Physics A Level - Personal Learning Checklist

OCR Physics A Topics 21 to 27

Topic 21 - Capacitance		R	A	G
Capacitance	6.1.1 a - Can you explain capacitance, $C = \frac{Q}{v}$?			
	6.1.1a Can you define the unit farad?			
	6.1.1b Can you describe charging and discharging of capacitors in terms of the flow of electrons?			
	6.1.1c Can you demonstrate the total capacitance of capacitors in series, $\frac{1}{c} = \frac{1}{c_1} + \frac{1}{c_2} +$?			
	6.1.1d Can you demonstrate the total capacitance of capacitors in parallel, C = $c_1 + c_2 +$?			
	6.1.1.ei Can you describe an analysis of circuits containing capacitors?			
	6.1.1 eii Can you understand an investigation of circuits containing capacitors?			
	6.1.2 a Can you understand p.d.–charge graphs for capacitors?			
	6.1.2 b Can you describe how energy is stored by capacitors?			
	6.1.2 b Can you demonstrate that W = $\frac{1}{2}Qv = \frac{1}{2}\frac{Q^2}{c} = \frac{1}{2}v^2C$?			
	6.1.2 c Can you describe the use of capacitors to store energy?			
	6.1.3 a i Can you describe discharging a capacitor through a resistor?			
	6.1.3 a ii Can you investigate the charge and the discharge of a capacitor?			
	6.1.3 b Can you explain the time constant CR of a capacitor–resistor circuit?			
	6.1.3 c Can you demonstrate $x = x_0 e^{\frac{1}{CR}}$ and $x = xo\ (1 - e\frac{1}{CR})$ for a discharging capacitor?			
	6.1.3 e Can you explain exponential decay and the constant-ratio property of decay graphs?			

Topic 22 - Electric Fields		R	A	G
Electric Fields	6.2.1.a Can you explain electric fields being due to charges?			
	6.2.1 b Can you understand a uniformly charged sphere modelled as a point charge at its centre?			
	6.2.1 c Can you describe using electric field lines to map electric fields			
	6.2.1d Can you demonstrate that electric field strength is E = $\frac{F}{Q}$?			
	6.2.2a Can you demonstrate Coulomb's law, F = $\frac{Qq}{4\pi\varepsilon_0 r2}$ for the force between two point charges?			
	6.2.2b Can you calculate electric field strength, E = $\frac{Q}{4\pi\varepsilon_0 r^2}$ for a point charge?			
	6.2.2c Can you describe the similarities and differences between the gravitational field of a point mass and the electric field of a point charge?			
	6.2.3a Can you calculate uniform electric field strength, E = ? $\frac{v}{d}$			
	6.2.3b Can you explain parallel-plate capacitor and permittivity: C = , $\frac{\varepsilon_0 A}{d}$ $C = \frac{\varepsilon A}{d} \varepsilon = ? \varepsilon_r \varepsilon_0$			
	6.2.3c Can you describe the motion of charged particles in a uniform electric field?			
	6.2.4a Can you describe electric potential as the work done in bringing a unit charge from infinity to a point?			
	6.2.4b Can you calculate electric potential, V = $\frac{Q}{4\pi\varepsilon_0 r}$			
	6.2.4c Can you calculate capacitance, C = $4\Pi\varepsilon_0 R$ for an isolated sphere?			
	6.2.4d Can you demonstrate force–distance graphs for point or spherical charges?			
	6.2.4e Can you calculate electric potential energy, E = Vq = $\frac{Qq}{4\pi\varepsilon_0 r}$?			

