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GCSE Physics

Full Specification - Spec Cheat Sheet · Papers 1 & 2

AQA Physics (8463) | Papers 1 & 2 | 118 spec points

Every specification point for **Full Specification**, in spec order - tick each one off as you revise. Codes match the official AQA specification. Nothing here is optional.

1. Energy

4.1.1.1	Describe how energy is stored in a system and transferred between stores (kinetic, gravitational, elastic, chemical, etc.).
4.1.1.1	Identify changes in energy stores for everyday systems, e.g. an object projected upwards, a moving object hitting an obstacle, a vehicle braking.
4.1.1.2	Calculate kinetic energy using Ek = 1/2 m v^2 for a moving object.
4.1.1.3	Calculate elastic potential energy stored in a stretched spring using Ee = 1/2 k e^2 (no permanent deformation).
4.1.1.4	Calculate gravitational potential energy using Ep = m g h for an object raised above ground level.
4.1.2.1	Calculate the energy stored or released as the temperature of a system changes using E = m c delta-theta.
4.1.2.1	Define specific heat capacity as energy needed to raise 1 kg of a substance by 1 degree C; required practical to measure it.
4.1.3	Define power as the rate of energy transfer or rate of doing work, P = E/t and P = W/t; unit the watt.
4.1.3	Give examples to show the difference between two devices doing the same task with different power ratings.
4.2.1	State that energy is conserved: it can be transferred, stored or dissipated but never created or destroyed.
4.2.2	Explain that some energy is dissipated (wasted) so it is transferred to less useful stores, e.g. by friction.
4.2.2	Describe ways to reduce unwanted energy transfers: lubrication and thermal insulation.
4.2.2	Explain how the rate of cooling of a building depends on the thickness and thermal conductivity of its walls.
4.2.3	Calculate efficiency = useful output energy transfer / total input energy transfer (or power equivalent).
4.2.3	Describe ways to increase the efficiency of an energy transfer (HT some).
4.3.1	Name the main renewable and non-renewable energy resources: fossil fuels, nuclear, biofuel, wind, hydroelectric, geothermal, tides, Sun, water waves.
4.3.2	Describe the main uses of energy resources: transport, electricity generation and heating.
4.3.2	Distinguish between renewable and non-renewable resources and evaluate their use, including reliability and environmental impact.

2. Electricity

4.2.1.1	Draw and interpret standard circuit symbols (cell, battery, switch, lamp, resistor, variable resistor, diode, LED, fuse, voltmeter, ammeter, etc.).
4.2.1.2	Define electric current as the rate of flow of charge; calculate charge using Q = I t.
4.2.1.3	State that current depends on the potential difference (voltage) and the resistance of the circuit.

4.2.1.3	Use the equation V = I R relating potential difference, current and resistance.
4.2.1.3	Required practical: investigate how the resistance of a wire depends on its length.
4.2.1.4	Describe how the resistance of components such as a filament lamp, diode, fixed and variable resistors changes with current/voltage (I-V characteristics).
4.2.1.4	Required practical: investigate the I-V characteristics of a filament lamp, a diode and a resistor at constant temperature.
4.2.1.5	Explain how the resistance of a thermistor varies with temperature and an LDR varies with light intensity, and their uses in sensing circuits.
4.2.2	Compare series and parallel circuits: rules for current, potential difference and total resistance.
4.2.2	Calculate total resistance of resistors in series (sum); know that adding parallel resistors decreases total resistance.
4.2.3.1	Describe direct potential difference (d.c.) and alternating potential difference (a.c.); UK mains is 230 V at 50 Hz a.c.
4.2.3.2	Identify the live, neutral and earth wires in a three-core cable and their colours and potentials; explain the role of each.
4.2.4.1	Use power equations P = V I and P = I^2 R for electrical devices.
4.2.4.2	Calculate energy transferred using E = P t and E = Q V; relate energy, power and the work done when charge flows.
4.2.4.3	Describe the National Grid: transformers step voltage up for efficient transmission then step it down for safe use.
4.2.5.1	Explain how rubbing insulators transfers electrons, producing static charge and forces of attraction or repulsion (HT).
4.2.5.2	Describe an electric field around a charged object and that the field is strongest close to the object (HT).

