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AQA GCSE (9-1) PHYSICS 8463

SEPARATE SCIENCE / TRIPLE SCIENCE

MASTER SPECIFICATION & PRACTICAL REFERENCE

Foundation + Higher | Paper 1 + Paper 2 | Separate / Triple Science

8 topics | 10 required practicals | current equation-sheet regime | specification-mapped revision audits

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Research status: checked against public AQA material available on 1 November 2026.

How to use this reference

Use this as a curriculum audit, not as a substitute for teaching. Each entry identifies what the AQA specification requires, the level of performance that should be secure before a topic is marked complete, common diagnostic risks, and an exam-style revision test written independently for this publication.

- Paper 1: Topics 1-4 (Energy, Electricity, Particle model of matter, Atomic structure), 100 marks, 1 h 45 min, 50%.
- Paper 2: Topics 5-8 (Forces, Waves, Magnetism/electromagnetism, Space physics), 100 marks, 1 h 45 min, 50%.
- Both papers are offered at Foundation and Higher tier. Space physics is part of the separate Physics GCSE, not Combined Science.
- Paper 2 may draw on energy conservation and energy transfers from Paper 1.

Sources: GLANCE; SPEC

Required practical map

#	Required practical	Status	AT focus
1	Specific heat capacity	Common with Combined Science	AT1, AT5
2	Thermal insulation effectiveness	Physics only	AT1, AT5
3	Resistance: wire length + series/parallel	Common	AT1, AT6, AT7
4	I-V characteristics: resistor, lamp, diode	Common	AT6, AT7
5	Density of regular/irregular solids and liquids	Common	AT1
6	Force-extension for spring	Common	AT1, AT2
7	Force/mass and acceleration	Common	AT1, AT2, AT3
8	Wave frequency/wavelength/speed measurements	Common	AT4
9	Reflection and refraction of light	Physics only	AT4, AT8
10	Infrared absorption/emission by surfaces	Common	AT1, AT4

Source: PRACT; RPG

4.1.1 Energy stores, systems and changes

Tier / paper	F/H | Paper 1

Understand energy stores, transfers and quantitative changes in mechanical and thermal systems.

Secure performance

- Identify initial/final energy stores without treating energy as a substance that is "used up".
- Calculate kinetic, gravitational potential and elastic potential energy; select SI units.
- Apply conservation of energy to multi-step transfers and compare useful/dissipated pathways.

High-risk mistakes

- Calling pathways "types of energy" rather than stores/transfers.
- Missing squared terms in kinetic/elastic energy.
- Using centimetres or grams without converting where the equation requires SI units.

Exam / revision test

Given an unfamiliar system, explain the energy-store changes, then complete a calculation and justify where dissipated energy has gone.

Required-practical link

Required practical 1: specific heat capacity links electrical work/energy transfer to temperature rise.

Source mapping: SPEC; EQ

4.1.2 Energy transfer, efficiency and resources

Tier / paper	F/H | Paper 1

Compare useful and wasted transfers, efficiency, insulation, power generation and environmental/operational trade-offs.

Secure performance

- Calculate efficiency as decimal or percentage.
- Explain conduction/convection/radiation effects using appropriate physics.
- Evaluate renewable and non-renewable resources with evidence-based advantages, disadvantages and reliability.

High-risk mistakes

- Giving generic environmental statements with no link to the resource.
- Confusing power with energy.
- Assuming a device can be more than 100% efficient.

Exam / revision test

Evaluate two energy-resource options for a stated context and calculate one efficiency/power quantity from data.

Required-practical link

Required practical 2 (Physics only): thermal insulation effectiveness and factors affecting insulation.

Source mapping: SPEC; PRACT; EQ

4.2.1 Charge, current, potential difference and resistance

Tier / paper	F/H | Paper 1

Develop the circuit model linking charge flow, current, potential difference and resistance.

Secure performance

- Use Q=It and V=IR with correct units.
- Read/construct circuit diagrams and place ammeters/voltmeters correctly.
- Explain resistance changes in filament lamps, thermistors and LDRs from physical behaviour.

High-risk mistakes

- Putting a voltmeter in series or ammeter in parallel.
- Treating current as "used up" in components.
- Describing curved I-V graphs without relating slope/resistance.

Exam / revision test

Interpret an I-V graph, determine resistance at a stated operating point and explain the shape physically.

