Physics Definitions

Topic	Term	Definition
Measurements	Systematic error	Systematic errors cause measurements to be consistently higher/lower than the true value by a fixed extent.
	Accuracy	The degree of closeness of a measured value to the true value of a quantity. An experiment that has small systematic errors is said to have high accuracy.
	Random errors	Random errors cause measurements to be scattered about a mean value.
	Precision	The degree of closeness between repeated measured values. An experiment with small random errors is said to have high precision.
Kinematics	Viscous drag force	The force which opposes the relative motion of a body moving through a fluid.
	Distance vs disp	Distance is the total length of the actual path travelled. Displacement is the straight line distance.
Forces	Hooke's law	States that within the limit of proportionality, the extension produced in a material is directly proportional to the load applied. (F=kx)
	Pressure	Is force per unit area, where force is acting perpendicular to area. (P=F/A)
	Density	Is mass per unit volume of substance.
	Upthrust	Is the net upward force exerted by a fluid on a body fully or partially submerged in the fluid, due to a difference in pressure.
	Principle of flotation	For a body floating in a fluid, the weight of the fluid displaced by the body is equal to the weight of the body.
	Torque MOMENT	Torque: turning effect of a couple Moment : The product of the magnitude of the force and the perpendicular distance of the line of action of the force to the pivot. (M=Fd)

	Couple	A pair of forces which are equal in magnitude but opposite in direction, and whose lines of action do not coincide (parallel). Produce rotation only.
	Principle of moments	For a body in rotational equilibrium, the sum of all clockwise moments about any point is equal to the sum of the anticlockwise moments about that same point.
	Rotational equilibrium	The net moment on the body about any point is zero.
	Translational equilibrium	The net force on the body is zero.
Dynamics	centre of gravity	point at which the whole weight of body appears to act
	N1L	An object at rest will remain at rest. An object in motion will remain in motion at constant velocity in a straight line unless acted upon by a resultant external force
	Inertia	Reluctance of a stationary body to start moving, or reluctance of a moving body to change its motion / Reluctance of a body to change its state of motion / Property of a body to stay in a state of rest or stay in motion at constant velocity in a straight line. Mass is a measure of inertia in a body to change in velocity.
	N2L	• (MAG) rate of change of linear momentum of body is directly proportional to net external force exerted on it • (DIR) change in momentum and net external force are in the same direction VS state the relation between force and momentum : force is equal to the rate of change of momentum. (SI units cause proportionality constant to be =1.)
	N3L	If body A exerts a force on body B, then body B will exert a force equal and opposite and of the same type to body A.
	linear momentum	(p=mv) product of mass and velocity And it is in the direction of the velocity

	POCOM	Total linear momentum of a system of interacting bodies remains constant provided there is no resultant external force acting on it.
	Impulse	product of average force exerted on body and time interval over which force is applied ($\Delta p=Ft$)
	head-on collision	Velocities before and after the collision are along the line joining the 2 centres of mass.
	perfectly inelastic collision	colliding bodies coalesce (stick together) and move off with common velocity after collision.
	Inelastic collision	Reference to the speed of the objects: Relative speed of approach of the objects is greater than the relative speed of separation. (cuz some KE is lost after collision)
WEP	POCOE	Energy cannot be created nor destroyed, and can only be converted from one form to another. The total energy of an isolated system is constant.
	Work done	The product of magnitude of the constant force acting on the body and the displacement of the body in the direction of the force. ($WD=Fd$)
	Energy	Is the stored ability to do work.
	Potential energy	Ability of a body to do work due to position (gpe/electric pe)/shape (elastic pe)
	Power	The rate of work done. ($P=E/t$)
	Efficiency	The ratio of useful power output to total power input.
CM	angular velocity (ω) units: rad s^{-1}	product of 2pi and frequency of circular motion ($\omega=2\pi f$) Rate of change of angular displacement
	period	Time taken for a body in CM to make a complete revolution

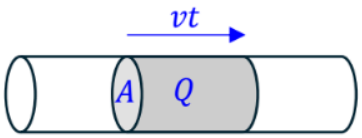
	frequency	Number of revolutions per unit time
Oscillations	SHM	($a=-\omega^2x$) ● acceleration is directly proportional to displacement ● acceleration in opposite direction to displacement
	Angular frequency (ω)	($w=2\pi f$) product of 2 pi and frequency of oscillation
	Displacement	Shortest possible distance in a specified direction from equilibrium position
	speed	Distance travelled by a wave per unit time v=f(lambda)
	Frequency	No. of complete waves per unit time
	Wavelength	Shortest distance between 2 points on a progressive wave which are oscillating in phase
	period	Time taken for 1 complete oscillation of a particle on the wave
	amplitude	Magnitude of the maximum displacement of a particle on a wave
	Wavefront	An imaginary line that joins all adjacent points that have the same phase of vibration
	damping	progressive decrease in amplitude of an oscillatory system caused by dissipative forces Explain damping: decrease in energy of an oscillating system over time.
	resonance	● driver frequency = natural frequency of driven system ● oscillatory system responds with maximum amplitude to an external periodic force ● there is maximum energy transfer
	refractive index of a medium	the ratio of speed of light in vacuum to the speed of light in the medium
	Ultrasound	Sound with frequency > 20 kHz

