GCSE Combined Science: Physics

Curriculum Overview, Years 9–11

AQA GCSE Combined Science: Trilogy (8464) · Teaching sequence from the Curriculum Road Map (Physics: Combined Science)

Course at a glance

This overview sets out the physics content of AQA GCSE Combined Science: Trilogy (8464) in the order taught on the Combined Science route, with the specification content for each unit. Unit codes follow the textbook chapters; P11, P14 and P16 are Triple only and are not part of this course. Specification references are to the AQA 8464 specification.

Assessment

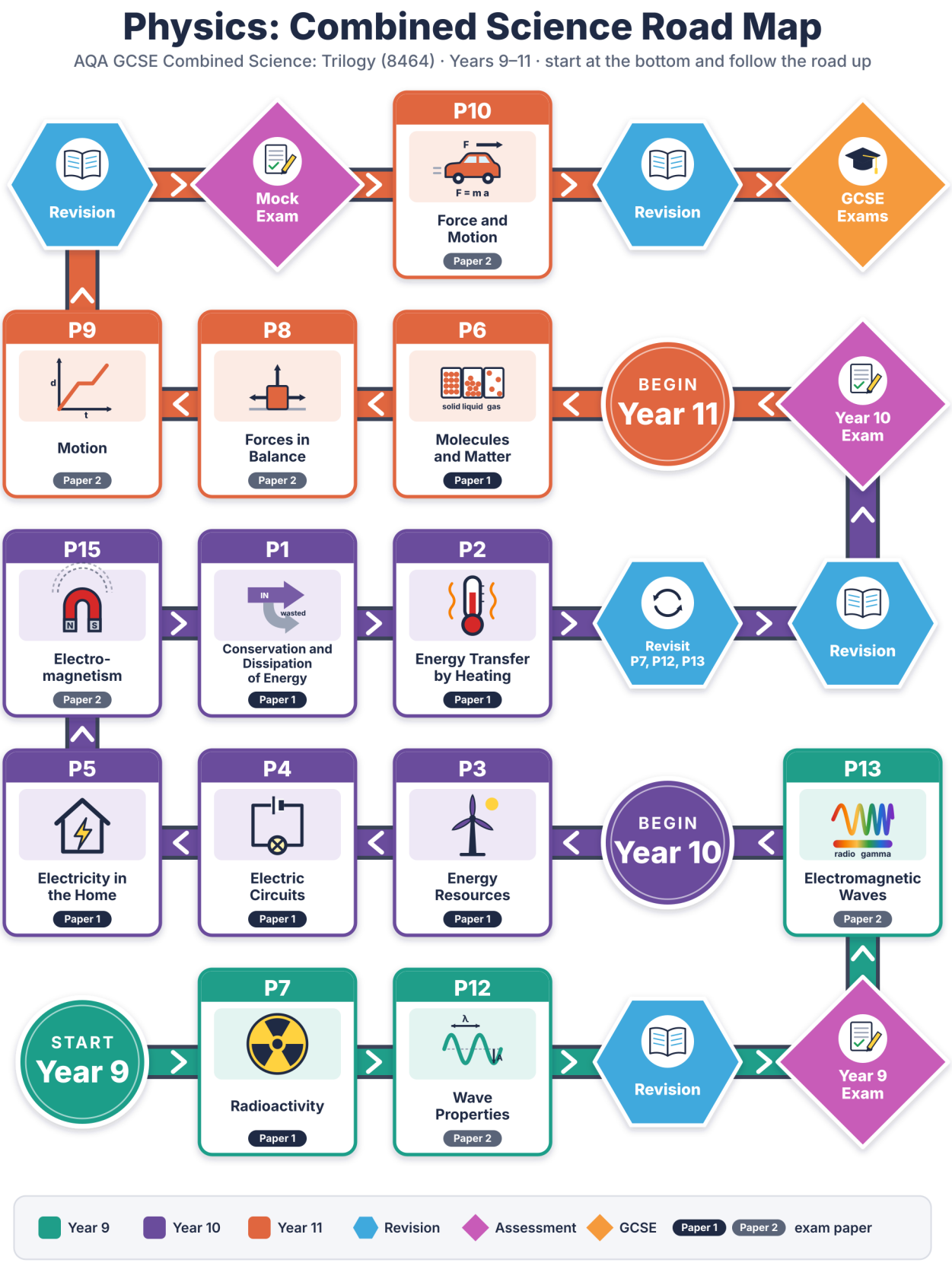
Paper	Specification content	Road map units	Format
Physics Paper 1	6.1 Energy 6.2 Electricity 6.3 Particle model of matter 6.4 Atomic structure	P1, P2, P3, P4, P5, P6, P7	Written exam, 1 h 15 min, 70 marks, 16.7% of the qualification
Physics Paper 2	6.5 Forces 6.6 Waves 6.7 Magnetism and electromagnetism	P8, P9, P10, P12, P13, P15	Written exam, 1 h 15 min, 70 marks, 16.7% of the qualification