Topic 23 - Magnetic fields		R	A	G
Magnetic fields	6.3.1a Can you explain moving charges or permanent magnets as causes of magnetic fields?			
	6.3.1b Can you demonstrate using magnetic field lines to map magnetic fields?			
	6.3.1c Can you describe magnetic field patterns for a long straight current carrying conductor, a flat coil, and a long solenoid?			
	6.3.1d Can you define Fleming's left-hand rule?			
	6.3.1ei Can you calculate the force on a current-carrying conductor, F = BIL sinθ ?			
	6.3.1e ii Can you describe the techniques and procedures used to determine the uniform magnetic flux density between the poles of a magnet using a current-carrying wire and digital balance?			
	6.3.1f Can you define magnetic flux density and the unit tesla?			
	6.3.2a Can you calculate the force on a charged particle travelling at right angles to a uniform magnetic field, F = BQv			
	6.3.2 b Can you describe the movement of charged particles in a uniform magnetic field?			
	6.3.2c Can you describe the movement of charged particles moving in a region occupied by both electric and magnetic fields?			
	6.3.2c Can you define velocity selector?			
	6.3.3a Can you explain magnetic flux ϕ, the unit weber and ϕ = BAcosθ?			
	6.3.3b Can you define magnetic flux linkage?			
	6.3.3c Can you describe Faraday's law of electromagnetic induction?			
	6.3.3c Can you define Lenz's law?			
	6.3.3d Can you demonstrate that e.m.f. = – rate of change of magnetic flux linkage, $\varepsilon = -\frac{\Delta(N\phi)}{\Delta t}\Delta$ and explain techniques and procedures used to investigate magnetic flux using search coils?			
	6.3.3e Can you describe a simple a.c. generator?			
	6.3.3fi Can you describe a simple laminated, iron-cored transformer?			
	6.3.3fi Can you explain $\frac{n_s}{n_p} = \frac{v_s}{v_p} = \frac{I_s}{I_p}$ for an ideal transformer?			
	6.3.3fii Can you explain the techniques and procedures used to investigate transformers?			

Topic 24 - Particle physics		R	A	G
Particle physics	6.4.1a Can you explain the alpha-particle scattering experiment?			
	6.4.1b Can you describe the simple nuclear model of the atom; protons, neutrons, and electrons?			
	6.4.1c Can you describe the relative sizes of the atom and the nucleus?			
	6.4.1d Can you define proton number, nucleon number and isotopes, and explain the notation for the representation of nuclei?			
	6.4.1e Can you explain the strong nuclear force and its short-range nature?			
	6.4.1f Can you calculate the radius of nuclei, R = $r_0 A^{\frac{1}{3}}$?			
	6.4.1g Can you calculate the mean densities of atoms and nuclei?			
	6.4.2a Can you define particles and antiparticles, including electron–positron, proton–antiproton, neutron–antineutron, and neutrino–antineutrino?			
	6.4.2b Can you describe relative masses and charges of particles and their corresponding antiparticles?			
	6.4.2c Can you describe the classification, examples, and behaviour of hadrons?			
	6.4.2d Can you describe the classification, examples, and behaviour of leptons?			
	6.4.2e Can you explain the simple quark model of hadrons in terms of up and down, and strange quarks and their anti-quarks?			
	6.4.2f Can you explain the quark model of the proton and the neutron?			
	6.4.2g Can you explain the charges of the up, down, strange, anti-up, anti-down, and anti-strange quarks as fractions of the elementary charge e?			
	6.4.2 h Can you describe beta-minus (β−) and betaplus (β+) decay, and the quark models for these decays?			
	6.4.2 k Can you demonstrate quark transformation equations balanced in terms of charge?			
	6.4.2l Can you explain decay of particles in terms of the quark model?			

