XII PHYSICS FORMULAE SHEET

HEAT

Section	Topic	Formula
Section – I Heat and Temperature	Conversion of Fahrenheit into Celsius	$T_C = \frac{5}{9}(T_F - 32)$
	Conversion of Celsius into Fahrenheit	$T_F = \frac{9}{5}T_c + 32$
	Conversion of Kelvin into Celsius	$T_C = T_K - 273$
	Conversion of Celsius into Kelvin	$T_K = T_C + 273$
	Conversion of Kelvin into Fahrenheit	$T_F = \frac{9}{5}(T_k - 273) + 32$
	Conversion of Fahrenheit into Kelvin	$T_K = \frac{5}{9}(T_F - 32) + 273$
Section - II Thermal Expansion	Linear Thermal Expansion	$\alpha = \frac{\Delta L}{L_o \Delta T}$ & $L' = L_o(1 + \alpha\Delta T)$
	Volumetric Thermal Expansion	$\beta = \frac{\Delta V}{V_o \Delta T}$ & $V' = V_o(1 + \beta\Delta T)$
	Relation between linear and volumetric expansion	$\beta = 3\,\alpha$
Section – III Gas Laws	Boyle's Law	$PV = K$
		$P_1V_1 = P_2V_2$
		$\frac{P_1V_1}{m_1} = \frac{P_2V_2}{m_2}$
	Charles Law	$V/T = K$
		$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
	General Gas Equation	$PV = nRT$
Section – IV Kinetic Molecular Theory of Gases	Kinetic Gas Equation	$P = 1/3\,\rho V^2$
	Relation between Kinetic Energy and Temperature	$\frac{3}{2}kT = \frac{1}{2}mV^2$ (For one molecule)
		K.E. per mole = $(\frac{3}{2}kT) \times N_A$
	Root mean square velocity	$V_{rms} = \sqrt{\frac{3kT}{m}}$
		$V_{rms} = \sqrt{\frac{3RT}{M}}$
		$V_{rms} = \sqrt{\frac{3P}{\rho}}$
Section – V 1st Law of Thermodynamics	Isochoric Process	$\Delta Q = \Delta U$
	Isobaric Process	$\Delta Q = \Delta U + P\Delta V$
	Isothermal Process	$\Delta Q = \Delta W$
	Adiabatic Process	$\Delta U = -\Delta W$
	General Expression	$\Delta Q = \Delta U + \Delta W$

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Section VI Heat Capacity	Heat Capacity	$Q = c\Delta T$
	Specific Heat Capacity	$C = \frac{Q}{m\Delta T}$
	Molar Specific heat Capacity	$C = \frac{Q}{n\Delta T}$
	MSHC at constant pressure	$Q_p = nCp\Delta T$
	MSHC at constant volume	$Q_v = nCv\Delta T$
	Relation between 2 capacities	$Cp - Cv = R$
	Specific heat ratio	$\frac{C_p}{C_v} = \gamma$
	Latent Heat	$Q = mH_f$ $Q = mHv$
Section VII 2^{nd} Law of Thermodynamics	Work done	$\Delta W = Q_1 - Q_2$
	Efficiency	$\eta = \frac{\text{Work done}}{\text{Heat supplied}}$ or $\eta = \frac{Q_1 - Q_2}{Q_1}$
	% Efficiency	$\% \eta = \frac{Q_1 - Q_2}{Q_1} \times 100$
	% Efficiency	$\% \eta = \left[1 - \frac{Q_2}{Q_1}\right] \times 100$
	% Efficiency	$\% \eta = \left[1 - \frac{T_2}{T_1}\right] \times 100$
	Entropy	$\Delta S = \frac{\Delta Q}{T}$

ELECTROSTATICS

Section	Topic	Formula
Section I – Concept of Charge and Coulomb's Law	Quantization of Charge	$q = ne$
	Coulomb's Law	$F = k\frac{q_1 q_2}{r^2}$
Section II – Electric Field	In terms of test charge	$E = \frac{F}{q_o}$
	In terms of source charge	$E = \frac{kq}{r^2}$
Section III – Electric Flux and Gauss Law	Definition	$\Delta\phi = \vec{E}.\vec{A}$ $\Delta\phi = EA\cos\theta$
	Flux Density	$E = \frac{\Delta\phi}{A}$
	Gauss Law	$\Delta\phi = \frac{q}{\varepsilon_o}$
	Due to positively charged sheet	$E = \frac{\delta}{2\varepsilon_o}$
	Between two oppositely charged sheets	$E = \frac{\delta}{\varepsilon_o}$
	Outside a charged sphere	$E = \frac{\delta}{\varepsilon_o}\left[\frac{a}{r}\right]^2$ or $E = \frac{kq}{r^2}$
	On the surface of charged sphere	$E = \frac{\delta}{\varepsilon_o}$
	Inside a charged sphere	$E = 0$

