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Personalised Learning Checklist

AQA A Level Physics (Concept) P6 :Further mechanics and thermal physics P6.1: Periodic motion	Red	Amber	Green
Recall that motion in a circular path at constant speed implies there is an acceleration and requires a centripetal force			
Use the equation $\omega = v/r = 2\pi f$ for magnitude of angular speed			
Recall that the radian is a measure of an angle and estimate the acceleration and centripetal force in situations that involve rotation			
Use the equation $a = v^2/r = \omega^2 r$ for centripetal acceleration			
Use the equation $F = mv^2/r = m\omega^2 r$ for centripetal force			
Describe and analyse characteristics of simple harmonic motion (SHM).			
Describe the condition for SHM as: $a \propto -x$			
Define and use the equations $a = -\omega^2 x$ and $x = A \cos \omega t$ and $v = \pm \omega \sqrt{(A^2 - x^2)}$			
Sketch relationships between ***x, v, a*** and ***– t*** for simple harmonic oscillators.			
Draw graphical representations linking the variations of ***x, v*** and ***a*** with time			
Explain how the ***v – t graph*** is derived from the gradient of the ***x – t graph*** and that the ***a – t graph*** is derived from the gradient of the ***v – t graph***			
Recall that maximum speed = ωA and maximum acceleration = $\omega^2 A$			
Use the small-angle approximation in the derivation of the time period for examples of approximate SHM			
Use the equation $T = 2\pi \sqrt{(m/k)}$ for the study of a mass spring system and $T = 2\pi \sqrt{(l/g)}$ for a simple pendulum			
Explain the variation of E_k, E_p, and total energy with both displacement and time			
Describe the effects of damping on oscillations			
Explain how free and forced vibrations can be measured quantitatively			
Explain resonance and describe the effects of damping on the sharpness of resonance			
Describe examples of these effects in mechanical systems and situations involving stationary waves			
Investigate the factors that determine the resonant frequency of a driven system			
P6.2: Thermal physics			
Describe internal energy as the sum of the randomly distributed kinetic energies and potential energies of the particles in a body			
Explain how the internal energy of a system is increased when energy is transferred to it by heating or when work is done on it (and vice versa)			
Complete calculations involving transfer of energy and continuous flow			
Explain that during a change of state the potential energies of the particle ensemble are changing but not the kinetic energies.			
Use the equation $Q = mc\Delta\theta$ for a change of temperature, where c is specific heat capacity.			
Use the equation $Q = ml$ for a change of state where l is the specific latent heat			
Describe gas laws as experimental relationships between ***p, V, T*** and the mass of the gas			
Explain the concept of absolute zero of temperature.			
Use the ideal gas equation: $pV = nRT$ for n moles and $pV = NkT$ for N molecules			
Recall that work done = $p\Delta V$			
Recall and use the following constants: Avogadro constant N_A, molar gas constant R, Boltzmann constant k			
Describe and explain the following: molar mass and molecular mass.			

Investigate Boyle's law (constant temperature) and Charles's law (constant pressure) for a gas			
Explain Brownian motion as evidence for existence of atoms			
Explain the relationships between ***p, V and T*** in terms of a simple molecular model			
Explain that the gas laws are empirical in nature whereas the kinetic theory model arises from theory			
Use and derive the equation $pV = \frac{1}{3}Nm(c_{rms})^2$			
Use a simple algebraic approach for conservation of momentum			
Explain that for an ideal gas internal energy is the kinetic energy of the atoms			
Use the equation ***average molecular kinetic energy*** $= \frac{1}{2} m(c_{rms})^2 = \frac{3}{2} kT = 3RT / 2N_A$			
Explain how knowledge and understanding of the behaviour of a gas has changed over time			