- Combined Science: Trilogy is a double award worth two GCSEs, assessed by six papers (two each in biology, chemistry and physics). Grades are on a 17-point scale from 1–1 to 9–9: Foundation tier 1–1 to 5–5, Higher tier 4–4 to 9–9.
- Papers include multiple choice, structured, closed short answer and open response questions.
- At least 15% of marks draw on the 21 required practicals; RP14–RP21 are physics. Across the qualification at least 20% of marks assess mathematical skills (weighted 10% biology, 20% chemistry, 30% physics).
- Assessment objectives: AO1 knowledge and understanding 40%, AO2 application 40%, AO3 analysis, interpretation and evaluation 20%.
- Work done (6.5.2) is taught in P1 but assessed on Physics Paper 2.

Key to labels

HT only Assessed on the Higher tier paper only. A label beside a topic heading applies to the whole subsection; a label at the start of a bullet applies to that point only.

Teaching sequence



#	Unit	AQA spec ref	Paper	Required practicals
Year 9				
1	**P7 Radioactivity**	6.4	1	–
2	**P12 Wave Properties**	6.6.1	2	RP20
Revision → Year 9 assessment				
3	**P13 Electromagnetic Waves**	6.6.2	2	RP21
Year 10				
4	**P3 Energy Resources**	6.1.3	1	–
5	**P4 Electric Circuits**	6.2.1, 6.2.2	1	RP15, RP16
6	**P5 Electricity in the Home**	6.2.3, 6.2.4	1	–
7	**P15 Electromagnetism**	6.7	2	–
8	**P1 Conservation and Dissipation of Energy**	6.1.1, 6.1.2, 6.5.2	1	–
9	**P2 Energy Transfer by Heating**	6.1.1.3, 6.1.2.1	1	RP14
Revisit P7, P12 and P13 → Revision → Year 10 exams				
Year 11				
10	**P6 Molecules and Matter**	6.3	1	RP17
11	**P8 Forces in Balance**	6.5.1	2	–
12	**P9 Motion**	6.5.4.1	2	–
Revision → Year 11 mock exam				
13	**P10 Force and Motion**	6.5.3, 6.5.4.2–6.5.4.3, 6.5.5	2	RP18, RP19
Revision → GCSE exams (Physics Paper 1 and Paper 2)				

Year 9

Year 9 begins with radioactivity and wave properties, followed by revision and the Year 9 assessment, and then electromagnetic waves.

P7 Radioactivity

Specification: 6.4 **Exam:** Physics Paper 1 **Required practicals:** None

The first GCSE unit in Year 9: atomic structure, the development of the atomic model, radioactive decay, nuclear equations and half-life. Revisited at the end of Year 10.

Spec ref and topic	Content to be covered
6.4.1 **Atoms and isotopes**	• Atomic structure: radius about 1×10^{-10} m; nucleus, protons, neutrons and electrons; electrons can change orbit by absorbing or emitting EM radiation. • Atomic number, mass number and isotopes; atoms become positive ions by losing outer electrons. • Development of the model of the atom: plum pudding model, alpha scattering, Bohr's energy levels, Chadwick's neutron.
6.4.2.1–6.4.2.2 **Radioactive decay and nuclear equations**	• Unstable nuclei emit alpha particles, beta particles, gamma rays or neutrons; activity in becquerels; count rate. Penetration, range and ionising power of each type. • Balance nuclear equations for alpha and beta decay.
6.4.2.3 **Half-lives and the random nature of decay**	• Radioactive decay is random; half-life is the time for the number of unstable nuclei, or the count rate, to halve. Determine half-life from graphs. • **HT only** Calculate the net decline, as a ratio, after a given number of half-lives.
6.4.2.4 **Radioactive contamination**	• Contamination versus irradiation; precautions to protect against hazards; importance of peer review in publishing findings.