Required-practical link

Required practicals 3 and 4: resistance factors and I-V characteristics.

Source mapping: SPEC; EQ

4.2.2 Series and parallel circuits

Tier / paper	F/H | Paper 1

Apply current, potential difference and resistance rules to series and parallel networks.

Secure performance

- Use conservation of charge/current at junctions.
- Recognise potential-difference sharing in series and equality across parallel branches.
- Calculate combined resistances and reason about changes when branches/components are added.

High-risk mistakes

- Adding resistances in parallel as if they were series.
- Assuming current is identical everywhere in a parallel circuit.
- Failing to distinguish total current from branch current.

Exam / revision test

Solve a mixed network from supplied measurements and explain qualitatively what happens after adding a parallel branch.

Required-practical link

Required practical 3 includes resistor combinations in series and parallel.

Source mapping: SPEC; EQ

4.2.3 Domestic electricity, power and energy transfer

Tier / paper	F/H | Paper 1

Understand AC mains, live/neutral/earth, safety, power and electrical energy.

Secure performance

- Explain function and danger of live/neutral/earth wires.
- Use P=VI, $P=I^2R$, E=Pt and E=QV as appropriate.
- Connect rating, current, fuse/circuit protection and energy cost logically.

High-risk mistakes

- Memorising wire colours without understanding potential.
- Using kW as though it were W.
- Confusing kWh (energy) with kW (power).

Exam / revision test

Calculate appliance current and energy use, then explain the safety role of earth/fuse in a fault.

Source mapping: SPEC; EQ

4.2.5 Static electricity and electric fields

Tier / paper	Physics only; mainly H extension | Paper 1

Explain charging by electron transfer, forces between charges and electric fields.

Secure performance

- State that electrons move; protons remain bound in nuclei.
- Distinguish attraction/repulsion from induction effects.
- Describe electric-field direction and force on a charge.

High-risk mistakes

- Saying positive charge moves between insulating materials.
- Confusing current electricity with static charge.
- Drawing field lines crossing or in the wrong direction.

Exam / revision test

Explain a charging sequence at particle level and interpret/draw an electric-field diagram.

Source mapping: SPEC

4.3.1 Density and particle model

Tier / paper	F/H | Paper 1

Use density and particle arrangements to explain macroscopic properties.

Secure performance

- Calculate density for solids/liquids using appropriate volume method.
- Describe particles in solids, liquids and gases with spacing, arrangement and motion.
- Connect state and density without claiming particles themselves expand.

High-risk mistakes

- Using displaced volume incorrectly.
- Forgetting cm^3-to-m^3 or g-to-kg conversions when needed.
- Saying particles "get bigger" when heated.

Exam / revision test

Choose apparatus for regular/irregular objects, calculate density and explain a density difference using the particle model.

Required-practical link

Required practical 5: densities of regular/irregular solids and liquids.

Source mapping: SPEC; PRACT; EQ

4.3.2 Internal energy, changes of state and latent heat

Tier / paper	F/H | Paper 1

Explain heating/cooling in terms of internal energy and quantify specific heat capacity/latent heat.

Secure performance

- Distinguish temperature change from change of state.
- Use $\Delta E = mc\Delta\theta$ and $E = mL$.
- Explain heating curves and why temperature is constant during a state change.

High-risk mistakes

- Using latent-heat equations during temperature change.
- Assuming temperature rises during boiling.
- Confusing specific heat capacity with specific latent heat.

Exam / revision test

Interpret a heating graph, identify energy-transfer stages and calculate energy for one temperature-change and one state-change stage.

Required-practical link

Required practical 1 measures specific heat capacity.

Source mapping: SPEC; EQ

4.3.3 Gas pressure, temperature and pressure-volume relation

Tier / paper	F/H, with pressure-volume relation HT | Paper 1

Use particle collisions to explain gas pressure and quantitative changes.

Secure performance

- Explain pressure as momentum change from particle-wall collisions.
- Relate temperature to average kinetic energy qualitatively.
- For HT, use pV=constant at constant temperature with consistent units.

High-risk mistakes

- Saying particles speed up because pressure increases rather than vice versa.
- Applying pV=constant when temperature changes.
- Mixing absolute and gauge ideas not required by the question.