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AQA A Level Physics (Concept) P7: Fields and their consequences P7.1: Fields	Red	Amber	Green
Describe the concept of a force field as a region in which a body experiences a non-contact force			
Recognise that a force field can be represented as a vector, the direction of which must be determined by inspection			
Describe how force fields arise from the interaction of mass, of static charge, and between moving charges			
Explain the similarities and differences between gravitational and electrostatic forces			
P7.2: Gravitational fields			
Describe what gravity is			
Use the equation $F = Gm_1m_2/r^2$ for magnitude of force between point masses where G is the gravitational constant			
Be able to estimate the gravitational force between a variety of objects			
Be able to represent a gravitational field by gravitational field lines			
Use the equation $g = F/m$ with g as force per unit mass			
Use the equation $g = GM/r^2$ for magnitude of g in a radial field			
Define gravitational potential, including zero value at infinity			
Describe what gravitational potential difference is			
Use the equation: work done in moving mass for m given by $\Delta W = m\Delta V$			
Explain what equipotential surfaces are and explain why no work is done when moving along an equipotential surface			
Use the equation: $V = -GM/r$ for V in a radial field			
Explain the significance of the negative sign			
Draw graphical representations of variations of g and V with r			
Use the equation: $g = -\Delta V/\Delta r$ for V related to g			
Determine ΔV from area under graph of g against r			
Describe orbital period and speed related to radius of circular orbit; ab derive $T^2 \propto r^3$			
Estimate various parameters of planetary orbits, eg kinetic energy of a planet in orbit			
Calculate total energy of an orbiting satellite, escape velocity and describe synchronous orbits			
Describe the use of satellites in low orbits and geostationary orbits, to include plane and radius of geostationary orbit			
Use logarithmic plots to show relationships between T and r for given data			
P3: Electric fields			
Use the equation $F = 1/4\pi\varepsilon_0 \times Q_1Q_2/r^2$ for the force between two charges in a vacuum			
Describe what the permittivity of free space is, ε_0			
Recall that air can be treated as a vacuum when calculating force between charges			
Recall that for a charged sphere, charge may be considered to be at the centre			
Compare magnitude of gravitational and electrostatic forces between subatomic particles			
Estimate the magnitude of the electrostatic force between various charge configurations			
Be able to represent electric fields by electric field lines and explain electric field strength			
Use the equation: $E = F/Q$, where where E is the force per unit charge			

Use the equation: $E = V/d$, for magnitude of E in a uniform field			
Derive the equation: $Fd = Q\Delta V$ from work done for moving charge between plates			
Describe the trajectory of moving charged particle entering a uniform electric field initially at right angles			
Use the equation $E = 1/4\pi\varepsilon_0 \; x \; Q/r^2$, for magnitude of E in a uniform field			
Investigate the patterns of various field configurations using conducting paper (2D) or electrolytic tank (3D)			
Define absolute electric potential, including zero value at infinity, and of electric potential difference			
Use the equation: $\Delta W = Q\Delta V$ for work done in moving charge Q			
Explain what equipotential surfaces are and explain why no work is done when moving charge along an equipotential surface			
Use the equation: $V = 1/4\pi\varepsilon_0 \; x \; Q/r^2$ for magnitude of V in a radial field			
Draw graphical representations of variations of E and V with r			
Use the equation: $E = \Delta V/\Delta r$ to related V to E			
Determine ΔV from the area under graph of E against r			
P4: Capacitance			
Define capacitance and use the equation: $C = Q/V$			
Describe the dielectric action in a capacitor by $C = A\varepsilon_0 \varepsilon_r/d$			
Define relative permittivity and dielectric constant			
Determine the relative permittivity of a dielectric using a parallel-plate capacitor			
Describe the action of a simple polar molecule that rotates in the presence of an electric field			
Investigate the relationship between C and the dimensions of a parallel-plate capacitor			
Interpret the area under a graph of charge against pd $E = ½QV = ½CV^2 = ½Q^2/C$			
Draw graphical representation of charging and discharging of capacitors through resistors			
Draw corresponding graphs for Q, V and I against time for charging and discharging			
Interpret gradients and areas under graphs			
Calculate time constants RC including their determination from graphical data			
Use the equation: $T_{½} = 0.69RC$ for time to halve			
Use the equation: $Q = Q_0 e^{-t/RC}$ for quantitative treatment of capacitor discharge			
Use the corresponding equations for V and I			
Use the equation: $Q = Q_0 (1 - e^{-t/RC})$ for quantitative treatment of capacitor charge			
Investigate the charge and discharge of capacitors			
P5: Magnetic fields			
Describe force on a current-carrying wire in a magnetic field: $F = BIl$ when field is perpendicular to current			
Describe and use Fleming's left hand rule			
Explain magnetic flux density B and give a definition for the tesla			
Investigate how the force on a wire varies with flux density, current and length of wire using a top pan balance			
Describe force on charged particles moving in a magnetic field, using $F = BQv$ when the field is perpendicular to velocity			
Recall the direction of force on positive and negative charged particles			
Describe the circular path of particles in application in devices such as the cyclotron			