P12 Wave Properties

Specification: 6.6.1 **Exam:** Physics Paper 2 **Required practicals:** RP20 Waves

Transverse and longitudinal waves and their properties. Taught in Year 9 and revisited at the end of Year 10.

Spec ref and topic	Content to be covered
6.6.1.1 **Transverse and longitudinal waves**	• Waves transfer energy, not matter; oscillations are perpendicular (transverse) or parallel (longitudinal) to the direction of energy transfer.
6.6.1.2 **Properties of waves**	• Amplitude, wavelength, frequency and period ($T = 1/f$); wave speed $v = f\lambda$; measuring the speed of sound in air and of ripples on water. • **Required practical 20:** measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid.

Revision → Year 9 assessment. Revision and assessment on the units taught so far.

P13 Electromagnetic Waves

Specification: 6.6.2 **Exam:** Physics Paper 2 **Required practicals:** RP21 Infrared radiation

The electromagnetic spectrum, the properties, uses and dangers of electromagnetic waves. Taught at the end of Year 9 and revisited at the end of Year 10.

Spec ref and topic	Content to be covered
6.6.2.1 **Types of electromagnetic waves**	• EM waves are transverse and form a continuous spectrum; all travel at the same speed through a vacuum. Order: radio, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays.

Spec ref and topic	Content to be covered
6.6.2.2 **Properties of electromagnetic waves 1**	• Different substances absorb, transmit, refract or reflect EM waves depending on wavelength. • **Required practical 21:** investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. • HT only Explain refraction using wave front diagrams.
6.6.2.3 **Properties of electromagnetic waves 2**	• Changes in atoms and nuclei can generate or absorb EM radiation; ultraviolet, X-rays and gamma rays can have hazardous effects on body tissue; radiation dose in sieverts. • HT only Radio waves can be produced by oscillations in electrical circuits and can induce an alternating current in a receiver.
6.6.2.4 **Uses and applications of electromagnetic waves**	• Radio (TV and radio), microwaves (satellite communications, cooking), infrared (heaters, cooking, cameras), visible light (fibre optics), ultraviolet (energy-efficient lamps, sun tanning), X-rays and gamma rays (medical imaging and treatments). • HT only Explain why each type of EM wave is suitable for its practical application.

Year 10

Year 10 covers energy resources, electricity and electromagnetism, and finishes with energy and heating. P7, P12 and P13 are revisited before revision and the Year 10 exams.

P3 Energy Resources

Specification: 6.1.3 **Exam:** Physics Paper 1 **Required practicals:** None

The main energy resources, renewable and non-renewable, and the environmental, political, social and economic issues of using them.

Spec ref and topic	Content to be covered
6.1.3 **National and global energy resources**	• Main energy resources: fossil fuels, nuclear fuel, bio-fuel, wind, hydro-electricity, geothermal, tides, the Sun and water waves. • Distinguish renewable and non-renewable resources; uses for transport, electricity generation and heating. • Compare reliability and environmental impact; explain patterns and trends in use; consider environmental issues and the limits on what science can do.

P4 Electric Circuits

Specification: 6.2.1 and 6.2.2 **Exam:** Physics Paper 1 **Required practicals:** RP15 Resistance; RP16 I–V characteristics

Charge, current, potential difference and resistance, component characteristics, and series and parallel circuits.

Spec ref and topic	Content to be covered
6.2.1.1–6.2.1.2 **Circuit symbols, charge and current**	• Standard circuit diagram symbols. • Current is the rate of flow of charge: Q = It; current is the same at any point in a single closed loop.
6.2.1.3 **Current, resistance and potential difference**	• V = IR. • **Required practical 15:** investigate factors affecting resistance, including wire length and resistors in series and parallel.
6.2.1.4 **Resistors**	• Ohmic conductors; resistance of filament lamps, diodes, thermistors and LDRs; I–V graphs. • **Required practical 16:** investigate the I–V characteristics of a filament lamp, a diode and a resistor at constant temperature.
6.2.2 **Series and parallel circuits**	• Rules for current, potential difference and resistance in series and parallel circuits; $R_t$otal = R_1 + R_2 in series; adding resistors in parallel decreases total resistance. • Solve problems for circuits including resistors in series.

P5 Electricity in the Home

Specification: 6.2.3 and 6.2.4 **Exam:** Physics Paper 1 **Required practicals:** None

Direct and alternating current, mains electricity and safety, electrical power and energy transfers in appliances, and the National Grid.

