25.08.19
2nd A-Day

STRUGGLE

Modern Physics

~~Relo~~

Relativity

The process of relative measurement of a body / characterestics of a body is called the relativity.

1. Special Theory of Relativity: (mass, space, time)

The mass, space and time of any body is not absoutate. They are changable.

2. General Theory of Relativity (all of the universe).

* Reference Frame: When a point body is selected by three dimensional characteristic.

1. Inertial Reference frame.
2. ~~Un~~ Non inertial Reference frame.

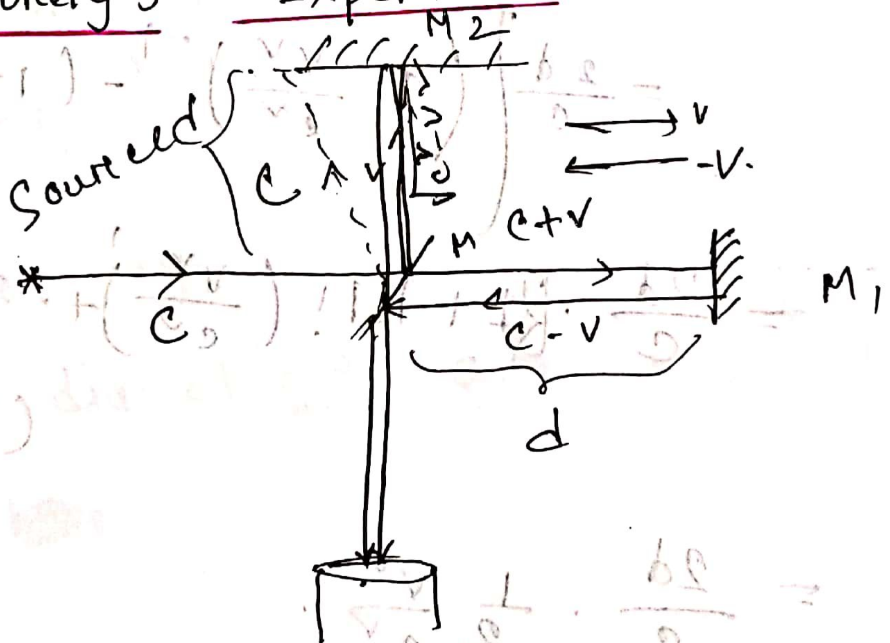
Inertial R.f: They have a constant or equal velocity respect to each other.

Postulates of the special Theory of relativity:

1. All ~~equations~~ law of physics can be expressed in equations having the same form in all inertial frames of reference. ~~frames of re~~

2. The velocity of light is always constant. ~~The~~ It is not dependent on the velocity of the observer.

Miealson - Morely's Experiment:



MM₁M.

$$t_1 = \frac{d}{c+v} + \frac{d}{c-v}$$

$$= \frac{2dc}{c^2 - v^2} = \frac{2dc}{c^2\left(1 - \frac{v^2}{c^2}\right)} = \frac{2d}{c\left(1 - v^2/c^2\right)} \quad \text{--- (1)}$$

After 90° ~~rotation~~ shift,

fringe shift ; $\Delta N = \frac{2\Delta t}{T}$.

$$= \frac{2\Delta t \cdot c}{\lambda}$$

$$= 2 \frac{d v^2}{c^3} \cdot \frac{c}{\lambda}.$$

$$= \frac{2d}{\lambda}\left(\frac{v^2}{c^2}\right) \longrightarrow (12).$$

$d = 11 m.$

$\lambda = 5.2 \times 10^{-7} m,$

$\frac{v}{c} = 10^{-4}.$

then, $\Delta N = 0.4.$

But they didnot get any value of ΔN.

So, light ~~wave~~

MM_2M, $t_2 = \frac{2d}{\sqrt{c^2-v^2}}$

$$= \frac{2d}{c\sqrt{1-v^2/c^2}}$$

$$= \frac{2d}{c}\left(1-\frac{v^2}{c^2}\right)^{-1/2} \text{ — (ii)}$$

Time difference, $\Delta t = t_1 \sim t_2$.

$$= \frac{2d}{c}\left[\left(1-\frac{v^2}{c^2}\right)^{-1} - \left(1-\frac{v^2}{c^2}\right)^{-1/2}\right]$$

$$= \frac{2d}{c}\left[\left\{1 + 1.1!\left(\frac{v^2}{c^2}\right)^1 + \cdots\right\} - \left\{1 + \frac{1}{2}.1!\left(\frac{v^2}{c^2}\right)^1 \cdots\right\}\right].$$

$$= \frac{2d}{c} \cdot \frac{1}{2}\frac{v^2}{c^2}$$

$$= \frac{dv^2}{c^3} \text{ — (iii)}$$

Lorentz Transformation:

