PHY 124
Formulae

① $V = IR$

② $Q = It$

③ $Q = CV$

④ $Q = En$

⑤ $V = Ed$

E = dielectric strength
E = electric field
d = distance

⑥ $F = Eq$; Torque $\tau = PE$, P = dipole moment

⑦ $V = IR$

$I = V/R$, $V = E$

$I = \frac{E}{R} = \frac{E}{R+r}$

$I = \frac{E}{R+r}$

r = internal resistance.

⑧ Dipole moment (p)

$P = Qd$

⑨ Le Broglie formula

$\lambda = \frac{h}{P}$; P = momentum, P = mv

$\lambda = \frac{h}{mv}$

⑩ $R = \frac{\rho L}{A}$; $R \propto L$, $R \propto \frac{1}{A}$

$R = \frac{V}{I}$ (from V = IR)

$\frac{\rho L}{A} = \frac{V}{I}$

ρ = resistivity

$\frac{1}{\rho} = \sigma$ = conductivity

⑪ $F = Eq = ma$

$Eq = ma$

12 $P = \frac{V^2}{R} = I^2R = IV$

$P = IV\cos\theta$

$\cos\theta$ = Power factor

13 $W = mg$, $f = \frac{Qq}{\varepsilon A}$

$W = f$

$mg = \frac{Qq}{\varepsilon A}$; $E = \frac{Q}{\varepsilon A}$

⑭ $F = Eq$, $f = ma_c$

$a_c = \frac{v^2}{r}$

$F = \frac{mv^2}{r}$

f = f

$Eq = \frac{mv^2}{r}$

15 $\omega = \frac{v}{r}$, $\omega = 2\pi f$

$\frac{v}{r} = 2\pi f$

$f = \frac{1}{T}$

$Q = IT$

⑯ Current density J,

$J = I/A$

17 $E = F/Q = K\left(\frac{q_1}{r_1^2} - \frac{q_2}{r_2^2}\right)$

⑱ $I = \frac{NQ}{t}$

19 $V = m/d$,

$n = \frac{N}{V}$

N = no of electron (6.02×10^{23} per mole)
n = no of electron per unit volume
V = Volume

⑳ i no of atom = $n \times N_A$

ii 1 atom = n electron
x atoms = y electron

iii 1 electron = 1.6×10^{-19} C
x electron = y C

㉑ $C = \frac{\varepsilon A}{d} = \frac{\varepsilon_0 \varepsilon_r A}{d}$

$A = L \times b$

$U = \frac{KQq}{r}$; $U = Kq_1\left(\frac{q_2}{r_1} + \frac{q_3}{r_1}\right)$

$W_0 = eV_0$

22 $K.E = W_0 = QV = \frac{1}{2}mv^2$

23 $\omega = 2\pi f$

$X_L = 2\pi fL = \omega L$

$X_C = \frac{1}{2\pi fC} = \frac{1}{\omega C}$

$Z = \sqrt{(X_L - X_C)^2 + R^2}$; $(V_L - V_C)^2 + V_R^2$

Power factor = $\cos\theta$

Phase angle,

$\tan\theta = \left(\frac{X_L}{R}\right)$

$\tan\theta = \left(\frac{X_L - X_C}{R}\right)$

$E = E_0 \sin\omega t$

V = E

$V_{rms} = \frac{V_0}{\sqrt{2}}$; $V = \frac{C_1 V_0}{C_1 + C_2}$

Power loss $= I^2R$
$= IV\cos\theta$

$\cos\theta$ = power factor

$f = \frac{1}{2\pi\sqrt{LC}}$ from $X_L = X_C$, make f the subj.

$V = \sqrt{(V_L - V_C)^2 + V_R^2}$

24 $F = ma_c = \frac{mv^2}{r}$

$F = BQV$

f = f , $\frac{mv^2}{r} = BQV$

$r = \frac{mv}{BQ}$

25 $F = BQV$; V = velocity

$= BQV\sin\theta$

26 magnetic field

i ~~Straight~~ Round wire, $B = \frac{\mu_0 NI}{2r}$

ii ~~Round~~ Straight wire, $\frac{\mu_0 NI}{2\pi r}$

iii Solenoid, $B = \mu_0 NI$

flux density for solenoid,

$B = \frac{\mu_0 NI}{L}$

iv $B = \frac{\mu_0 Ve}{4\pi r^2}$; $V = 2.2\times10^{-6}$ velocity of e, $e = 1.6\times10^{-19}$ C

$\mu_0 = 4\pi\times10^{-7}$

N = turns

v ui vii viii 27 28 29 30 31 32 i v $F = \frac{\mu_0 I_1 I_2}{2\pi r}$

vi $E_{mf} = \frac{NAB\cos\theta}{t}$ A = area, t = time

vii Induced Emf $E = N\omega AB$ | Torque $\tau = BIAN$

viii $F = BIL$

27 $H = \frac{I}{2\pi x}$

28 $\phi = EA = EA\cos\theta = \frac{Q}{\varepsilon_0}$

A = area = πr^2

E = e. field = $\frac{Kq}{r^2} = \frac{Kq}{\varepsilon_r r^2}$

29 $E = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{\lambda}{2\pi\varepsilon_0\varepsilon_r r}$

