A Level Physics Online

AQA Physics - 7408

Module 7: Fields and their Consequences (A-level only)

You should be able to demonstrate and show your understanding of:	**Progress and understanding:**			
	1	**2**	**3**	**4**
7.1 Fields (A-level only)				
Concept of a force field as a region in which a body experiences a non-contact force.				
You should recognise that a force field can be represented as a vector, the direction of which must be determined by inspection.				
Force fields arise from the interaction of mass, of static charge, and between moving charges.				
Similarities between gravitational and electrostatic forces: Both have inverse-square force laws that have many characteristics in common, e.g. use of field lines, use of potential concept, equipotential surfaces etc				
Differences between gravitational and electrostatic forces: masses always attract, but charges may attract or repel.				
7.2 Gravitational fields (A-level only)				
Gravity as a universal attractive force acting between all matter.				
Magnitude of force between point masses: $F = \frac{Gm_1m_2}{r^2}$ Where G is the gravitational constant.				
Representation of a gravitational field by gravitational field lines.				
'g' as force per unit mass as defined by $g = F/m$				
Magnitude of g in a radial field given by $g = GM/r^2$				
Understanding of definition of gravitational potential, including zero value at infinity.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	**2**	**3**	**4**
Understanding of gravitational potential difference.				
Work done in moving mass m given by $\Delta W = m\Delta V$				
Idea that no work is done when moving along an equipotential surface.				
V in a radial field given by $V = -GM/r$ (Considering the significance of the negative sign)				
Graphical representations of variations of g and V with r.				
V related to g by: $g = -\Delta V/\Delta r$				
ΔV from area under graph of g against r.				
Orbital period and speed related to radius of circular orbit;				
Derivation of $T^2 \propto r^3$				
Energy considerations (including total energy) for an orbiting satellite.				
Escape velocity and synchronous orbits.				
Use of satellites in low orbits and geostationary orbits, to include plane and radius of geostationary orbit.				
7.3 Electric fields (A-level only)				
Force between point charges in a vacuum: $F = \frac{1}{4\pi \varepsilon_0} \frac{Q_1 Q_2}{r^2}$				
Permittivity of free space, ε_0				
Appreciation that air can be treated as a vacuum when calculating force between charges.				
For a charged sphere, charge may be considered to be at the centre.				
Comparison of magnitude of gravitational and electrostatic forces between subatomic particles.				
Representation of electric fields by electric field lines.				
Electric field strength, E, as force per unit charge defined by $E = F/Q$				
Magnitude of E in a uniform field given by $E = V/d$				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Derivation from work done moving charge between plates: $Fd = Q\Delta V$				
Trajectory of moving charged particle entering a uniform electric field initially at right angles.				
Magnitude of E in a radial field given by: $E = \dfrac{Q}{4\pi \varepsilon_0 r^2}$				
Understanding of definition of absolute electric potential, including zero value at infinity, and of electric potential difference.				
Work done in moving charge Q given by $\Delta W = Q\Delta V$				
No work done moving charge along an equipotential surface.				
Magnitude of V in a radial field given by: $V = \dfrac{1}{4\pi \varepsilon_0} \dfrac{Q}{r}$				
Graphical representations of variations of E and V with r.				
V related to E by $E = \Delta V / \Delta r$				
ΔV from the area under graph of E against r.				
7.4 Capacitance (A-level only)				
Definition of capacitance: $C = Q/V$				
Dielectric action in a capacitor: $C = \dfrac{A \varepsilon_0 \varepsilon_r}{d}$				
Relative permittivity and dielectric constant.				
You should be able to describe the action of a simple polar molecule that rotates in the presence of an electric field.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Interpretation of the area under a graph of charge against pd. $E = ½\ QV = ½\ CV^2 = ½\ Q^2/C$				
Graphical representation of charging and discharging of capacitors through resistors. Corresponding graphs for Q, V and I against time for charging and discharging.				
Interpretation of gradients and areas under graphs where appropriate.				
Time constant RC. Calculation of time constants including their determination from graphical data.				
Time to halve: $T_{½} = 0.69RC$				
Quantitative treatment of capacitor discharge: $Q = Q_0 e^{-t/RC}$ Use of the corresponding equations for V and I.				
Quantitative treatment of capacitor charge: $Q = Q_0 (1 - e^{-t/RC})$				
7.5 Magnetic fields (A-level only)				
Force on a current-carrying wire in a magnetic field: $F = BIL$ when field is perpendicular to current.				
Fleming's left hand rule.				
Magnetic flux density B and definition of the tesla.				
Force on charged particles moving in a magnetic field, $F = BQv$ when the field is perpendicular to velocity.				
Direction of force on positive and negative charged particles				
Circular path of particles; application in devices such as the cyclotron.				
Magnetic flux defined by $\Phi = BA$ where B is normal to A.				
Flux linkage as $N\Phi$ where N is the number of turns cutting the flux.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Flux and flux linkage passing through a rectangular coil rotated in a magnetic field:				
Flux linkage $N\Phi = BAN\cos\theta$				
Faraday's and Lenz's laws.				
Magnitude of induced emf = rate of change of flux linkage $\varepsilon = N\,\Delta\Phi/\Delta t$				
Applications such as a straight conductor moving in a magnetic field.				
emf induced in a coil rotating uniformly in a magnetic field: $\varepsilon = BAN\,\omega \sin \omega t$				
Sinusoidal voltages and currents only; root mean square, peak and peak-to-peak values for sinusoidal waveforms only. $I_{rms} = I_0/\sqrt{2}$ $V_{rms} = V_0/\sqrt{2}$				
Application to the calculation of mains electricity peak and peak-to-peak voltage values.				
Use of an oscilloscope as a dc and ac voltmeter, to measure time intervals and frequencies, and to display ac waveforms.				
No details of the structure of the oscilloscope are required but familiarity with the operation of the controls is expected.				
The transformer equation: $N_s/N_p = V_s/V_p$				
Transformer efficiency = $I_S V_S / I_P V_P$				
Production of eddy currents and causes of inefficiencies in a transformer.				
Transmission of electrical power at high voltage including calculations of power loss in transmission lines.				