Formulas Sheet

Chapter	Quantity	Formula	Instruction
1-Energy	*Speed*	$\vec{v}_{av} = \frac{\Delta \vec{r}}{\Delta t}$	Memorize
	Acceleration	$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t}$	Memorize
	U.R.M	$x = vt + x_o$ $v = constant$ $a = 0$	Memorize
	U.A.R.M	$x = \frac{1}{2}at^2 + v_o t + x_o$ $v = at + v_o$ $a = constant$ $v^2 - v_o^2 = 2ad$	Memorize
	Newton's 2nd law	$\Sigma \vec{F} = m.\vec{a}$	Memorize
	Kinetic energy	$K.E = \frac{1}{2}mv^2$	Memorize
	Gravitational potential energy	$P.E_g = mgh$	Memorize
	Elastic potential energy	$P.E_e = \frac{1}{2}k(l - l_o)^2 = \frac{1}{2}kx^2$	Memorize
	Mechanical energy	$M.E = K.E + P.E$	Memorize
	Work	$W = F.d$	Memorize
	Power	$P = \frac{W}{t}$	Memorize
2-Linear momentum	*Linear momentum*	$\vec{P} = m.\vec{v}$	Memorize
	Center of inertia of a system	$\vec{OG} = \frac{\Sigma m_i . \vec{OM_i}}{\Sigma m_i}$	Memorize
	Fundamental relation of dynamics	$\Sigma \vec{F}_{ext} = \frac{d\vec{P}}{dt}$	Memorize
	The conservation of linear momentum	$\Sigma \vec{F}_{ext} = \vec{0} \Rightarrow \vec{P}$ is constant $\vec{P} = \vec{P}'$	Memorize
	Elastic collision	$KE = K.E'$	Memorize
4-Mechanical oscillations	*Proper period*	$T_o = \frac{1}{f} = \frac{2\pi}{\omega_o}$	Memorize
	Differential equation	$x'' + \frac{k}{m}x = 0$ where $\omega_o^2 = \frac{k}{m}$	Derive
	Its solution	$x = x_m \sin(\omega_o t + \varphi)$ or $x = x_m \cos(\omega_o t + \varphi)$	Given
8-Electromagnetic induction	*Magnetic flux*	$\Phi = N.B.S.\cos\theta$	Memorize
	Faraday's law	$e = -\frac{d\Phi}{dt}$	Memorize
	Ohm's law applied to a generator:	$U_{AB} = e - ri$	Memorize
	Electric Power	$P = u.i$	Memorize

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9- Self-induction	*Inductance of a coil*	$\Phi = L.i$ where $L = \mu_o \frac{S.N^2}{\ell}$ in vacuum	Memorize
	Self-induced e.m.f	$e = -L\frac{di}{dt}$	Derive
	Ohm's law applied to a coil	$u = r.i + L\frac{di}{dt}$	Derive
	The current in an R-L (DC voltage) "Growth"	$E = L\frac{di}{dt} + R_e.i$ where $R_e = r + R$	Derive
	Its solution	$i = \frac{E}{R_e}(1 - e^{-\frac{R_e t}{L}})$	Given
	The current in an R-L (DC voltage) "Decay"	$0 = L\frac{di}{dt} + R_e.i$	Derive
	Its solution	$i = \frac{E}{R_e} e^{-\frac{R_e t}{L}}$	Given
	Time constant (coil)	$\tau = \frac{L}{R_e}$	Derive
	Magnetic energy stored in a coil	$E = \frac{1}{2}Li^2$	Memorize
10- Alternating sinusoidal current	*Capacitance of a capacitor*	$C = \frac{Q}{U}$ and $C_o = \epsilon_o \frac{S}{d}$ in vacuum	Memorize
	Stored energy in a capacitor	$E = \frac{1}{2}QU = \frac{1}{2}CU^2 = \frac{Q^2}{2C}$	Memorize
	Charging of the capacitor ($u_G = E$)	$E = u_C + RC\frac{du_C}{dt}$	Derive
	Its solution	$u_C = E(1 - e^{-\frac{t}{RC}})$	Given
	Discharging of the capacitor ($u_G = 0$)	$0 = u_C + RC\frac{du_C}{dt}$	Derive
	Its solution	$u_C = Ee^{-\frac{t}{RC}}$	Given
	Time constant (capacitor)	$\tau = RC$	Derive
	alternating sinusoidal voltage	$u = U_m \sin(\omega t + \varphi)$	Given
	Alternating current	$i = I_m \sin(\omega t + \varphi')$	Given
	Effective voltage and current	$U_{eff} = \frac{U_m}{\sqrt{2}}$; $I_{eff} = \frac{I_m}{\sqrt{2}}$	Memorize
	Frequency of RLC circuit	$f_o = \frac{\omega_o}{2\pi} = \frac{1}{2\pi\sqrt{LC}}$ where $\omega_o^2 = \frac{1}{LC}$	Memorize
	Average power	$P_{aver} = UI.\cos\varphi$	Memorize
11- Transformers	*Laws of transformations*	$\frac{U_2}{U_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2} = m$	Memorize
	Efficiency	$\eta = \frac{P_2}{P_1}$	Memorize