Spec ref and topic	Content to be covered
6.2.3 **Domestic uses and safety**	• Direct and alternating potential difference; UK mains is ac at 50 Hz and about 230 V. • Three-core cables: live (brown), neutral (blue) and earth (green and yellow) wires and their functions; dangers of touching the live wire.
6.2.4.1–6.2.4.2 **Power and energy transfers in appliances**	• P = VI and P = I^2R; energy transferred E = Pt and E = QV. • Everyday appliances transfer energy to kinetic and thermal stores; power ratings and how much energy an appliance transfers depends on time and power.

Spec ref and topic	Content to be covered
6.2.4.3 **The National Grid**	• A system of cables and transformers; step-up transformers increase the potential difference for transmission, reducing current and energy loss; step-down transformers make it safer for domestic use.

P15 Electromagnetism

Specification: 6.7 **Exam:** Physics Paper 2 **Required practicals:** None

Magnets and magnetic fields, and electromagnetism. Higher tier adds Fleming's left-hand rule and electric motors.

Spec ref and topic	Content to be covered
6.7.1 **Permanent and induced magnetism, magnetic forces and fields**	• Poles of a magnet; attraction and repulsion; permanent and induced magnets. • Magnetic field patterns and direction; plotting fields with a compass; the Earth's magnetic field.
6.7.2.1 **Electromagnetism**	• A current in a wire produces a magnetic field; a solenoid increases the field strength, and an iron core makes an electromagnet.
6.7.2.2–6.7.2.3 **Fleming's left-hand rule and electric motors** HT only	• The motor effect: F = BIl; use Fleming's left-hand rule to find the direction of the force. • A coil carrying a current in a magnetic field rotates, which is the basis of an electric motor.

P1 Conservation and Dissipation of Energy

Specification: 6.1.1, 6.1.2 and 6.5.2 **Exam:** Physics Paper 1 **Required practicals:** None

Energy stores and transfers, work, power, conservation and dissipation of energy, and efficiency. Follows electricity so pupils can apply energy ideas to appliances.

Spec ref and topic	Content to be covered
6.1.1.1–6.1.1.2 **Energy stores, systems and changes in energy**	• Describe changes in the way energy is stored when a system changes (e.g. a falling object, a vehicle braking, water being heated). • Calculate kinetic energy ($E_k = ½ mv^2$), elastic potential energy ($E_e = ½ ke^2$) and gravitational potential energy ($E_p = mgh$).
6.5.2 **Work done and energy transfer**	• Work is done when a force moves an object: W = Fs; one joule of work is done when a force of one newton moves an object one metre. • Work done against friction causes a rise in temperature.
6.1.1.4 **Power**	• Power is the rate of energy transfer or work done: P = E/t and P = W/t; one watt is one joule per second.
6.1.2.1 **Energy transfers in a system**	• Energy can be transferred, stored or dissipated but cannot be created or destroyed; in all changes some energy is dissipated to the surroundings. • Reducing unwanted transfers by lubrication and thermal insulation; thermal conductivity (see P2).
6.1.2.2 **Efficiency**	• Efficiency = useful output energy transfer ÷ total input energy transfer (or using power). • HT only Describe ways to increase the efficiency of an intended energy transfer.

P2 Energy Transfer by Heating

Specification: 6.1.1.3 and 6.1.2.1 **Exam:** Physics Paper 1 **Required practicals:** RP14 Specific heat capacity

Conduction, specific heat capacity and insulating buildings.

Spec ref and topic	Content to be covered
6.1.1.3 **Energy changes in systems: specific heat capacity**	• The energy needed to raise the temperature of 1 kg of a substance by 1 °C: $\Delta E = mc\Delta\theta$. • **Required practical 14:** determine the specific heat capacity of one or more materials.
6.1.2.1 **Energy transfers by heating and insulation**	• Higher thermal conductivity means a higher rate of energy transfer by conduction; the rate of cooling of a building depends on wall thickness and thermal conductivity.

Revisit P7, P12 and P13 → Revision → Year 10 exams. The Year 9 units are revisited before revision and exams on the units taught so far.

Year 11

Year 11 starts with the particle model of matter, completing the Paper 1 content, then covers forces in balance and motion, followed by revision and the Year 11 mock, then force and motion, before revision for the GCSE exams.