Explain the terms: magnetic flux density $\phi = BA$, and flux linkage $N\phi$, where B is normal to A and N is the number of turns cutting the flux			
Describe flux and flux linkage passing through a rectangular coil rotated in a magnetic field as flux linkage $N\phi = BAN\cos\theta$			
Investigate, the effect on magnetic flux linkage of varying the angle between a search coil and magnetic field direction			
Describe simple experimental phenomena for electromagnetic induction			
Describe and apply Faraday's and Lenz's laws for electromagnetic induction			
Use the equation: $\varepsilon = N\Delta\phi/\Delta$ for magnitude of induced emf = rate of change of flux linkage			
Describe applications such as a straight conductor moving in a magnetic field			
Use the equation: $\varepsilon = BAN\omega \sin \omega t$ for emf induced in a coil rotating uniformly in a magnetic field			
Recall Sinusoidal voltages and currents, root mean square, peak and peak-to-peak values for sinusoidal waveforms only			
Use the equation: $I_{rms} = I_0/\sqrt{2}$; $V_{rms} = V_0/\sqrt{2}$			
Apply the calculation of mains electricity peak and peak-to-peak voltage values			
Use an oscilloscope as a dc and ac voltmeter, to measure time intervals and frequencies, and to display ac waveforms			
Use the following transformer equation: $N_s/N_p = V_s/V_p$			
Use the equation: $I_s V_s / I_p V_p$ to calculate transformer efficiency			
Describe and explain the production of eddy currents and causes of inefficiencies in a transformer			
Describe the transmission of electrical power at high voltage including calculations of power loss in transmission lines			

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AQA A Level Physics (Concept) **P8: Nuclear physics** **P8.1: Radioactivity**	Red	Amber	Green
Describe the qualitative study of Rutherford scattering			
Describe how knowledge and understanding of the structure of the nucleus has changed over time			
Describe the properties and experimental identification using simple absorption experiments for α, β and γ radiation			
Describe and explain the hazards of exposure for humans to α, β and γ radiation			
Describe the applications of α, β and γ radiation			
Recall the inverse-square law for γ radiation: $I = k/x^2$ and use experiments for verification of inverse-square law			
Explain how radioactive sources can be handled safely			
Define background radiation giving examples of its origins and experimental elimination from calculations.			
Evaluate the balance between risk and benefits in the uses of radiation in medicine			
Describe the random nature of radioactive decay; constant decay probability of a given nucleus			
Use the equations: $\Delta N/\Delta t = -\lambda N$; $N = N_0 e^{-\lambda t}$ and $A = \lambda N$			
Use modelling to describe constant decay probability			
Investigate the decay equation (including the use of experimental data, dice simulations etc) and a variety of analytical methods			
Use the equation: $A = A_0 e^{-\lambda t}$			
Use the half life equation: $T_{½} = \ln 2/\lambda$			
Determine half-life from graphical decay data including decay curves and log graphs			
Describe application for radioactive decay e.g. relevance to storage of radioactive waste, radioactive dating etc			
Draw graphs of N against Z for stable nuclei			
Describe possible decay modes of unstable nuclei including α, β+, β– and electron capture			
Describe changes in N and Z caused by radioactive decay and representation in simple decay equations			
Interpret nuclear energy level diagrams			
Recall the existence of nuclear excited states; γ ray emission; discuss applications e.g. use of technetium-99m as a γ source in medical diagnosis			
Estimate nuclear radius from closest approach of alpha particles and determination of radius from electron diffraction			
Recall of typical values for nuclear radius and use the Coulomb equation for the closest approach estimate			
Describe how the nuclear radius depends on the nucleon number			
Derive $R = R_0 A^{1/3}$ from experimental data and interpret the of equation as evidence for constant density of nuclear material			
Calculate nuclear density and describe the graph of intensity against angle for electron diffraction by a nucleus			
Recall that $E = mc^2$ applies to all energy changes			
Complete simple calculations involving mass difference and binding energy			
Recall and use the Atomic mass unit, u and conversion of units; $1\ u = 931.5$ MeV			
Describe and explain fission and fusion processes			
Complete simple calculations from nuclear masses of energy released in fission and fusion reactions			
Draw graphs of average binding energy per nucleon against nucleon number			

Identify, on a plot, the regions where nuclei will release energy when undergoing fission/fusion			
Describe how knowledge of the physics of nuclear energy allows society to use science to inform decision making			
Describe fission as induced by thermal neutrons; possibility of a chain reaction due to critical mass			
Explain the functions of the moderator, control rods, and coolant in a thermal nuclear reactor.			
Describe simple a mechanical model of moderation by elastic collisions			
Recall factors affecting the choice of materials for the moderator, control rods and coolant and give examples of materials used			
Describe safety aspects of fuel used, remote handling of fuel, shielding, emergency shut-down			
Describe safety aspects of production, remote handling, and storage of radioactive waste materials.			
Evaluate the of balance between risk and benefits in the development of nuclear power			