Section IV – Electric Potential	Definition	$\Delta V = \frac{\Delta W}{q}$
	Potential gradient	$E = \frac{\Delta V}{\Delta r}$
	Absolute potential	$V = \frac{kq}{r}$
	Relation b/w K.E. and Electric potential	K.E. = $q_o \Delta V$
Section V - Capacitors	Capacitance	$C = \frac{q}{V}$
	Capacitance when air is between plates	$C = \frac{A\varepsilon_0}{d}$
	Capacitance in the presence of dielectric	$C' = \frac{A\varepsilon_0\varepsilon_r}{d}$ or $C' = C\,\varepsilon_r$
	Parallel combination	$C = C_1 + C_2 + C_3 + \ldots\ldots$
	Series combination	$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\ldots$
	Compound capacitor	$C_e = \frac{\varepsilon_0 A}{(d-t)+\frac{t}{\varepsilon_r}}$

CURRENT ELECTRICITY

Section	Topic	Formula
Section I – Electric Current	Definition	$I = \frac{q}{t}$
		$I = \frac{ne}{t}$
Section II – Ohm's Law	In terms of Resistance	V = IR
	In terms of conductance	I = kV (k=conductance)
Section III – Concept of Resistance and Conductance	In terms of Resistivity	$R = \frac{\rho L}{A}$
	Effect of Temperature	$\alpha = \frac{R_t - R_o}{R_o \Delta T}$
		$R_t = R_o\,(1 + \alpha\Delta T)$
	Series Combination	$R_e = R1 + R2 + R3 + \ldots\ldots$
		$R_s = nR$
	Parallel Combination	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\ldots$
		$R_p = \frac{R}{n}$
Section IV – Power Dissipation	Power Dissipation	$P = VI = I^2R = \frac{V^2}{R}$
	Heat Energy Dissipation	$H = VIt = I^2Rt = \frac{V^2}{R}t$
Section V – Concept of EMF, Terminal Potential Difference and Loss Voltage	Definition	EMF = T.P.D. + Loss Voltage
		$\varepsilon = IR + Ir$
		$\varepsilon = I\,(R + r)$
	Discharging Battery	V = E – Ir
	Charging Battery	V = E + Ir

Magnetism and Electromagnetism

Section	Topic	Formula
Section I – Introduction to Electromagnetism and Magnetic force	Force on a charge in magnetic field	$F = qVB \sin\theta$
	Force on a current carrying conductor in magnetic field	$F = BIL \sin\theta$
Section II – Charge to Mass Ratio of Electron	e/m ratio in terms of Velocity	$\frac{e}{m} = \frac{V}{Br}$
	Radius of circular path	$r = \frac{b^2}{2a}$
	Velocity by potential difference method	$V = \sqrt{\frac{2\Delta Ve}{m}}$
	Velocity selector method	$V = \frac{E}{B} = \frac{\Delta V}{dB}$
	e/m in terms of potential	$\frac{e}{m} = \frac{2\Delta V}{B^2 r^2}$
	e/m in terms of electric field intensity	$\frac{e}{m} = \frac{E}{B^2 r}$
Section III - Torque	Torque on a current carrying coil in magnetic field	$\tau = BINA \cos\alpha$
Section IV – Ampere's Law and its applications	Biot-sawart Law	$B = \frac{\mu_0 I}{2\pi r}$
	Ampere's Law	$\sum \vec{B}.\overrightarrow{\Delta L} = \mu_0$x net current
	Magnetic field due to Solenoid	$B = \mu_0 nI$ $(n = \frac{N}{L})$
	Magnetic Field due to Toroid	$B = \mu_0 nI$ $(n = \frac{N}{2\pi r})$
	Force between two wires	$F = \frac{\mu_0 I_1 I_2 L}{2\pi r}$
Section V – Magnetic Flux and Electromagnetic Induction	Magnetic Flux	$\Delta\phi = \vec{B}.\vec{A}$
		$\Delta\phi = BA\cos\theta$
	Flux density	$B = \frac{\Delta\phi}{A}$
	Faraday's Law	$emf = -N\frac{\Delta\phi}{\Delta t}$
		$emf = -\frac{\text{Flux linkage}}{\Delta t}$
	Mutual Induction and Inductance	$emf_s = -M\frac{\Delta I_p}{\Delta t}$
		$M = \frac{emf}{\frac{\Delta I_p}{\Delta t}}$ or $M = \frac{N\Delta\phi}{\Delta I_p}$
	Self Induction and Inductance	$emf = -L\frac{\Delta I}{\Delta t}$
		$L = \frac{emf}{\frac{\Delta I}{\Delta t}}$ or $L = \frac{N\Delta\phi}{\Delta I}$
	Transformer Equation	$\frac{N_s}{N_p} = \frac{E_s}{E_p} = \frac{I_p}{I_s}$
Section VI - Motional Emf	Motional EMF	$Emf = VBL \sin\theta$
	EMF in A.C. Generator	$Emf = N\omega AB \sin\theta$
		$Emf = N(2\pi f)AB\sin(2\pi ft)$