P6 Molecules and Matter

Specification: 6.3 (except 6.3.2.2) **Exam:** Physics Paper 1 **Required practicals:** RP17 Density

Opens Year 11: density, changes of state, internal energy, specific latent heat and particle motion in gases.

Spec ref and topic	Content to be covered
6.3.1.1 **Density of materials**	• ρ = m/V; explain differences in density of solids, liquids and gases using the particle model. • **Required practical 17:** determine the densities of regular and irregular solid objects and liquids.
6.3.1.2 **Changes of state**	• Mass is conserved when substances change state; changes of state are physical changes that can be reversed.
6.3.2.1 **Internal energy**	• Internal energy is the total kinetic and potential energy of the particles; heating increases internal energy, raising temperature or changing state.
6.3.2.3 **Changes of state and specific latent heat**	• Specific latent heat: E = mL; latent heat of fusion and of vaporisation. Interpret heating and cooling graphs.
6.3.3.1 **Particle motion in gases**	• Gas molecules are in constant random motion; temperature is related to average kinetic energy; increasing temperature at constant volume increases pressure.

P8 Forces in Balance

Specification: 6.5.1 **Exam:** Physics Paper 2 **Required practicals:** None

Scalars and vectors, contact and non-contact forces, weight and resultant forces.

Spec ref and topic	Content to be covered
6.5.1.1–6.5.1.2 **Scalars, vectors and types of force**	• Scalars have magnitude only; vectors have magnitude and direction and can be shown by arrows. • Contact forces (friction, air resistance, tension, normal contact force) and non-contact forces (gravitational, electrostatic, magnetic).
6.5.1.3 **Gravity**	• Weight is the force acting on an object due to gravity: W = mg; weight acts at the object's centre of mass; weight is measured with a newtonmeter.
6.5.1.4 **Resultant forces**	• Calculate the resultant of forces acting along a line. • HT only Use free body diagrams; resolve a force into two components; use vector diagrams (parallelogram of forces) to show equilibrium.

P9 Motion

Specification: 6.5.4.1 **Exam:** Physics Paper 2 **Required practicals:** None

Describing motion: distance, displacement, speed, velocity and acceleration, and interpreting motion graphs.

Spec ref and topic	Content to be covered
6.5.4.1.1–6.5.4.1.3 **Distance, displacement, speed and velocity**	• Distance is scalar and displacement is a vector. Typical speeds for walking, running, cycling and transport; speed of sound in air. • s = vt; velocity is speed in a given direction. • HT only Motion in a circle involves constant speed but changing velocity.
6.5.4.1.4 **The distance–time relationship**	• The gradient of a distance–time graph gives speed. • HT only Find speed at a given time by drawing a tangent to a curved graph.

Spec ref and topic	Content to be covered
6.5.4.1.5 **Acceleration**	• $a = \Delta v/t$; $v^2 - u^2 = 2as$; acceleration near the Earth's surface due to gravity is about 9.8 m/s^2. • The gradient of a velocity–time graph gives acceleration. • HT only The area under a velocity–time graph gives distance travelled.

Revision → Year 11 mock exam. Revision and mock exam on the units taught so far.

P10 Force and Motion

Specification: 6.5.3, 6.5.4.2, 6.5.4.3 and 6.5.5 **Exam:** Physics Paper 2 **Required practicals:** RP18 Force and extension; RP19 Acceleration

Newton's laws, stopping distances, momentum (Higher tier) and the elasticity of springs. The final new content before the GCSE exams.

Spec ref and topic	Content to be covered
6.5.4.2 **Newton's laws of motion**	• First law: an object stays at rest or at constant velocity unless a resultant force acts. Second law: F = ma. Third law: equal and opposite forces in interactions. • **Required practical 19:** investigate the effect of varying force on the acceleration of an object of constant mass, and of varying mass with constant force. • HT only Inertia; inertial mass as the ratio of force to acceleration.
6.5.4.3 **Forces and braking**	• Stopping distance = thinking distance + braking distance; factors affecting reaction time (tiredness, drugs, alcohol, distractions) and braking distance (road conditions, tyres, brakes, speed). • Braking reduces kinetic energy through work done by friction; large decelerations can cause brakes to overheat or skid. • HT only Estimate the forces involved in the deceleration of road vehicles.
6.5.5 **Momentum** HT only	• p = mv; in a closed system, total momentum before an event equals total momentum after (conservation of momentum).
6.5.3 **Forces and elasticity**	• Elastic and inelastic deformation; F = ke up to the limit of proportionality; work done in stretching a spring is stored as elastic potential energy. • **Required practical 18:** investigate the relationship between force and extension for a spring.