3. Particle model of matter

4.3.1.1	Calculate density using rho = m/V; describe the differences in arrangement of particles in solids, liquids and gases.
4.3.1.2	Required practical: determine the densities of regular and irregular solid objects and of liquids.
4.3.2.1	Describe changes of state (melting, freezing, boiling, evaporating, condensing, subliming) as physical changes that conserve mass.
4.3.2.2	Define internal energy as the total kinetic and potential energy of all particles in a system.
4.3.2.3	Explain that heating changes the temperature or the state of a substance and changes the energy stored.
4.3.2.3	Calculate energy for a change of temperature using specific heat capacity (links to topic 1).
4.3.2.3	Define specific latent heat and use E = m L; distinguish latent heat of fusion and vaporisation.
4.3.2.3	Interpret heating and cooling graphs showing flat sections during changes of state.
4.3.3.1	Explain gas pressure in terms of particle collisions with container walls and the link between temperature and average kinetic energy.
4.3.3.2	Use the relationship p V = constant for a fixed mass of gas at constant temperature (Boyle's law) (HT for some applications).
4.3.3.3	Explain how doing work on a gas (e.g. compressing rapidly) can increase its temperature (HT).

4. Atomic structure

4.4.1.1	Describe the basic structure of an atom: nucleus of protons and neutrons surrounded by electrons; sizes and scale (radius ~ 1x10^-10 m).
4.4.1.1	Explain how electrons changing energy levels by absorbing or emitting electromagnetic radiation.
4.4.1.2	Define atomic number and mass number; use notation for elements and isotopes; relative charges and masses of subatomic particles.

4.4.1.2	Define isotopes as atoms with the same number of protons but different numbers of neutrons; explain how atoms become ions.
4.4.1.3	Describe the development of the atomic model: plum pudding, Rutherford's alpha scattering, the nuclear model, Bohr and the discovery of the neutron.
4.4.2.1	Define radioactive decay as a random process and activity; units becquerel; explain count-rate measured by detectors.
4.4.2.2	Describe alpha, beta and gamma radiation and neutron emission, including their nature, range, penetration and ionising power.
4.4.2.2	Write balanced nuclear equations for alpha and beta decay using mass and atomic numbers.
4.4.2.3	Define half-life of a radioactive isotope; determine half-life from data or graphs and calculate net decline as a ratio (HT).
4.4.2.4	Distinguish irradiation from contamination; explain the hazards and precautions for each, and peer review of findings.
4.4.3.1	Describe uses of radioactivity in medicine (diagnosis and treatment) and evaluate the associated risks (Physics only).
4.4.3.2	Explain the difference between background radiation and dose; sources of background radiation (Physics only).
4.4.4.1	Describe nuclear fission of an unstable nucleus, the chain reaction and its control in a nuclear reactor (Physics only).
4.4.4.2	Describe nuclear fusion as the joining of light nuclei to form a heavier nucleus, releasing energy (Physics only).

5. Forces

4.5.1.1	Distinguish scalar quantities (magnitude only) from vector quantities (magnitude and direction); represent vectors with arrows.
4.5.1.2	Describe contact and non-contact forces; give examples of each.
4.5.1.3	Calculate weight using W = m g; weight acts at the centre of mass and is proportional to mass; use a newtonmeter.
4.5.1.4	Calculate the resultant of forces acting in a line; describe a single force having the same effect as several forces.
4.5.1.5	Use free body diagrams and resolve a force into two perpendicular components by scale drawing (HT).
4.5.2	Calculate the work done by a force using W = F s; one joule is the work done when a force of one newton moves an object one metre.
4.5.2	Explain that work done against friction causes a rise in temperature of the object.
4.5.3	Describe how forces can stretch, bend or compress an object; distinguish elastic and inelastic deformation.
4.5.3	Use F = k e for a spring within the limit of proportionality; calculate the work done in stretching (elastic potential energy).
4.5.3	Required practical: investigate the relationship between force and extension of a spring.
4.5.4.1	Calculate distance travelled using distance = speed x time; recall typical everyday speeds for walking, running, cycling and vehicles.
4.5.4.1	Define velocity as speed in a given direction; explain motion in a circle at constant speed has changing velocity (HT).
4.5.4.1	Interpret distance-time graphs; calculate speed from the gradient and acceleration of an object.
4.5.4.1	Use a = delta-v / t for acceleration; estimate areas under velocity-time graphs to find distance (HT for non-uniform).
4.5.4.1	Use v^2 - u^2 = 2 a s for uniform acceleration; quote acceleration of free fall g ~ 9.8 m/s^2.
4.5.4.2	State Newton's first law: a body stays at rest or constant velocity unless acted on by a resultant force; explain inertia.
4.5.4.2	Use Newton's second law F = m a; define inertial mass as the ratio of force to acceleration (HT).
4.5.4.2	Required practical: investigate the effect of varying force and mass on the acceleration of an object.
4.5.4.2	State Newton's third law: when two objects interact the forces are equal and opposite.