$t = t' = 0.$

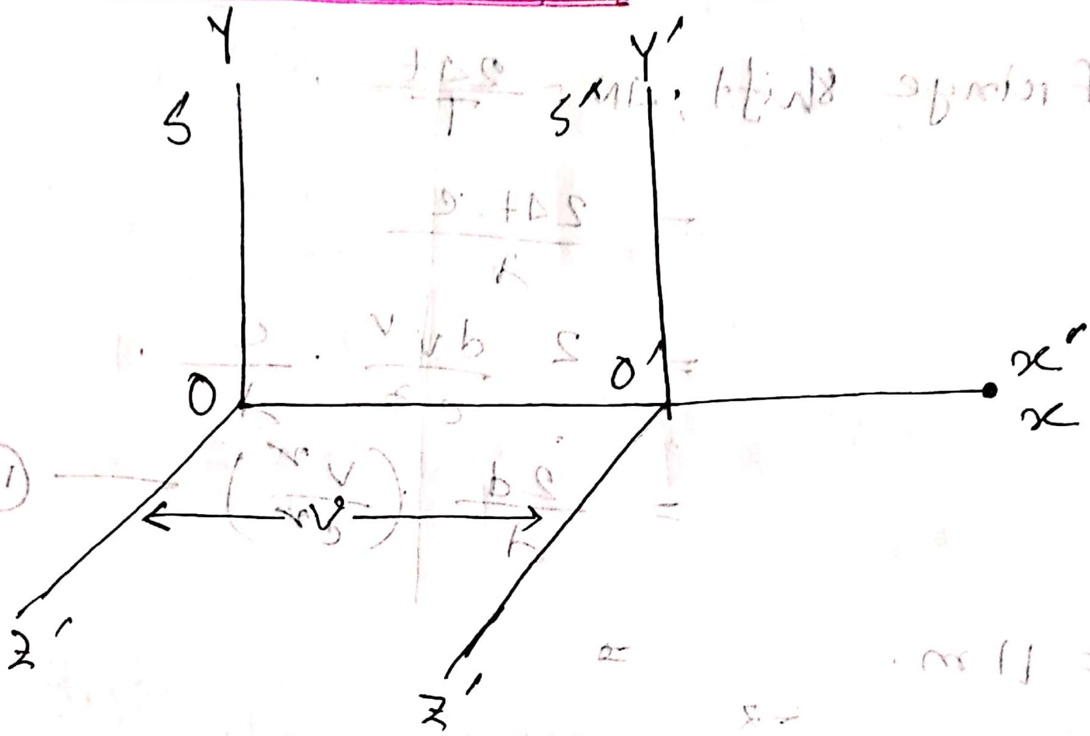
$x = ct$ ——— (I)

$x' = ct'$ ——— (II)

$x' = k(x - vt)$ ——— (III)

$x = k(x' + vt')$. ——— (IV)

4. Galilean Transformation:



1. $\boxed{x' = x - vt} \Rightarrow x = x' + vt$.

2. $y' = y$.

3. $z' = z$.

4. $t' = t$.