FROM THE DESK OF: TALHA SALEEM

Electrical Measuring Instruments

Instrument	Description	Formula
Galvanometer	Current through the coil	$I = \frac{c}{BAN}\theta$
	Sensitivity of Galvanometer	Sensitivity $\left(\frac{\theta}{I}\right) = \frac{BAN}{c}$
Ammeter	Resistance of Shunt	$Rs = \left(\frac{I_g}{I - I_g}\right) R_g$
Voltmeter	Resistance of Multiplier	$Rx = \frac{V}{I_g} - R_g$
Wheatstone Bridge	Balanced Wheatstone bridge	$\frac{R_1}{R_2} = \frac{R_3}{R_4}$
Meter Bridge	Unknown Resistance	$X = R\frac{l_x}{l_r}$
P.O. Box	Unknown resistance	$X = R\frac{Q}{P}$
Potentiometer	Compare two EMF's	$\frac{E_x}{E_s} = \frac{l_x}{l_s}$

Electronics

Topic	Description	Formula
Electromagnetic Waves	Speed of EM Wave	$C = \frac{1}{\mu_o \varepsilon_o}$
Transistor	Current	$I_E = I_B + I_C$
	Current Gain	$\alpha = \frac{I_C}{I_E}$

Advent of Modern Physics

Topic	Description	Formula
Special Theory of Relativity	Mass increment	$m = \frac{m_o}{\sqrt{1-\frac{V^2}{c^2}}}$
	Length Contraction	$l = l_o\sqrt{1-\frac{V^2}{c^2}}$
	Time dilation	$t = \frac{t_o}{\sqrt{1-\frac{V^2}{c^2}}}$
	Mass Energy Relation	$E = mc^2$
	Rest Mass Energy	$E_o = m_oc^2$
	Total Energy	$E = E_o + K.E.$
		$mc^2 = m_oc^2 + K.E$
Black Body Radiation	Wien's Displacement Law	$\lambda_{max} \times T =$ constant
	Stefan-Boltzmann Law	$E = \sigma T^4$
	Raleigh-Jeans Law	$E\lambda^4 =$ constant
	Planck's Quantum Theory	$E = \frac{hc}{\lambda}$
Photoelectric Effect	Photoelectric Equations	Total Energy = Work Function + Kinetic Energy
		$E = \phi_o + K.E$
		$h\nu = h\nu_o + \frac{1}{2}mV^2$
		$h\nu = h\nu_o + V_oe$
		$V_oe = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_o}\right]$

Compton's Effect	Compton's shift in wavelength	$\Delta\lambda = \frac{h}{m_o c}(1 - \cos\theta)$
Inter-conversion of matter and Energy	Pair Production	$h\nu = 2m_oc^2 + K.E_{e^-} + K.E_{e^+}$
	Annihilation of Matter	$2m_oc^2 + K.E_{e^-} + K.E_{e^+} = 2h\nu$
Wave nature of matter	De-Broglie's Wavelength	$\lambda = \frac{h}{P} = \frac{h}{mV}$
Heisenberg's Uncertainty Principle	Uncertainty of Position and momentum	$\Delta P.\ \Delta x = \hbar$
	Uncertainty of Energy and time	$\Delta E.\ \Delta t = \hbar$
	Kinetic Energy	$K.E. = \frac{\Delta P^2}{2m}$

Atomic Spectra

Topic	Description	Formula
Bohr's Model	Angular Momentum	$L = \frac{nh}{2\pi}$ or $L = mVr$
	Radius of nth orbital	$r_n = n^2 \times 0.53\ °A$
	Energy of nth orbit	$E_n = \frac{-13.6\ eV}{n^2}$
Hydrogen spectrum	Wave number	$\frac{1}{\lambda} = R_H \left[\frac{1}{p^2} - \frac{1}{n^2}\right]$

Nuclear Physics

Topic	Description	Formula
Radioactivity	Radioactive decay Law	$\frac{\Delta N}{\Delta t} = -\lambda N$
	Activity	$A = \frac{\Delta N}{\Delta t}$ or $A = \lambda N$
	Relation b/w radioactivity and time	$N = N_o e^{-\lambda t}$
Half - Life	Relation between Half life and decay constant	$T_{1/2} = \frac{0.693}{\lambda}$
	Calculate the number of nuclei decayed	$\frac{N}{N_o} = \left(\frac{1}{2}\right)^n$
Mass defect and binding Energy	Mass Defect	Δm = Mass of nucleons – Mass of Nucleus
	Binding Energy	Binding Energy = Δmc^2
	Binding Energy per nucleon (Packing Fraction)	Packing Fraction = $\frac{B.E}{A}$