A Level Physics Online

AQA Physics - 7408

Module 6: Further Mechanics and Thermal Physics (A-level only)

You should be able to demonstrate and show your understanding of:	Progress and understanding: 1	2	3	4
6.1 Periodic Motion (A-level only)				
Motion in a circular path at constant speed implies there is an acceleration and requires a centripetal force. Estimate the acceleration and centripetal force in situations that involve rotation.				
Magnitude of angular speed $\omega = v / r = 2\pi f$				
Radian as the measure of angle.				
Direction of angular velocity will not be considered.				
Centripetal acceleration $a = v^2 / r = \omega^2 r$				
The derivation of the centripetal acceleration formula will not be examined.				
Centripetal force $F = mv^2 / r = m\omega^2 r$				
Analysis of characteristics of simple harmonic motion (SHM).				
Condition for SHM: $a \propto -x$				
Defining equation: $a = -\omega^2 x$				
$x = A \cos \omega t$ and $v = \pm\omega \sqrt{(A^2 - x^2)}$				
Graphical representations linking the variations of x, v and a with time (including sketching these).				
Appreciation that 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.				
Maximum speed $= \omega A$				
Maximum acceleration $= \omega^2 A$				
Study of mass-spring systems: $T = 2\pi \sqrt{(m/k)}$				
Study of simple pendulums: $T = 2\pi \sqrt{(l/g)}$				

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You should recognise the use of the small angle approximation ($\theta = \sin\theta$) in the derivation of the time period for these examples of SHM.				
Questions may involve other harmonic oscillators (eg liquid in U-tube) but full information will be provided in questions where necessary.				
Variation of E_k, E_p and total energy with both displacement and time.				
Effects of damping on oscillations.				
Qualitative treatment of free and forced vibrations.				
Resonance and the effects of damping on the sharpness of resonance.				
Examples of these effects in mechanical systems and situations involving stationary waves.				
6.2 Thermal Physics (A-level only)				
Internal energy is the sum of the randomly distributed kinetic energies and potential energies of the particles in a body.				
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), eg a qualitative treatment of the first law of thermodynamics.				
Appreciation that during a change of state the potential energies of the particle ensemble are changing but not the kinetic energies. Calculations involving transfer of energy.				
For a change of temperature: $Q = mc\,\Delta\,\theta$ where c is specific heat capacity.				
Calculations including continuous flow.				
For a change of state $Q = ml$ where l is the specific latent heat.				
Gas laws as experimental relationships between p, V, T and the mass of the gas.				
Concept of absolute zero of temperature.				
Ideal gas equation: $pV = nRT$ for n moles and $pV = NkT$ for N molecules.				
Work done = $p\Delta V$				
Avogadro constant N_A, molar gas constant R, Boltzmann constant k				
Molar mass and molecular mass.				
Brownian motion as evidence for existence of atoms.				

You should be able to demonstrate and show your understanding of:	**Progress and understanding:**			
	1	**2**	**3**	**4**
Explanation of relationships between p, V and T in terms of a simple molecular model.				
Students should understand that the gas laws are empirical in nature whereas the kinetic theory model arises from theory.				
Assumptions leading to $pV = \frac{1}{3}Nm\,(c_{\mathrm{rms}})^2$ including derivation of the equation and calculations.				
A simple algebraic approach involving conservation of momentum is required.				
Appreciation that for an ideal gas internal energy is kinetic energy of the atoms.				
Use of *average molecular kinetic energy* = $\frac{1}{2} m\,(c_{rms})^2 = 3/2\ kT = 3RT / 2N_A$				
Appreciation of how knowledge and understanding of the behaviour of a gas has changed over time.				