Exam / revision test

Explain a sealed-gas pressure change microscopically; HT students also solve a pressure-volume problem.

Source mapping: SPEC; EQ

4.4.1 Atomic structure, isotopes and development of the model

Tier / paper	F/H | Paper 1

Know subatomic structure and how evidence changed atomic models.

Secure performance

- Use proton/neutron/electron numbers correctly for atoms/ions/isotopes.
- Explain Rutherford scattering evidence and model change.
- Use order-of-magnitude scale ideas for atoms and nuclei.

High-risk mistakes

- Confusing isotope with ion.
- Saying most alpha particles were deflected.
- Attributing nuclear charge to neutrons.

Exam / revision test

Use nuclide information to determine composition, then explain how scattering evidence contradicted the plum-pudding model.

Source mapping: SPEC

4.4.2 Radioactive decay, half-life and nuclear radiation

Tier / paper	F/H | Paper 1

Interpret random decay, alpha/beta/gamma properties, half-life and hazard.

Secure performance

- Balance nuclear equations for alpha/beta emission.
- Use half-life graphs/data without assuming linear decrease.
- Distinguish contamination from irradiation and choose precautions by radiation type.

High-risk mistakes

- Treating half-life as time until all nuclei decay.
- Confusing penetration with ionising power.
- Giving generic "protective clothing" without matching the hazard.

Exam / revision test

Determine half-life/activity from data and justify a source/shielding choice using penetration and ionisation.

Source mapping: SPEC; ER22

4.4.3 Nuclear fission and fusion

Tier / paper	F/H; deeper mechanisms commonly H | Paper 1

Explain chain reactions, reactor control and fusion conditions.

Secure performance

- Describe fission sequence including neutron absorption, unstable nucleus, products and released neutrons.
- Explain control rods/moderator roles without mixing them.
- Explain why fusion requires very high temperature/pressure and releases energy.

High-risk mistakes

- Saying control rods slow neutrons (moderator does).
- Claiming fusion happens in ordinary reactors.
- Omitting mass/energy ideas and chain-reaction logic.

Exam / revision test

Describe a controlled fission chain reaction and compare it with fusion in stars.

Source mapping: SPEC

4.5.1 Forces as vectors, gravity and resultants

Tier / paper	F/H | Paper 2

Represent forces as vectors and determine resultant force/equilibrium.

Secure performance

- Distinguish scalar mass from vector weight.
- Use W=mg and vector diagrams accurately.
- Explain zero resultant as constant velocity or rest, not necessarily stationary.

High-risk mistakes

- Equating zero resultant with zero motion.
- Confusing contact/non-contact forces.
- Adding vector magnitudes without considering direction.

Exam / revision test

Draw a free-body/vector representation and infer motion from the resultant.

Source mapping: SPEC; EQ; ER23P2

4.5.2 Work done, springs and elastic energy

Tier / paper	F/H | Paper 2

Connect force, displacement, work and elastic deformation.

Secure performance

- Use W=Fs and F=ke; identify limit of proportionality.
- Interpret force-extension graphs and area/energy ideas where required.
- Explain elastic vs inelastic deformation.

High-risk mistakes

- Using spring length instead of extension.
- Assuming Hooke law beyond proportional region.
- Confusing gradient direction in force-extension graphs.

Exam / revision test

Analyse a spring graph, find k in the linear region and explain what happens beyond the limit of proportionality.

Required-practical link

Required practical 6: force-extension relationship for a spring.

Source mapping: SPEC; EQ

4.5.3 Moments, levers, gears and pressure

Tier / paper	F/H; liquid pressure HT | Paper 2

Apply turning effects and pressure relationships.

Secure performance

- Use moment=force×perpendicular distance.
- Apply pressure=force/area and explain area effects.
- HT: use liquid pressure p=hρg and explain depth/density dependence.

High-risk mistakes

- Using total lever length rather than perpendicular pivot distance.
- Reversing pressure/area relationship.
- Forgetting that pressure acts normal to a surface.

Exam / revision test

Solve a balanced lever problem, then a pressure problem; HT add liquid-pressure calculation/explanation.

Source mapping: SPEC; EQ; ER23P2

4.5.4 Motion, distance-time and velocity-time graphs

Tier / paper	F/H | Paper 2

Describe motion quantitatively and graphically.

