Radioactivity

① $A = -dN/dt = \lambda N$ (dN = disintegrating Nucelei; N = remained nuclei)

② N_0 = initial nuclei
N = remained nuclei.
n = no. of half life.

③ No. of Nuclei after n half life.

$$N = N_0/2^n \qquad n = \frac{t_{given}}{t_{1/2}}$$

$$t_{1/2} = \frac{0.693}{\lambda} \quad \text{or} \quad \frac{2.3 \log 2}{\lambda} = \frac{\ln 2}{\lambda}$$

④ Probability of decay:

$$\frac{N_0 - N}{N_0} \qquad 1 - \left(\frac{1}{2^n}\right)$$

Probability of survival of life

$$\frac{1}{2^n} \text{ or } \frac{N}{N_0}$$

⑤ Mean or Average life (τ)

$$\tau = \frac{1}{\lambda} = 1.44\, t_{1/2}$$

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

$$t = \frac{2.3}{\lambda} \log \frac{N_0}{N}.$$

$$t_2 - t_1 = \frac{2.3}{\lambda} \log \frac{N_1}{N_2}$$

$$t_{1/2} = \frac{0.693}{\lambda} = \frac{2.3 \log 2}{t_{1/2}}$$

Photoelectric effect & Dual Nature

① photoelectric efficiency

$$\eta = \frac{\text{no. of photo } e^- \text{ emmitted}}{\text{no. of photons incidented}}$$

② Einstein's photoelectric eqn

$$K_{max} = E - W = h\nu - h\nu_0$$

$$K_{max} = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

⇒ photoelectric emmission takes place instantaneously (10^{-10} sec)

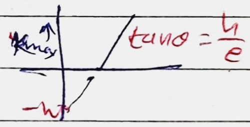
$hc = 12400$ eV-Å 20×10^{-26} J-m

$hc = 1240$ eV-nm

⇒ If energy of light radn becomes (n) times, then max. K.E of emitted photo e^- becomes greater than (n) times.

③ $eV_0 = K - W$

$$V_0 = \frac{h}{e}\nu - \frac{W}{e}$$



④ photon theory

a) No. of photons $= \frac{E}{h\nu}$

b) No of photons/time $(N/t) = \frac{\text{Power}}{h\nu}$

c) No. of photons/time/Area. $\frac{\text{Intensity}}{h\nu}$

W = Power, I = Intensity

⑤ momentum (P) $= E/c = h/\lambda$ - for photons.

Surface	ΔP	(F)	Radiation pressure
i) Perfectly reflecting	$\Delta P = 2E/c$	$F = 2W/c$	$P = 2I/c$
ii) Perfectly Absorbing	$\Delta P = E/c$	$F = W/c$	$P = I/c$
iii) partially reflecting having Reflecting coefficient	$\Delta P = \frac{E}{c}(1+r)$	$F = \frac{W}{c}(1+r)$	$P = \frac{I}{c}(1+r)$
iv) angle θ	$\Delta P = \frac{2E}{c}(\cos\theta)$	$F = \frac{2W}{c}(\cos\theta)$	$P = \frac{2I}{c}\cos\theta$

$$\boxed{2\sqrt{2} \approx 2.8}$$

$$\boxed{\frac{E}{\rho} = \frac{I}{A}}$$

⑥ De-broglie wavelength

$\Rightarrow \boxed{\frac{hc}{eV_{acc}}}$ $\lambda = \frac{h}{p} = \frac{hc}{E}$ (for only photons)

$\Rightarrow \lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mK}} = \frac{h}{\sqrt{2mqV_{acc}}}$ (for matters)

$\boxed{\lambda = 2\pi r}$

a) electron : $\lambda_{e^-} = \frac{12.27}{\sqrt{V}}$ Å

b) proton : $\lambda_p = \frac{0.128}{\sqrt{V}}$ Å $\Rightarrow \frac{0.1\sqrt{2}}{\sqrt{V}}$ Å

c) Deuteron : $\lambda_D = \frac{0.2}{\sqrt{V}}$ Å

d) α-particle : $\lambda_\alpha = \frac{0.1}{\sqrt{V}}$ Å

e) Neutron : $\lambda_N = \frac{30.83}{\sqrt{T}}$ — Temp

$\lambda_{gaseous\ atom} =$ $\boxed{\lambda_N = \frac{h}{\sqrt{3mK_BT}}}$ $= \lambda_{neutron}$

(K_B = Boltzmann const)

Kinetic energy (gaseous atom) : $\frac{3}{2}K_BT$

$$\boxed{\frac{1}{\alpha} = \frac{1}{\beta} + 1}$$

α = current gain for CB configuration

current amplification factor $\Rightarrow \beta$ = current gain for CE configuration

$\boxed{XOR \Rightarrow \bar{A}.B + A.\bar{B}}$

Semiconductors

$(w+x).(w+y) \Rightarrow w+(x.y)$

	Ge	Si	
	0.7	1.1	Eg — Energy gap
	0.3V	0.7V	V_B — potential barrier
	$\sim 10^{19}/m^3$	$\sim 10^{16}/m^3$	e^- density

$\Rightarrow \boxed{n_e \times n_h = n_i^2}$

$\Rightarrow i = n_e eAV_e + n_h eAV_h$ $\quad \sigma = n_e u_e + n_e u_h$

① mobility of e^- $\quad \boxed{u = \frac{|V_d|}{E}}$

$\boxed{\sigma = e(n_e u_e + n_h u_h)}$

① Forward biasing $\quad \boxed{V_{net} = V_{ext} - V_{barrier\ or\ diode}}$

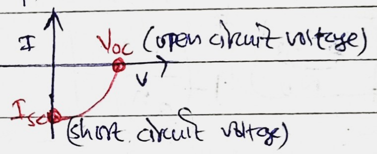
② Reverse biasing $\quad \boxed{V_{net} = V_{ext} + V_{Barrier}}$

zener diode → Reverse bias

LED — forward bias

photodiode — Reverse bias

solar cell —



✱ Transistor

(BE) ⇒ forward bias

(CE) ⇒ Reverse bias

I_c = collector current

I_B = base current

① $\beta = \frac{I_c}{I_B}$ (β = current gain)

② Voltage gain $= \frac{V_C}{V_B} = \beta_{BC} \times$ Resistance gain.

③ Resistance gain $= R_C/R_B$.

④ power gain ; $\beta \times$ Voltage gain $= \frac{(V_{gain})^2}{R_{gain}} \Rightarrow \beta^2 . R_{gain}$

Logic gates.

① OR Gate $\quad Y = A+B$

② AND Gate $\quad Y = A.B$

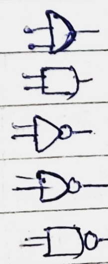
③ Not Gate $\quad Y = \bar{A}$

(fundamental gate)

④ NOR Gate (OR + NOT)

⑤ NAND (NOT + AND)

(universal gate)



$\overline{A+B} = \bar{A}.\bar{B}$ $\quad \overline{A.B} = \bar{A} + \bar{B}$

$\overline{\overline{A.B}} = A.B$ $\quad \overline{\bar{A}.\bar{B}} = A+B$

$\overline{\overline{A+B}} = A+B$ $\quad \overline{\bar{A}+\bar{B}} = A.B$