Topic 25 - Radioactivity		R	A	G
Radioactivity	6.4.3a Can you define radioactive decay?			
	6.4.3 a Can you describe the spontaneous and random nature of decay?			
	6.4.3bi Can you define α-particles, β-particles and γ-rays?			
	6.4.3bii Can you describe the nature, penetration and range of these radiations, and the techniques used to investigate their absorption?			
	6.4.3c Can you demonstrate the nuclear decay equations for alpha, beta-minus and beta-plus decays?			
	6.4.3c Can you demonstrate balancing nuclear transformation equations?			
	6.4.3d Can you define activity of a source?			
	6.4.3d Can you calculate the decay constant λ of an isotope, A = λN?			
	6.4.3ei Can you calculate the half-life of an isotope, $\lambda \frac{t_1}{2}$in(2)?			
	6.4.3 eii Can you describe the techniques used to determine the half-life of an isotope?			
	6.4.3fi Can you explain the equations A = $A_0 e^{-\lambda t}$ and $N_0 e^{-\lambda t}$?			
	6.4.3fii Can you understand a simulation of radioactive decay?			
	6.4.3g Can you demonstrate the graphical methods and spreadsheet modelling of the equation $\frac{\Delta N}{\Delta t} = -\lambda_N$ for radioactive decay?			
	6.4.3h Can you define radioactive dating, such as carbon-dating?			

Topic 26 - Nuclear physics		R	A	G
Nuclear physics	6.4.4a Can you demonstrate Einstein's mass–energy equation, $\Delta E = \Delta mc^2$			
	6.4.4 b Can you understand how energy is released or absorbed in simple nuclear reactions?			
	6.4.4c Can you describe the creation and annihilation of particle–antiparticle pairs?			
	6.4.4d Can you define mass defect; binding energy; and binding energy pernucleon?			
	6.4.4 e Can you explain the binding energy per nucleon against nucleon number curve; and energy changes in reactions?			
	6.4.4 f Can you calculate the binding energy of nuclei using and $\Delta E = \Delta mc^2$ calculate the masses of nuclei?			
	6.4.4g Can you define induced nuclear fission and chain reaction?			
	6.4.4h Can you describe the basic structure of a fission reactor (components: fuel rods, control rods and moderator)?			
	6.4.4i Can you explain the environmental impact of nuclear waste?			
	6.4.4j Can you define nuclear fusion, fusion reactions and temperature?			
	6.4.4k Can you demonstrate balancing nuclear transformation equations?			

Topic 27 - Medical imaging		R	A	G
Medical imaging	6.5.1a Can you describe the basic structure of an X-ray tube (components heater (cathode), anode, target metal and high-voltage supply)?			
	6.5.1b Can you describe the production of X-ray photons from an X-ray tube?			
	6.5.1c Can you define these X-ray attenuation mechanisms: simple scatter, photoelectric effect, Compton effect, and pair production?			
	6.5.1d Can you explain the attenuation of X-rays?			
	6.5.1d Can you demonstrate that I = I0e−μx?			
	6.5.1e Can you describe X-ray imaging with contrast media?			
	6.5.1f Can you describe computerised axial tomography (CAT) scanning and the necessary components?			
	6.5.1g Can you explain the advantages of a CAT scan over an X-ray image?			
	6.5.2a Can you describe the medical tracers technetium-99m and fluorine-18?			
	6.5.2b Can you describe the gamma camera and its components, and the formation of gamma camera images?			
	6.5.2c Can you explain diagnosis using the gamma camera?			
	6.5.2d Can you define positron emission tomography (PET)?			
	6.5.2e Can you explain diagnosis using PET scanning?			
	6.5.3a Can you explain ultrasound frequency?			
	6.5.3b Can you define the piezoelectric effect?			
	6.5.3b Can you define ultrasound transducers?			
	6.5.3c Can you describe ultrasound A-scans and B-scans?			
	6.5.3d Can you calculate the acoustic impedance of a medium, Z = ρc?			
	6.5.3e Can you explain the reflection of ultrasound at a boundary?			
	6.5.3e Can you explain the reflection of ultrasound at a boundary?			
	6.5.3e Can you demonstrate that $\frac{Ir}{I_0} = \left(\frac{z_2 - z_1}{z_2 + z_1}\right)$?			
	6.5.3f Can you describe impedance (acoustic) matching?			
	6.5.3f Can you explain the use of gel in ultrasound scanning?			
	6.5.3g Can you describe the Doppler effect in ultrasound?			
	6.5.3g Can you calculate the speed of blood v in the body: $\frac{\Delta f}{f} = \frac{2v\cos}{c}$?			