4.5.4.3	Define stopping distance as thinking distance plus braking distance; describe factors affecting each.
4.5.4.3	Explain how braking transfers kinetic energy to thermal energy; describe dangers of large decelerations (HT estimate forces).
4.5.5	Define momentum using p = m v; state that momentum is conserved in a closed system (HT).
4.5.5	Use conservation of momentum and relate force to rate of change of momentum F = m delta-v / t in safety applications (HT).

6. Waves

4.6.1.1	Describe transverse and longitudinal waves; give examples of each and explain oscillation direction relative to energy transfer.
4.6.1.2	Define amplitude, wavelength, frequency and period; use period T = 1/f and the wave equation v = f lambda.
4.6.1.2	Required practical: measure the frequency, wavelength and speed of waves in a ripple tank and on a stretched string.
4.6.1.3	Describe reflection and refraction of waves at a boundary; construct ray diagrams (Physics only).
4.6.1.3	Required practical: investigate reflection and refraction by different substances using ray diagrams (Physics only).
4.6.1.4	Explain how sound waves travel through a medium and the range of human hearing (20 Hz to 20 kHz) (Physics only, HT).
4.6.1.5	Describe uses of ultrasound and seismic waves (P and S waves) for detection and exploration (Physics only).
4.6.2.1	Describe the electromagnetic spectrum as transverse waves transferring energy, all travelling at the same speed in a vacuum.
4.6.2.1	List the seven EM groups in order: radio, microwave, infrared, visible, ultraviolet, X-rays, gamma rays.
4.6.2.2	Explain refraction in terms of change of wave speed at a boundary using wave front diagrams (HT).
4.6.2.3	Explain how radio waves are produced and detected by oscillations in electrical circuits (HT).
4.6.2.4	Describe how different EM waves are absorbed, transmitted, reflected or refracted and their effects on the body (UV, X-rays, gamma).
4.6.2.5	Give practical uses of each part of the EM spectrum and relate the use to the properties of the wave.
4.6.3.1	Describe the properties of convex and concave lenses; construct ray diagrams and define magnification (Physics only).
4.6.3.1	Calculate magnification = image height / object height; describe real and virtual images (Physics only).
4.6.3.2	Explain how opaque objects appear coloured due to absorption, transmission and reflection of light; colour of filters (Physics only).
4.6.3.3	Describe a perfect black body and how all bodies emit and absorb infrared radiation depending on temperature (Physics only).
4.6.3.3	Explain how the temperature of the Earth depends on the balance of radiation absorbed and emitted (Physics only, HT).

7. Magnetism and electromagnetism

4.7.1.1	Describe the attraction and repulsion between magnetic poles; distinguish permanent and induced magnets.
4.7.1.2	Describe the magnetic field around a bar magnet; explain that field strength depends on distance and the field direction.
4.7.1.2	Explain how a compass shows the direction of a magnetic field and provides evidence that Earth's core is magnetic.
4.7.2.1	Describe the magnetic field around a current-carrying wire and how a solenoid increases field strength; uses of electromagnets.

4.7.2.2	Explain the motor effect; use Fleming's left-hand rule and calculate force using F = B I L (HT).
4.7.2.3	Explain how the motor effect is used in an electric motor and a moving-coil loudspeaker (HT for loudspeaker).
4.7.3.1	Describe electromagnetic induction (the generator effect) and how an induced potential difference produces a current (Physics only, HT).
4.7.3.2	Explain how the generator effect is used in alternators (a.c.) and dynamos (d.c.); interpret output graphs (Physics only, HT).
4.7.3.3	Describe how a moving-coil microphone uses the generator effect (Physics only, HT).
4.7.3.4	Explain how a transformer works; use the turns ratio Vp/Vs = np/ns and Vs Is = Vp Ip for 100% efficiency (Physics only, HT).

8. Space physics (Physics only)

4.8.1.1	Describe our solar system: the Sun, the eight planets, dwarf planets, moons and the order of the planets.
4.8.1.1	Describe the formation of the Sun and the solar system from a cloud of dust and gas (nebula) pulled together by gravity.
4.8.1.2	Describe the life cycle of a star the size of the Sun and of a much larger star, including main sequence, red giant, white dwarf, supernova, neutron star and black hole.
4.8.1.2	Explain how fusion in stars produces the chemical elements and how elements heavier than iron are formed in supernovae.
4.8.1.3	Explain that gravity provides the force for circular orbits of planets, moons and artificial satellites; relate orbital speed and radius (HT).
4.8.2	Describe red-shift of light from distant galaxies and how it provides evidence that the universe is expanding (the Big Bang theory).
4.8.2	Explain how the observed red-shift increases with distance and the limitations of current knowledge about dark mass and dark energy.