	Circular Motion	Oscillations
θ	angular displacement	phase (fraction of the cycle completed)
period T	time to complete one revolution	time to complete one cycle
frequency $f = \frac{1}{T}$	number of revolutions in 1 s	number of cycles in 1 s
$\omega = \frac{2\pi}{T} = 2\pi f$	angular velocity	angular frequency

Wave Motion	Progressive wave	• Energy is transferred in the direction of wave propagation • Waveform appears to be moving but particles (medium) do not get transported along the wave
	Transverse waves	Waves where direction of oscillation is perpendicular to direction of energy transfer (NOT wave propagation).
	Longitudinal waves	Wave where direction of oscillation is parallel (NOT same direction) to direction of energy transfer (NOT wave propagation).
	compression/rarefaction	region where particles are closest/furthest apart
	Phase difference	Phase difference between 2 particles on a wave measures the fraction of a cycle that 1 particle is moving out of step with the other particle (units: radian)
	Polarisation	Oscillations are confined to one direction only… …in a plane normal to the direction of energy transfer. - Oscillations confined to 1 dir - Plane normal

		- Dir of energy transfer if 2m: + only transverse waves can be polarised
	Unpolarised light wave	Oscillations are in all directions… …in a plane normal to the direction of energy transfer.
	Intensity	Power per unit area transferred across an area perpendicular to the direction of energy transfer. I=P/A
Superposition	Principle of superposition (interference)	When 2 or more waves of the same type meet at a point, the resultant displacement (NOT amplitude!) at that point is equal to the vector sum of the displacements due to the individual waves at that point.
	Stationary waves	Is formed when two identical progressive waves of the same type, amplitude, speed and frequency (coherent) travelling in opposite directions superpose.
	Observable interference	1. Coherence (same speed and frequency) 2. Equal amplitudes (good contrast) 3. For transverse waves, they must either be unpolarized, or polarised in the same plane
	Diffraction	spreading (NOT bending) of waves after passing through a slit (aperture) or around the edge of an obstacle
	Path difference	Difference in distances from the sources that one wave travels compared with another wave to reach a particular point
	Coherence	Constant phase difference between waves/sources of waves with time
	Constructive interference	● occurs when 2 waves have a phase difference of 0 rad and are in phase ● component waves superpose to form a resultant with maximum amplitude and intensity
	Destructive interference	● Occurs when the phase difference is π, waves are in antiphase ● Component waves superpose, resultant is minimum amplitude and intensity
	Resolving power	$(resolving\ power = \theta min = \frac{\lambda}{b})$ (minimum theta) (The angular separation from slit to the 2 sources) is equal to the ratio of wavelength to the slit width.

	Rayleigh's criterion	When two images are just resolved, the central maximum of the diffraction pattern of one image coincides with the first minimum of the diffraction pattern of the other image.
Temperature and Ideal Gases	The mole	One mole of any substance contains 6.02 x 10^23 particles.
	Ideal gas	An ideal gas obeys the equation of state pV=nRT. Define the variables in eqn: p = pressure of gas, v = volume of gas, R = molar gas constant (NOT 8.31), T = thermodynamic temperature of the gas
D.C. Circuits	EMF	Amount of non-electrical energy converted to electrical energy per unit charge when the source drives a charge around a complete circuit.
	PD	Amount of electrical energy converted to other forms of energy per unit charge when the charge passes through an electrical component.
	Resistance	The ratio of the potential difference V across it to the current I through it. (R=V/I) ● DO NOT USE R=rho L/A !! THIS IS ONLY FOR DEFINITION OF RESISTIVITY
	Current	Rate of flow of electric charge (Q=It)
	Resistivity	The product of resistance and cross sectional area divided by length of material. (R=rho L / A)
	Efficiency	It is the ratio between useful power output and power supplied.

		 [B1] clear diagram Let the amount of charge that flowed through a cross-section of the wire in a time of t be Q as shown in the shaded volume above. (Set context) The current I flowing through the cross section is given by $I = \frac{Q}{t} = \frac{Nq}{t}$ Where N is the total number of mobile charge carriers present in the shaded volume. $N = \frac{N}{V}(V) = n(Avt)$ where $V = Avt$ is the volume of the shaded cylinder and $\frac{N}{V}$ is the number of mobile charge carriers per unit volume (number density). Hence, $I = \frac{Nq}{t} = \frac{nAvtq}{t} = nAvq$ (shown) [A1] Explain what t, Q and V means.
First law of thermodynamics	Specific heat capacity (c)	(q=mc Δθ) Thermal energy transferred per unit mass per unit change in temperature
	Specific latent heat (l)	(q=ml) Thermal energy transferred per unit mass during the change of state at constant temperature
	Specific latent heat of fusion (l_f)	Thermal energy transferred per unit mass during the change of state between solid and liquid at constant temperature
	Specific latent heat of	Thermal energy transferred per unit mass during the change of state between liquid and gas at constant temperature