$$\therefore x' = \frac{x - vt}{\sqrt{1 - v^2/c^2}}$$

$$y' = y.$$

$$z' = z.$$

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - v^2/c^2}}$$

<u>Inverse Lorentz transformation</u>

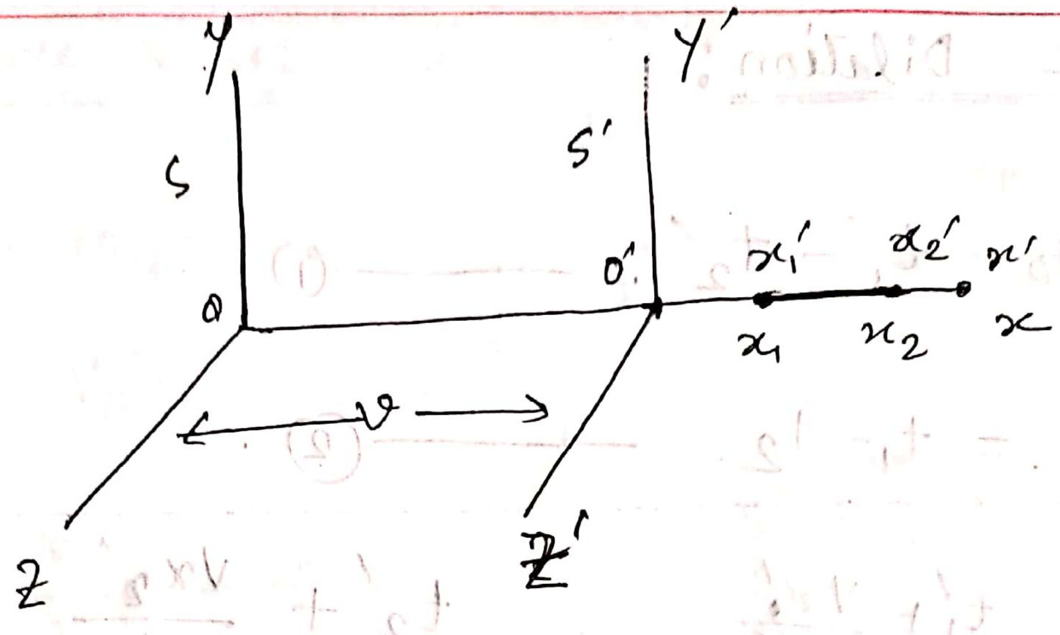
$$x = \frac{x' + vt'}{\sqrt{1 - v^2/c^2}}$$

$$y' = y.$$

$$z = z'.$$

$$t = \frac{t' + \frac{vx'}{c^2}}{\sqrt{1 - v^2/c^2}}$$

Space/Length contraction:



$$S, L_0 = x_2 - x_1 \quad \text{——— (1)}$$

$$S', L = x_2' - x_1' \quad \text{——— (2)}$$

$$L_0 = \frac{x_2' + vt'}{\sqrt{1 - v^2/c^2}} - \frac{x_1' + vt'}{\sqrt{1 - v^2/c^2}}$$

$$L_0 = \frac{x_2' - x_1'}{\sqrt{1 - v^2/c^2}} = \frac{L}{\sqrt{1 - v^2/c^2}}.$$

$$\therefore \boxed{L_0 = \frac{L}{\sqrt{1 - \frac{v^2}{c^2}}}}$$

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Time Dilation:

S', $t_0 = t_1' - t_2'$ ——— (1)

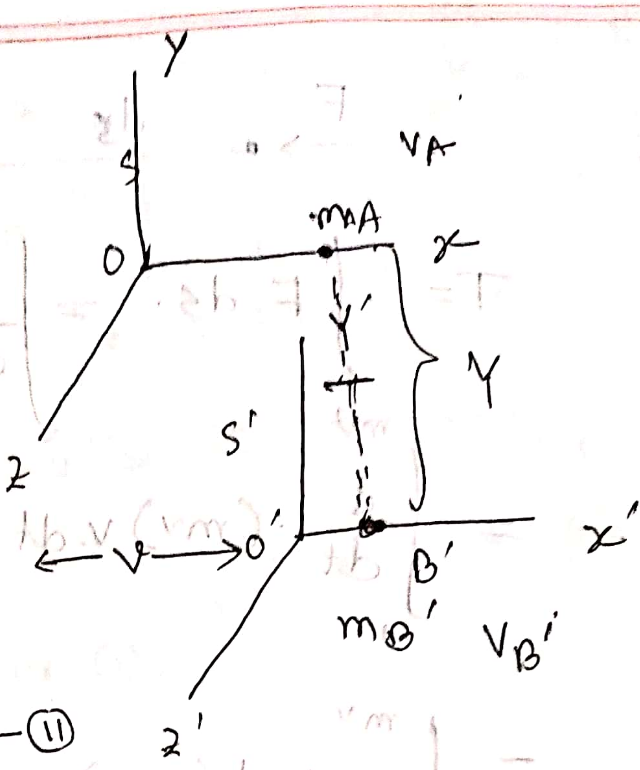
S, $t = t_1 - t_2$ ——— (2)

$$t = \frac{t_1' + \frac{vx_0'}{c^2}}{\sqrt{1 - v^2/c^2}} - \frac{t_2' + \frac{vx_0'}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$= \frac{t_1' - t_2'}{\sqrt{1 - v^2/c^2}} = \frac{t_0}{\sqrt{1 - v^2/c^2}}$$

$$\therefore \boxed{t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}}}$$

Relative Mass:



$m_A = m_B'$

$v_A = v_B'$

S,

$T_0 = \frac{Y}{v_A}$ —— (i)

S', $T = \frac{Y}{v_B'}$ —— (ii)

$m_A v_A = m_B' v_B'$ —— (iii)

$\Rightarrow m_A \frac{Y}{T_0} = m_B' \frac{Y}{T_0} \sqrt{1 - v^2/c^2}$

$\Rightarrow m_A = m_B' \sqrt{1 - v^2/c^2}$

$\Rightarrow m_B' = \frac{m_A}{\sqrt{1 - v^2/c^2}}$

$m_A = m_0$, $m_B' = m$.

$\therefore \boxed{m = \frac{m_0}{\sqrt{1 - v^2/c^2}}}$

$$F \longrightarrow \bullet \xrightarrow{ds}$$

$$T = \int F \cdot ds = \int \frac{d}{dt}(mv) \cdot ds$$

$$= \int_0^{mv} \frac{d}{dt}(mv)\, v \cdot dt$$

$$\frac{ds}{dt} = v$$

$$ds = v \cdot dt$$

$$= \int_0^{mv} v \cdot d(mv)$$

$$= \int_0^{mv} v \cdot (m \cdot dv + v\,dm)$$

$$T = \int_0^{mv} (mv \cdot dv + v^2 dm) \quad \text{—— (1)}$$

And we know,

$$\boxed{m = \frac{m_0}{\sqrt{1 - v^2/c^2}}}$$

3. Physics for engineers part - II

3. B.Sc physics - V (III)
→ Arroora.

8. Concept of modern physics
— Bizerx

A Text book of modern physics.
— Razon.

Modern physics — B.L Tharaja.

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$\Rightarrow 1 - \frac{v^2}{c^2} = \frac{m_0^2}{m^2}$

$(m - m_0)c^2 + m_0c^2$

$\Rightarrow mc^2$

$\Rightarrow m^2c^2 - m^2v^2 = m_0^2 c^2$

$\Rightarrow 2m\,dm\,c^2 - 2m\,dm\,v^2 - m^2 2v\,dv = 0$

$\Rightarrow c^2 dm = v^2 \cancel{dm} \cancel{mvdv}$. $v^2 dm + mv\,dv$ ⟵ (11)

Puting the value in (1),

$$T = \int_{m_0}^{m} c^2\,dm = \int_{m_0}^{m} mc^2 = mc^2 - m_0c^2$$

$\Rightarrow \cancel{T = E - m_0c^2}$

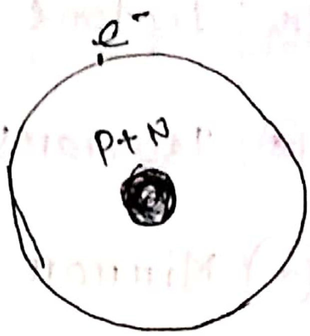
$$\therefore \boxed{E = T + m_0c^2 = mc^2}$$

Nucleare physics.

~~New~~

Nucleon: particles stay inside the nucleus.

$_{Z}X^{A} / X_{Z}^{A}$



A = mass number of nucleon.
(number of ~~mo~~ nucleon).

mass number ①
①2) 8563 a.m.u
mass

Z = Number of proton = Atomic number.

N = (A - Z).

Nomenclature:

Nuclei → mass number and nuclear number same

Nuclide → X_{Z}^{A}, Y_{Z}^{A}

Isotops → ~~mass number~~ ~~and~~ atomic number same but mass number different.

Isobars →

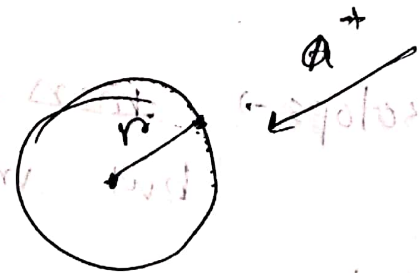
Isotone →

Isomass →

Mirror nuclei → mass number same and atomic number is inverse to other's ~~ne~~ nutron number.

$_3Br^7$ | $_4Li^7$
$Z = 3, N = 4$ | $Z = 4, N = 3$.

Nuclear Radius, r: where a ~~part~~ charged partical first feel the force coming from distant place then the distance between this point and the center is called nuclear Radius.



