photon	

Week 27	Weekly learning outcomes	Student book links	Practical activity links
1. Observations from the photoelectric effect 2. Explaining the photoelectric effect and its implications for the wave nature of electromagnetic radiation 3. Energy changes in the photoelectric effect 4. Einstein's photoelectric equation 5. Photoelectric current	Students should be able to: **2.5.2 The photoelectric effect** • Describe and explain the phenomenon of the photoelectric effect. • Explain that the photoelectric effect provides evidence for a particulate nature of electromagnetic radiation, whereas phenomena such as interference and diffraction provide evidence for a wave nature. • Define and use the terms *work function* and *threshold frequency*. • State that energy is conserved when a photon interacts with an electron. • Select, explain and use Einstein's photoelectric equation $hf = \varphi + KE_{max}$. • Explain why the maximum kinetic energy of the electrons is independent of intensity and why the photoelectric current in a photocell circuit is proportional to intensity of the incident radiation.	• 2.5.2 • 2.5.3	**G482 Electrons, Waves and Photons** 2.5.2 The photoelectric effect
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.5.2 The photoelectric effect	

Week 28	Weekly learning outcomes	Student book links	Practical activity links
1. The electron as a particle 2. Electron diffraction 3. The de Broglie equation 4. Applications of electron diffraction	Students should be able to: **2.5.3 Wave–particle duality** • Explain electron diffraction as evidence for the wave nature of particles such as electrons. • Explain that electrons travelling through polycrystalline graphite will be diffracted by the atoms and the spacing between the atoms. • Select and apply the de Broglie equation $\lambda = h/mv$. • Explain that the diffraction of electrons by matter can be used to determine the arrangement of atoms and the size of nuclei.	• 2.5.4	
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.5.3 Wave–particle duality	

Week 29	Weekly learning outcomes	Student book links	Practical activity links
1. Observing spectral lines 2. Explaining an emission spectrum 3. Energy levels within atoms 4. Absorption spectra	Students should be able to: **2.5.4 Energy levels in atoms** • Explain how spectral lines are evidence for the existence of discrete energy levels in isolated atoms – i.e. in a gas discharge lamp. • Describe the origin of emission and absorption line spectra. • Use the relationships $hf = E_1 - E_2$ and $hc/\lambda = E_1 - E_2$.	• 2.5.5 • 2.5.6	
		OCR Scheme of Work topic outlines	
		G482 Electrons, Waves and Photons 2.5.4 Energy levels in atoms	