Revision → GCSE exams. Physics Paper 1 covers specification 6.1–6.4 (P1–P7); Physics Paper 2 covers 6.5–6.7 (P8, P9, P10, P12, P13 and P15).

Required practical activities

Combined Science: Trilogy has 21 required practicals; RP14–RP21 are physics. Questions drawing on them make up at least 15% of the exam marks.

RP	Activity	Spec ref	Taught in
14	Determine the specific heat capacity of one or more materials	6.1.1.3	P2 Energy Transfer by Heating (Y10)
15	Investigate factors affecting resistance, including wire length and resistors in series and parallel	6.2.1.3	P4 Electric Circuits (Y10)
16	Investigate the I–V characteristics of a filament lamp, a diode and a resistor	6.2.1.4	P4 Electric Circuits (Y10)
17	Determine the densities of regular and irregular solid objects and liquids	6.3.1.1	P6 Molecules and Matter (Y11)
18	Investigate the relationship between force and extension for a spring	6.5.3	P10 Force and Motion (Y11)
19	Investigate the effect of varying force on acceleration (constant mass) and of varying mass (constant force)	6.5.4.2.2	P10 Force and Motion (Y11)
20	Measure the frequency, wavelength and speed of waves in a ripple tank and in a solid	6.6.1.2	P12 Wave Properties (Y9)
21	Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface	6.6.2.2	P13 Electromagnetic Waves (Y9)

Specification coverage map

Every physics subsection of the AQA 8464 subject content, with the unit that teaches it. All 21 subsections are covered.

Spec	Title	Unit	Year	Paper
6.1.1	Energy changes in a system, and the ways energy is stored (6.1.1.3 specific heat capacity in P2)	P1, P2	10	1
6.1.2	Conservation and dissipation of energy	P1, P2	10	1
6.1.3	National and global energy resources	P3	10	1
6.2.1	Current, potential difference and resistance	P4	10	1
6.2.2	Series and parallel circuits	P4	10	1
6.2.3	Domestic uses and safety	P5	10	1
6.2.4	Energy transfers	P5	10	1
6.3.1	Changes of state and the particle model	P6	11	1
6.3.2	Internal energy and energy transfers (6.3.2.2 specific heat capacity in P2)	P6, P2	10–11	1
6.3.3	Particle model and pressure	P6	11	1
6.4.1	Atoms and isotopes	P7	9	1
6.4.2	Atoms and nuclear radiation	P7	9	1
6.5.1	Forces and their interactions	P8	11	2
6.5.2	Work done and energy transfer	P1	10	2
6.5.3	Forces and elasticity	P10	11	2
6.5.4	Forces and motion	P9, P10	11	2
6.5.5	Momentum HT only	P10	11	2
6.6.1	Waves in air, fluids and solids	P12	9	2
6.6.2	Electromagnetic waves	P13	9	2
6.7.1	Permanent and induced magnetism, magnetic forces and fields	P15	10	2
6.7.2	The motor effect	P15	10	2

Textbook, revision guides and websites

Textbooks used in class

- AQA GCSE Biology Student Book (AQA GCSE Science 3rd Edition), Ann Fullick; series editor Lawrie Ryan (Oxford University Press)
- AQA GCSE Chemistry Student Book (AQA GCSE Science 3rd Edition), Lawrie Ryan (Oxford University Press)
- AQA GCSE Physics Student Book (AQA GCSE Science 3rd Edition), Jim Breithaupt; series editor Lawrie Ryan (Oxford University Press)

Recommended revision guide

- Collins AQA GCSE 9-1 Combined Science Trilogy Complete Revision & Practice (Higher or Foundation)

Useful websites

- **Physics & Maths Tutor:** GCSE Science past paper questions with mark schemes; some have video solutions. https://www.physicsandmathstutor.com/
- **AQA:** all past papers and mark schemes. https://www.aqa.org.uk/subjects/science/gcse/science-8464/assessment-resources
- **Revisely:** Free Science Lessons revision videos. https://www.revisely.com/gcse/combined-science/aqa
- **GCSE Physics Online:** revision videos; the school pays for a subscription and students are given the login in class. https://www.gcsephysicsonline.com/aqa
- **Also useful:** Seneca Learning, Cognito and the Free Science Lessons YouTube channel.

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