$\frac{4}{3}\pi r^3 \propto A.$

$\Rightarrow r^3 \propto A$

$\Rightarrow r \propto A^{1/3}.$

$\therefore R = r_0 A^{1/3}$ where, $r_0 = 1.3 \times 10^{-15} = 1.3$ fermi.

Nuclear Density; ρ_N :

$$\rho_N = \frac{\text{Nuclear mass}}{\text{Nuclear volume}}$$

$$\cancel{N.\text{Mass} = A}.\, M_{an} = \frac{A \cdot M_N}{\frac{4}{3}\pi R^3}$$

$$= \frac{A \cdot M_N}{\frac{4}{3}\pi r_0^3 A}$$

$$= \frac{M_N}{\frac{4}{3}\pi r_0^3}$$

Nuclear force :

Mass Defect : ΔM,

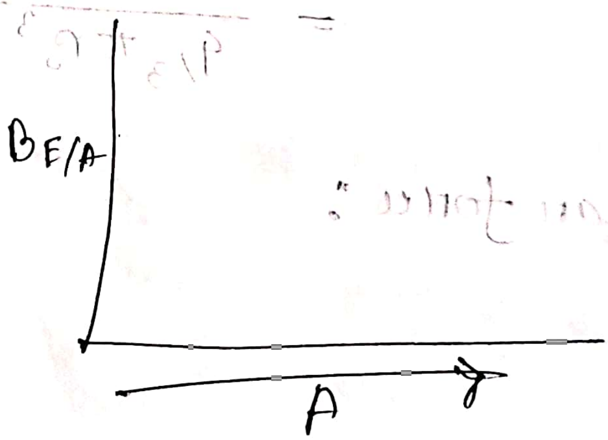
Σ Mass of nucleons > Σ Mass of the nucleus.

Difference between mass number and real mass is mass defect.

Binding energy : B_E.

For construction of Bonding or

Average Binding energy : $B_{E/A}$:



17.09.19
5th A

Nuclear Reaction: The reaction in which it is possible to bring about a change in the structure of nuclei by bombardment them with fast moving particle. as a result the identity or characterestics or energy or both of the stracted particle . is called Nuclear Reaction.

fast particle

Target nucleus

$$a + X \longrightarrow X + a.$$

$$\longrightarrow X^{*} + a.$$

$$\longrightarrow Y + \text{Energy}.$$

$$\longrightarrow Y + b.$$

Ideal Reaction,

$$a + X \longrightarrow Y + b.$$

$$X(a, b)\, Y$$

$${}_7N^{14} + {}_2He^4 \longrightarrow {}_8O^{17} + {}_1H^1$$

$${}_7N^{14}({}_2He^4, {}_1H^1)\,{}_8O^{17}$$

$${}_7N^{14}(\alpha, p)\,{}_8O^{17}.$$

1. Elastic reaction: After reaction physically no change.

2. Inelastic reaction: After reaction physically changed.

   i) Exothermic reaction.

   ii) Endothermic reaction.

Q-Value of Nuclear Reaction.

Total energy released or absorbed by the reaction.

Kinetic energy difference between of incident and product particle of the reaction.

$$a + X \longrightarrow Y + b.$$

$$E_a + m_a c^2 + (0 + m_x c^2) \Rightarrow (E_Y + m_Y c^2) + (E_b + m_b c^2).$$

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

$$P.E = m_0 c^2.$$

$$(E_Y + E_b - E_a) = \left[(m_a c^2 + m_x c^2) - (m_Y + m_b)\right] c^2.$$

$$= \Delta m c^2.$$

$$\therefore Q = E_Y + E_b - E_a = \Delta m c^2.$$

at x-axis,

$$m_a v_a = m_y v_y \cos\phi + m_b v_b \cos\theta \quad \text{--- (I)}$$

at y-axis,

$$0 = m_b v_b \sin\theta - m_y v_y \sin\phi \quad \text{--- (II)}$$

(I) $\Rightarrow$ $m_y v_y \cos\phi = -m_b v_b \cos\theta + m_a v_a$ --- (III)

(II) $\Rightarrow$ $m_y v_y \sin\phi = m_b v_b \sin\theta$ --- (IV)

(III)^2 + (IV)^2 $\Rightarrow$

$$m_y^2 v_y^2 = m_a^2 v_a^2 - 2 m_a m_b v_a v_b \cos\theta + m_b^2 v_b^2 \cos^2\theta + m_b^2 v_b^2 \sin^2\theta$$

$$= m_a^2 v_a^2 - 2 m_a m_b v_a v_b \cos\theta + m_b^2 v_b^2 \quad \text{--- (V)}$$

$E_a = \frac{1}{2} m_a v_a^2$ $\qquad v_y^2 = \frac{2E_y}{m_y}$, $v_b^2 = \frac{2E_b}{m_b}$.