30 $I = eVAn$

I = current, e = electronic charge, v = drift velocity, n = no of electron per unit volume

$n = \frac{N_A\, den}{M_0}$ vol = $\frac{mass}{den}$

31 $C^2 = a^2+b^2-2ab\cos C$

32 Electricity

$F = \frac{Kq_1q_2}{r^2} = \frac{Kq_1q_2}{\varepsilon_r r^2}$

electric potential, $V = \frac{Kq}{r}$ → $V_r = V_1+V_2$

$1e = 1.6\times10^{-19}$ J, $xe^- = y$ J

$E = \frac{Kq}{r^2}$ $F = Eq$

$W = \frac{Q_1 Q_2}{4\pi\varepsilon r}$

W = workdone $= \frac{Kq_1q_2}{r}$

For resultant force to be equal to zero, $F_1 = F_2$

$E_r = E_1+E_2 = \sqrt{E_1^2+E_2^2}$

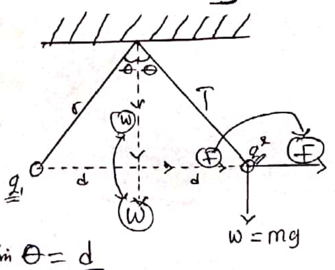
$R = R_0 e^{-\frac{t}{RC}}$

$V = V_0 e^{-\frac{t}{RC}}$

$Q = Q_0 e^{-\frac{t}{RC}}$

$I = I_0\left(1-e^{-\frac{Rt}{L}}\right)$

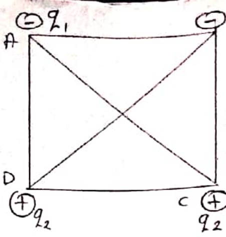
$R = R_0[1+\alpha(t-t_0)]$



$\sin\theta = \frac{d}{r}$

$\tan\theta = \frac{F}{W} = \frac{F}{mg}$

$F = \frac{Kq_1q_2}{r^2}$



$E_A = E_B$

$E_C = E_D$

$E_1 = E_A + E_C$

$E_2 = E_B + E_D$

$E_r = \sqrt{E_1^2+E_2^2}$

33 Field due to infinite LINE of charge

$E = \frac{\lambda}{2\pi\varepsilon_0 r}$

Field due to infinite SHEET of charge

$E = \frac{\sigma}{2\varepsilon_0}$ $\sigma = \frac{Q}{A}$

$E = \frac{Q}{2A\varepsilon_0}$ $F = EQ$

34 Transformers

$\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{I_p}{I_s}$

$I_t = I_g + I_s$

$I_g R_g = I_s R_s$

35 Efficiency $P = IV$

$E = \frac{\text{Power Output}}{\text{Power Input}} \times 100$

36 Potential divider

$\frac{V_{ac}}{R_{ac}} = \frac{V_{bc}}{R_{bc}}$

37 $F = eq = ma$

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

38 Bragg's law

$2d\sin\theta = n\lambda$

$2d\sin\theta = n\lambda$

d = interplanar spacing

n = order of reflection

λ = wavelength

θ = angle for order of reflection

39 Atomic/Nuclear Physics

$N = N_0 e^{-\lambda t}$

$A = A_0 e^{-\lambda t}$

where $\lambda = \frac{0.693}{t_{1/2}}$

$E = \frac{-13.6\,ev}{n^2}$ n = energy state

$E = W_0 - K.E_{max}$

where $E = hf = \frac{hc}{\lambda}$

$W_0 = eV_0 = \frac{1}{2}mv^2 = K.E$

Work function, W

$W = E_K$

$W = hf = \frac{hc}{\lambda}$

$\boxed{eV = 1.6\times10^{-19}}$

$E_K = hf - W_0$

$E_K = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$

$\lambda_1 - \lambda = \lambda_c(1-\cos\theta)$

$\lambda_c = 2.43\times10^{-12}$

$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$R_H = 1.097\times10^7$

Volume of Sphere (nucleus)

$V = \frac{4}{3}\pi r^3$

density = $\frac{Mass}{Volume}$

40 Potential

Magnetic potential, $V_m = \frac{m}{4\pi\mu_0 r} = \frac{Gm}{r}$

electric potential $V_e = \frac{q}{4\pi\varepsilon_0 r} = \frac{Kq}{r}$

$W = \frac{1}{2}CV^2$

$W = \frac{Q^2}{2C}$

$W = \frac{1}{2}QV$

$\sigma_i = \sigma\times\left(1-\frac{1}{K}\right)$

$\sigma = \frac{Q}{A}$

$K = \frac{\varepsilon}{\varepsilon_0}$

$u = \frac{1}{2}\varepsilon_0 E^2$

u = energy/volume = energy density

from $u = \frac{energy}{vol} = \frac{\frac{1}{2}CV^2}{Ad} = \frac{CV^2}{2Ad}$, $C = \frac{\varepsilon_0 A}{d}$, $\frac{V^2}{d^2} = E^2$