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ve aspect of . Diffraction	Wavelength	$\lambda = v \times T = \frac{v}{f}$	Memorize
	Index of refraction	$n = \frac{c}{v}$	Memorize
	Angular displacement between the central fringe and the k^{th} dark fringe	$\theta_{k\ (in\ rad)} \approx \sin\theta_k = k\frac{\lambda}{a}$	Memorize
	Angular width of the central spot	$\theta_o = 2\frac{\lambda}{a}$	Derive
14- Interference of light	Path difference: Bright Dark	$\delta = k\lambda$ $\delta = (2k'+1)\lambda/2$	Memorize
	Optical path difference	$\delta = d_2 - d_1 = \frac{ax}{D}$	Memorize
	Inter-fringe distance In vacuum	$i = \frac{\lambda D}{a}$	Derive
	Inter-fringe distance In a transparent medium	$i' = \frac{\lambda D}{na} = \frac{i}{n}$	Derive
16- Corpuscular aspect of light; Photoelectric effect	Energy of a photon	$E = h.\upsilon$ where $\upsilon = \frac{c}{\lambda}$ in vacuum	Memorize
	Einstein's equation	$h.\nu = W_o + \frac{1}{2}mv^2$	Memorize
17- The atom	Energy of an emitted photon	$E = E_i - E_f = h\upsilon \quad (E_i > E_f)$	Memorize
	Wavelengths of hydrogen spectrum	$\frac{1}{\lambda} = R(\frac{1}{p^2} - \frac{1}{n^2})$ where $p < n$	Memorize
	Energy of level n of the hydrogen atom	$E_n = -\frac{13.6}{n^2}$ eV	Given
18- Atomic nucleus	Number of neutrons	$N = A - Z$ if ${}^A_Z X$	Memorize
	Radius of nucleus	$r = r_o.A^{1/3}$	Derive
	Binding energy	$E_B = \Delta m.c^2 = [Z.m_p + (A - Z).m_n - m_X].c^2$	Memorize
	Binding energy per nucleon	$E_B/A = \Delta m.c^2/A$	Memorize
19- Radioactivity	Laws of conservation	${}^A_Z X \rightarrow {}^{A'}_{Z'} Y + {}^a_z P$ Conservation of atomic mass: $A = A' + a$ Conservation of mass number: $Z = Z' + z$ Conservation of energy: $E_X = KE_X + \Delta m.c^2$ where $\Delta m = m_{before} - m_{after} = m_X - (m_Y + m_P)$	Memorize
	Decay law	$N = N_0 e^{-\lambda t}$ where $N = \frac{m}{M}.N_A$	Memorize
	Activity	$A = -\frac{dN}{dt} = \lambda N$	Memorize
	Other form of decay law	$N = \frac{N_0}{2^n}$ where $t = nT$	Memorize
	Period	$T = \frac{0.693}{\lambda}$	Derive
20-Nuclear reaction	Conservation of energy	$(m.c^2 + KE)_{before} = (m'.c^2 + KE')_{after} + E_\gamma$	Memorize