Secure performance

- Calculate speed/velocity/acceleration with units.
- Use gradient on distance-time and velocity-time graphs correctly.
- Use area under velocity-time graph for displacement/distance in appropriate contexts.

High-risk mistakes

- Confusing distance and displacement.
- Using distance=speed×time when speed is varying without segmenting/integration by area.
- Misreading graph scales.

Exam / revision test

Interpret a multi-stage velocity-time graph, calculate acceleration and area, and describe the motion precisely.

Source mapping: SPEC; EQ; ER23P2

4.5.5 Newton laws, stopping distance and reaction

Tier / paper	F/H | Paper 2

Apply force-mass-acceleration and factors affecting stopping.

Secure performance

- Use F=ma and distinguish balanced from unbalanced forces.
- Explain inertia and Newton third-law force pairs correctly.
- Separate thinking distance and braking distance and factors affecting each.

High-risk mistakes

- Using third-law pairs on the same object.
- Saying a moving object needs a resultant force to keep moving at constant speed.
- Calling reaction time "slower" without saying longer/increased.

Exam / revision test

Explain a stopping-distance scenario and solve a resultant-force/acceleration problem.

Required-practical link

Required practical 7: effect of force/mass on acceleration.

Source mapping: SPEC; EQ; ER23P2

4.5.6 Momentum and impact

Tier / paper	Mostly HT | Paper 2

Use momentum conservation and force/change-in-momentum relationships.

Secure performance

- Use p=mv with direction/sign when relevant.
- Apply conservation in closed systems.
- Use force = change in momentum / time and explain safety features by increasing stopping time.

High-risk mistakes

- Treating momentum as scalar in collision problems.
- Applying conservation when external forces dominate.
- Saying airbags reduce momentum change rather than increasing time for the same change.

Exam / revision test

Solve a collision/explosion momentum problem and explain a safety feature quantitatively/qualitatively.

Source mapping: SPEC; EQ

4.6.1 Wave properties, reflection and refraction

Tier / paper	F/H; reflection/refraction physics only content | Paper 2

Describe transverse/longitudinal waves and quantify wave relationships.

Secure performance

- Identify amplitude/wavelength and use v=fλ, T=1/f.
- Explain reflection/refraction/transmission/absorption at boundaries.
- HT: explain refraction using speed change and wavefronts.

High-risk mistakes

- Confusing frequency with wave speed.
- Saying wavelength stays fixed when speed changes at constant frequency.
- Drawing reflected/refracted rays without normals/angles.

Exam / revision test

Calculate wave speed/period and construct a labelled reflection/refraction diagram with explanation.

Required-practical link

Required practicals 8 and 9: wave measurements; reflection/refraction (physics only practical 9).

Source mapping: SPEC; EQ

4.6.2 Electromagnetic spectrum and applications

Tier / paper	F/H | Paper 2

Order EM waves, link frequency/wavelength, uses and hazards.

Secure performance

- Recall order and common uses/hazards.
- Explain interactions with matter and wavelength-dependent behaviour.
- Evaluate applications using penetration, absorption and ionisation.

High-risk mistakes

- Ordering by frequency in the wrong direction.
- Assuming all EM waves are ionising.
- Giving a memorised use with no physical reason.

Exam / revision test

Choose the best EM band for a technology/medical application and justify using properties and risks.

Source mapping: SPEC

4.6.3 Lenses, visible light and black-body radiation

Tier / paper	Physics only | Paper 2

Understand ray diagrams, image properties, colour/filter behaviour and thermal radiation.

Secure performance

- Draw principal rays for convex/concave lenses and describe real/virtual images.
- Use magnification relationship.
- Explain black-body emission/absorption and temperature-spectrum changes.

High-risk mistakes

- Confusing real and virtual images.
- Drawing rays that do not obey lens conventions.
- Assuming a perfect black body looks black at all temperatures.

Exam / revision test

Complete a lens ray diagram and explain how temperature affects the wavelength/intensity distribution of emitted radiation.

Source mapping: SPEC; EQ

4.7.1 Permanent/induced magnetism and magnetic fields

Tier / paper	F/H | Paper 2

Describe field patterns and magnetic interactions.

Secure performance

- Know magnetic poles and field direction.
- Distinguish permanent and induced magnets.
- Explain compass behaviour in fields.