Personalised Learning Checklist

AQA A Level Physics (Concept) P9: Astrophysics (optional) P9.1: Telescopes	Red	Amber	Green
Recall that astronomical telescope consisting of two converging lenses			
Draw ray diagrams to show the image formation in normal adjustment			
Describe angular magnification in normal adjustment			
Use the equation: ***M = angle subtended by image at eye/ angle subtended by object at unaided eye***			
Calculate the Focal lengths of the lenses by using the equation: $M = f_o / f_e$			
Describe cassegrain arrangement using a parabolic concave primary mirror and convex secondary mirror for reflecting telescopes			
Draw ray diagram to show path of rays through the reflecting telescope up to the eyepiece			
Discuss the relative merits of reflectors and refractors including a qualitative treatment of spherical and chromatic aberration			
Recall what single dish radio telescopes, I-R, U-V and X-ray telescopes are			
Discuss the similarities and differences of radio telescopes compared to optical telescopes (Inc. structure, positioning and use)			
Compare the resolving and collecting powers of radio telescopes			
Describe the advantages of large diameter telescopes for minimum angular resolution of telescope			
Use the equation: Rayleigh criterion, $\theta \approx \lambda / D$			
Recall that collecting power is proportional to $\textit{diameter}^2$			
Compare the eye and CCD as detectors in terms of quantum efficiency, resolution, and convenience of use			
P9.2: Classification of stars			
Recall how stars are classified by luminosity and that the apparent magnitude, m			
Recall and describe the Hipparcos scale			
Recall that the dimmest visible stars have a magnitude of 6			
Discuss the relationship between brightness and apparent magnitude			
Recall that a difference of 1 on the magnitude scale is equal to an intensity ratio of 2.51			
Recall that brightness is a subjective scale of measurement			
Describe what a Parsec and a lightyear are			
For absolute magnitude define M, in relation to m: $m - M = 5 \log d/10$			
Recall how stars are classified by temperature and black-body radiation			
Apply Stefan's law and Wien's displacement law			
Recall the general shape of black-body curves, and use of Wien's displacement law to estimate black-body temperature of sources			
Use the equation: $\lambda_{max} T = \text{constant} = 2.9 \times 10^{-3}$ m K			
Recall the assumption that a star is a black body			
Use of Stefan's law to compare the power output, temperature and size of stars $P = \sigma A T^4$			
Describe the spectral classes OBAFGKM in terms of colour, temperature and prominent absorption lines			
Describe what the Hertzsprung-Russell (HR) diagram shows			
Describe the general shape: main sequence, dwarfs and giants			
Use axis scales range from –10 to +15 (absolute magnitude) and 50 000 K to 2 500 K (temperature) or OBAFGKM (spectral class)			
Recall the position of the Sun on the HR diagram			
Describe stellar evolution: path of a star similar to our Sun on the HR diagram from formation to white dwarf			
Define properties: rapid increase in absolute magnitude of supernovae; composition and density of neutron stars; escape velocity > c for black holes.			

Recall that gamma ray bursts are due to the collapse of supergiant stars to form neutron stars or black holes			
Compare energy output with total energy output of the Sun			
Describe the use of type 1a supernovae as standard candles to determine distances			
Discuss controversy concerning accelerating Universe and dark energy			
Recall the light curve of typical type 1a supernovae			
Recall that supermassive black holes are at the centre of galaxies			
Calculate the radius of the event horizon for a black hole using Schwarzschild radius (R_s), $R_s \approx 2GM/c^2$			
P9.3: Cosmology			
Describe the Doppler effect			
Apply $\Delta f / f = v/c$ and $z = \Delta\lambda/\lambda = -v/c$ for $v << c$ to optical and radio frequencies.			
Complete calculations on binary stars viewed in the plane of orbit			
Describe what galaxies and quasars are			
Define and use Hubble's law			
Use the following equation: $v = Hd$ for red shift			
Make simple interpretations for expansion of universe; estimation of age of universe, assuming H is constant			
Evaluate qualitative data for Big Bang theory including evidence from cosmological microwave background radiation, and relative abundance of H & He			
Define quasars as the most distant measurable objects			
Describe the discovery of quasars as bright radio sources			
Recall that quasars show large optical red shifts; estimation involving distance and power output			
Describe the formation of quasars from active supermassive black holes			
Discuss the difficulties in the direct detection of exoplanets			
Describe how detection techniques will be limited to variation in Doppler shift (radial velocity method) and the transit method			
Recognise a typical light curve			