	vaporisation (l_v)	
	Internal energy	Sum of the random distribution of kinetic (*due to random motion of molecules) and potential energies associated with the particles of the system. - If qn asks for internal energy of an ideal gas, then internal energy is the sum of the random distributions of kinetic energies associated with the particles of the system. No potential energy cuz ideal gas!
	First Law	(ΔU=Q+W) Increase in internal energy of the system is equal to the sum of the heat (❌ thermal energy) supplied to the system and the work done on the system.
Gravitational Field	field of force (general)	A field of force due to a body's property (origin) is a region of space in which a force is experienced by another body that carries that property.
	gravitational field	a region of space in which a gravitational force is experienced by a mass placed in the region
	gravitational field strength	gravitational force exerted per unit mass acting on a small test mass placed at that point (g=F/m)
	newton's law of gravitation	(F=Gmm/r^2) the mutual gravitational force of attraction between 2 point masses is directly proportional to product of masses and inversely proportional to square of their distance apart - Point masses !!! - Dir proportional & inv proportional
	gravitational potential energy	work done (by an external force) to bring the mass from infinity to that point, (without accelerating it)
	gravitational potential	work done by an external force per unit mass in bringing a small test mass from infinity to that point
Electric field	Electric field	A region of space in which an electrical force is experienced by a stationary charge placed at any point within that region
	Electrical field	Electric force exerted per unit positive charge acting on a small stationary test charge placed at that point

	strength	(E=F/q)
	Coulomb's Law	(F=$\frac{Q1Q2}{4\Pi\varepsilon r2}$) Magnitude of the electrostatic force between 2 point electric charges is directly proportional to the product of the magnitude of each charge and inversely proportional to the square of the distance between the charges
	Electric potential energy	Work done (by an external force) in bringing the charge from infinity to that point, (without a change in kinetic energy).
	Electric potential	Work done (by an external force) per unit positive charge in bringing a small (positive) test charge from infinity to that point
Electromagnetism	Magnetic flux density	(F=BILsinθ → B=$\frac{F}{ILsin\theta}$) The magnetic flux density at a point in space is [the magnetic force per unit length per unit current] Acting on [a long straight current-carrying-conductor placed at right angles to the field at that point] ① B=F/IL ② I is perpendicular to B
EMI	Magnetic flux	product of the area and the component of the magnetic flux density perpendicular (or normal) to the area.
	Magnetic flux linkage	product of the magnetic flux passing through the coil and the number of turns of the coil. Also need to define magnetic flux
	Faraday's Law	Faraday's Law states that the magnitude of the induced e.m.f in a conductor is directly proportional to the (rate of change of magnetic flux linkage) or to the (rate of cutting of magnetic flux).
	Lenz's law	direction of emf induced is such that it tends to produce a current that creates a magnetic field so as to oppose the change in magnetic flux Emf → current → B field → so as to oppose…
AC	Root mean square value	The root-mean-square (r.m.s.) value of an alternating current (or voltage) is the value of alternating current (or voltage) that is equal to the steady direct current (or voltage) which would dissipate heat at the same average

		rate in a given resistor. (same <P>)
Quantum	Photon	- A quantum/packet of electromagnetic radiation - E=hf, where E=Energy of photon, f refers to frequency, h is planck constant
	Ionisation energy	Energy required to remove an orbital electron completely from an atom
	Emission line spectrum	Series of distinct coloured lines against a dark background.
	Absorption line spectrum	Series of distinct dark lines against a continuous spectrum
	Ground state	Electrons occupy all the lowest energy states available. (ie no excited electrons)
		Radius of proton is order of 10^{-15}m
Nuclear	Mass defect	The difference in sum of rest masses of constituent nucleons of a particular nucleus and the mass of the nucleus itself.
	Binding energy	- It is the energy required to separate all the nucleons in a nucleus to infinity - It is the energy equivalent of the mass defect of a nucleus - If qn asks “how is binding energy related to the mass defect”, you are expected to give a formula (BE=mass defect x c^2 where c is speed of light in free space)
	Nuclear fusion	The fusion of 2 nuclei (of smaller nuclear numbers) to form a single more massive nucleus (of larger nuclear number)
	Nuclear fission	The splitting of a more massive nucleus into two less massive nuclei of approximately the same nucleon number.
	Radioactive decay	Random, Spontaneous emission of ionising radiation of an unstable nucleus to form a different nucleus (not nuclide)
	Spontaneous decay	The rate of decay process is not affected by presence of other nuclides, external physical factors such as temp and pressure, or environmental factors

	Random decay	Although the probability of decay per unit time is constant, it is impossible to predict when a particular nucleus will undergo radioactive decay, or identify which nucleus will undergo radioactive decay next. - Experimental evidence: count rate on ratemeter connected to Geiger Muller tube shows fluctuations
	Activity	Rate of nuclear disintegrations
	Decay constant	Probability per unit time of the decay of a nucleus (it is a nucleus, so it's not rate of decay, it is probability)
	Isotope	Nuclei with the same proton number, different nucleon number.
	Half life	Average amount of time taken for half the number of radioactive nuclei present in any given sample of isotope to decay at any given time (← need this to show that half life can be measured at any time, not just at the start of decay)