High-risk mistakes

- Using electric-charge language for magnetic poles.
- Saying induced magnets always retain magnetism.
- Drawing field lines from south to north outside the magnet.

Exam / revision test

Sketch and interpret magnetic fields around bar magnets and current-carrying conductors.

Source mapping: SPEC

4.7.2 Electromagnetism and motor effect

Tier / paper	F/H; quantitative motor equation HT | Paper 2

Relate current, magnetic field and force.

Secure performance

- Describe field around wire/solenoid and factors changing strength.
- Use Fleming left-hand rule qualitatively.
- HT: use F=BIl for perpendicular conductor and reason about variables.

High-risk mistakes

- Confusing motor effect with induction.
- Changing current direction but not updating force direction.
- Using F=BIl when wire is not perpendicular without considering context.

Exam / revision test

Predict force direction in a motor arrangement; HT calculate force and explain how to increase it.

Source mapping: SPEC; EQ

4.7.3 Electromagnetic induction, generators and transformers

Tier / paper	Mostly HT | Paper 2

Explain induced potential, generator effect, microphones and transformer operation.

Secure performance

- Explain that changing magnetic flux induces potential difference/current.
- Predict effect of speed, field strength and turns.
- Use transformer ratios and power relationships with appropriate assumptions.

High-risk mistakes

- Saying a stationary magnet beside a stationary coil induces current.
- Confusing input/output coil turns.
- Ignoring energy conservation/efficiency when interpreting transformer power.

Exam / revision test

Explain a generator waveform and solve a transformer turns/voltage/current problem.

Source mapping: SPEC; EQ

4.8 Space physics

Tier / paper	Physics only | Paper 2

Understand solar system, stars, orbits, red-shift and cosmology evidence.

Secure performance

- Describe formation/evolution of stars by mass.
- Explain stable orbits using gravity and velocity.
- Explain red-shift as evidence for recession/expansion and relate to Big Bang evidence.

High-risk mistakes

- Saying planets are pulled forward by gravity rather than inward.
- Mixing stellar life cycles for low/high-mass stars.
- Treating red-shift as proof of speed increasing rather than wavelength change indicating recession.

Exam / revision test

Construct a stellar life-cycle sequence for two star masses and explain how red-shift observations support an expanding universe.

Source mapping: SPEC

Working scientifically & maths audit

Experimental design

- Identify independent, dependent and control variables.
- Choose apparatus with suitable range/resolution.
- Plan repeats, mean values and anomaly handling.
- Distinguish random error, systematic error, accuracy, precision, repeatability and reproducibility.

Graphs/data

- Choose axes and scales; include units.
- Plot accurately and draw an appropriate line/curve of best fit.
- Use gradient and area only where physically meaningful.
- Translate among verbal, tabular, graphical and algebraic representations.

Calculations

- Select the right relationship before substituting.
- Convert prefixes/units before calculation.
- Rearrange algebra correctly at Higher demand.
- Use significant figures consistent with the data and context.

Extended responses

- Answer the command word: describe, explain, compare, evaluate, determine.
- Use linked physics statements rather than keyword lists.
- Reference supplied data explicitly where the question provides evidence.
- Keep terminology precise: energy transfer/store, distance/displacement, mass/weight, current/charge, etc.

Source register

Source keys are used throughout the handbook so that curriculum, data and examiner-evidence statements can be audited. URLs are provided for verification; this publication paraphrases rather than reproduces protected assessment material.

Key	Source	URL
SPEC	AQA GCSE Physics 8463 specification (current web specification; first teaching 2016).	https://www.aqa.org.uk/subjects/physics/gcse/physics-8463/specification
GLANCE	AQA GCSE Physics 8463 specification at a glance: paper structure and topic split.	https://www.aqa.org.uk/subjects/physics/gcse/physics-8463/specification/specification-at-a-glance
PRACT	AQA GCSE Physics 8463 practical assessment: apparatus/techniques and 10 required practicals.	https://www.aqa.org.uk/subjects/physics/gcse/physics-8463/specification/practical-assessment
EQ	AQA GCSE Physics 8463 Appendix A: Physics equations.	https://www.aqa.org.uk/subjects/physics/gcse/physics-8463/specification/appendix-a-physics-equations
EQPOL	AQA, GCSE Maths and GCSE Sciences formulae and equation sheets for 2027 and 2028 onwards, published 1 Sep 2026.	https://www.aqa.org.uk/news/gcse-maths-sciences-formulae-equation-sheets-2027-28
GB	AQA grade-boundary publications, June 2022-2026.	https://www.aqa.org.uk/exams-administration/results-days/grade-boundaries
RS	AQA results-statistics publications, June 2022-2026.	https://www.aqa.org.uk/exams-administration/results-days/results-statistics
ER22	AQA GCSE Physics 8463 examiner reports, June 2022 (Paper 1 Higher and related reports).	https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2022/june/AQA-84631H-WRE-JUN22.PDF
ER23P1	AQA GCSE Physics 8463 examiner report, June 2023 Paper 1 Higher.	https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2023/june/AQA-84631H-WRE-JUN23.PDF
ER23P2	AQA GCSE Physics 8463 examiner report, June 2023 Paper 2 Higher.	https://filestore.aqa.org.uk/sample-papers-and-mark-schemes/2023/june/AQA-84632H-WRE-JUN23.PDF
RPG	AQA GCSE Physics required practical activities teacher/student practical resource.	https://filestore.aqa.org.uk/resources/physics/AQA-8463-PRACTICALS.PDF

Appendix: Detailed required-practical reference

AQA requires all students taking GCSE Physics 8463 to complete ten required practical activities. The practical questions in exams can test planning, apparatus choice, variables, graphical processing, uncertainty/error, interpretation and evaluation—not simply recall of a memorised method. The cards below are independently written study summaries of the official practical requirements.

RP1: Specific heat capacity

Aim and specification purpose: Determine the specific heat capacity of one or more materials by linking energy transferred to temperature change.

Variables / quantities: mass, initial/final temperature, current, potential difference, heating time; energy transfer and temperature change.

Method logic: Measure mass; place heater/thermometer with good thermal contact; record V and I; heat for measured time; record temperature change. Insulate where possible.

Analysis expected: Use electrical work E = VIt (or P t) and DeltaE = mcDeltaT; alternatively use graph gradient where method supplies repeated data.

Evaluation / high-risk errors: Heat loss to surroundings; energy warming heater/thermometer; poor contact; temperature lag; inconsistent insulation.

Source mapping: PRACT; RPG; relevant subject-content section.

RP2: Thermal insulation (Physics only)

Aim and specification purpose: Compare insulation effectiveness and investigate factors affecting thermal insulation.

Variables / quantities: insulation material/thickness as IV; temperature fall/rate as DV; starting temperature, container, liquid volume, area and time controlled.

Method logic: Use identical containers/conditions; apply one controlled change; record temperature over equal time; repeat where possible.

Analysis expected: Compare temperature decrease or cooling rate; use graph/mean values if repeated.

Evaluation / high-risk errors: Different starting temperatures, lid effects, surface area, drafts, probe position, uncontrolled thickness.

Source mapping: PRACT; RPG; relevant subject-content section.

RP3: Resistance

Aim and specification purpose: Investigate factors affecting resistance: wire length at constant temperature and resistor combinations in series/parallel.

Variables / quantities: wire length; V/I measurements; temperature control; circuit configuration.

Method logic: Build circuit from diagram; measure p.d. and current; calculate R=V/I; vary one factor; keep current low enough to limit heating.

Analysis expected: Plot resistance vs length where appropriate; compare combined resistances in series/parallel.

Evaluation / high-risk errors: Wire heating; contact resistance; measuring length from wrong points; ammeter/voltmeter placement.

Source mapping: PRACT; RPG; relevant subject-content section.

RP4: I-V characteristics

Aim and specification purpose: Determine I-V behaviour for a resistor at constant temperature, filament lamp and diode.

Variables / quantities: potential difference/current; component type/polarity; temperature where relevant.

Method logic: Vary supply or resistance; record paired V and I values through positive/negative ranges where appropriate; reverse diode polarity safely.

Analysis expected: Plot I against V; identify ohmic straight line, filament changing gradient, diode threshold/asymmetry.

Evaluation / high-risk errors: Heating changes filament/resistor behaviour; incorrect polarity; scale/axis errors; treating curved graph as directly proportional.

Source mapping: PRACT; RPG; relevant subject-content section.

RP5: Density

Aim and specification purpose: Determine density of regular/irregular solids and liquids using suitable measurement methods.

Variables / quantities: mass and volume; dimensions for regular object; displacement for irregular object; liquid mass by difference.

Method logic: Zero balance; measure dimensions with suitable ruler/calipers/micrometer; use displacement for irregular object; measure liquid volume and mass.

Analysis expected: Calculate rho=m/V with consistent units; repeat dimensions/volume readings where sensible.

Evaluation / high-risk errors: Meniscus/parallax; trapped air; string displacement; balance zero; unit conversion for cm3/m3.

Source mapping: PRACT; RPG; relevant subject-content section.

RP6: Force and extension

Aim and specification purpose: Investigate relationship between force and extension for a spring.

Variables / quantities: force/load as IV; extension as DV; original length and alignment controlled.

Method logic: Measure original length; add loads incrementally; allow oscillations to settle; record new length; calculate extension; avoid excessive loading.

Analysis expected: Plot force-extension; identify linear proportional region and limit of proportionality; determine k from gradient depending axis convention.

Evaluation / high-risk errors: Using total length instead of extension; parallax; loading past elastic limit; inconsistent zero/reference point.

Source mapping: PRACT; RPG; relevant subject-content section.

RP7: Force, mass and acceleration

Aim and specification purpose: Investigate acceleration when force varies at constant mass and when mass varies at constant force.

Variables / quantities: resultant force, total moving mass, acceleration; track/friction conditions.

Method logic: Use trolley/system with motion sensor/light gates; vary one quantity at a time; measure acceleration; repeat.

Analysis expected: Test a proportional to F at constant m and a inversely related to m at constant F; apply F=ma.

Evaluation / high-risk errors: Not including hanging masses in system mass where relevant; friction; sloping track; poor timing; changing both force and mass unintentionally.

Source mapping: PRACT; RPG; relevant subject-content section.

RP8: Wave measurements

Aim and specification purpose: Measure frequency, wavelength and speed for waves in a ripple tank and waves in a solid.

Variables / quantities: frequency, wavelength, timing/distance measurements; medium conditions.

Method logic: Generate stable waves; measure several wavelengths then divide; use known/set frequency; for solid waves use suitable vibration/timing arrangement.

Analysis expected: Use v=f lambda; average repeated wavelength measurements; compare methods/apparatus suitability.

Evaluation / high-risk errors: Counting crests vs intervals; measuring one wavelength only; perspective/parallax; unstable pattern; wrong units.

Source mapping: PRACT; RPG; relevant subject-content section.

RP9: Reflection and refraction of light (Physics only)

Aim and specification purpose: Investigate reflection from surfaces and refraction through substances.

Variables / quantities: incident angle/material/surface as IV; reflected/refracted angle as DV; ray geometry controlled.

Method logic: Use ray box and narrow ray; mark rays accurately; draw normal; measure angles from normal; repeat for different angles/materials.

Analysis expected: Compare angle of incidence/reflection; describe refraction direction and link to speed change at Higher tier.

Evaluation / high-risk errors: Measuring angles from surface; broad/thick rays; moving block before marking; inaccurate normal; single reading only.

Source mapping: PRACT; RPG; relevant subject-content section.

RP10: Infrared radiation and surfaces

Aim and specification purpose: Investigate how surface nature affects infrared absorption or emission.

Variables / quantities: surface colour/finish as IV; detector reading/temperature change as DV; distance, angle, temperature and area controlled.

Method logic: Use surfaces at same temperature or identical heating; measure IR detector response/temperature change at fixed geometry; repeat.

Analysis expected: Rank emission/absorption; link dull black surfaces with strong emission/absorption and shiny surfaces with weak values.

Evaluation / high-risk errors: Different source temperatures; detector distance/angle; background IR; unequal surface areas; convection effects.

Source mapping: PRACT; RPG; relevant subject-content section.

Practical-question command words

- Plan: state apparatus, measurements, variables, method sequence, repeats and safety where relevant.
- Evaluate: identify a specific limitation and explain how it affects the result; propose a targeted improvement.
- Explain a graph: use physical variables and mechanism, not just “it goes up/down”.
- Determine: show readings/calculation and units; use graph gradient/area only when the relationship requires it.
- Compare: use both data sets and state a relevant similarity/difference; include numbers where provided.

Sources: PRACT; RPG; SPEC