$v_a^2 = \frac{2E_a}{m_a}$

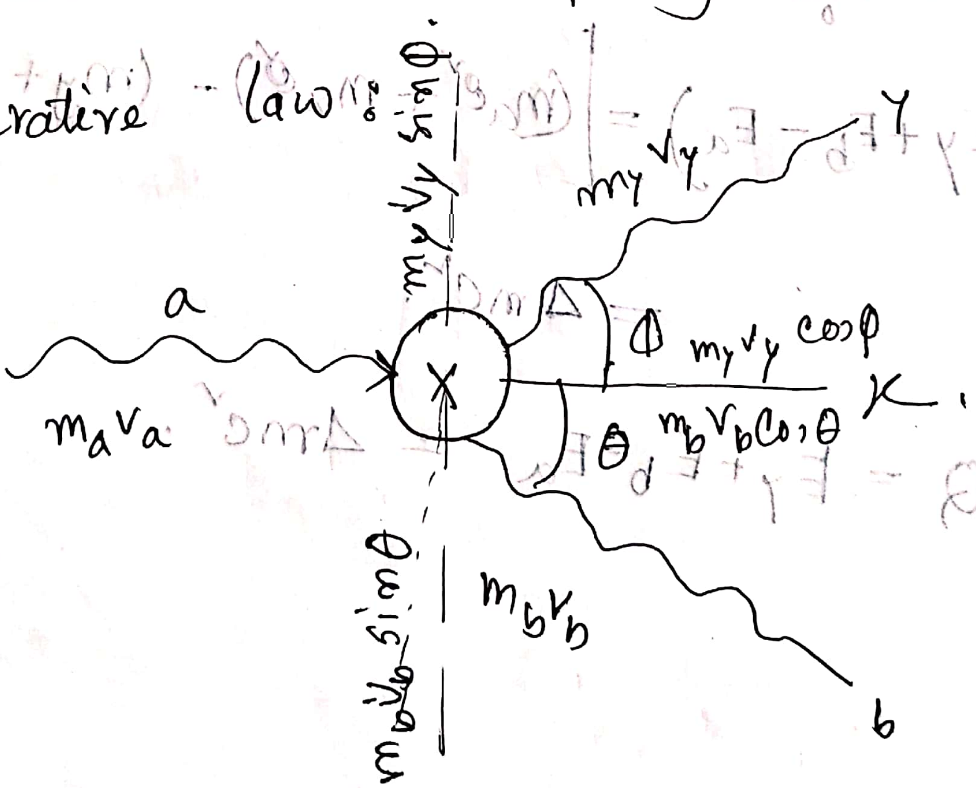
⊞ Significance of Q- value of N.R:

1. $Q > 0 \Rightarrow$ Exothermic Reaction
   Q_{+ve}
2. $Q < 0 \Rightarrow$ Endothermic Reaction.

Inelastic Reaction

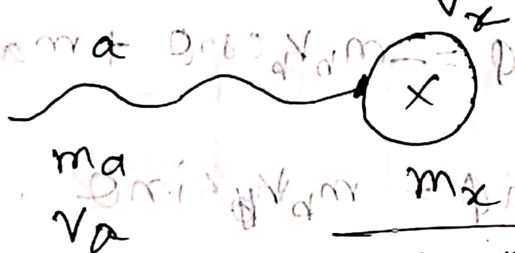
3. $Q = 0 \Rightarrow$ Elastic reaction

Q-Value with the help of mass-velocity conservative law:



Threshold Energy, E_{th} of N.R:

Threshold energy is the minimum energy which is required to start a nuclear reaction. / E_{th} is the intermidiate state of nuclear Reaction.



$m_c = m_a + m_x$.

$v_c = ?$

Compound Nucleus. C

$$m_a v_a = m_c v_c$$

$$\Rightarrow v_c = \frac{m_a v_a}{m_c} = \left(\frac{m_a}{m_a + m_x}\right) v_a .$$

We know, $Q = (E_y + E_b) - E_a$

$$= E_c - E_a .$$

$$\Rightarrow -Q = E_a - E_c .$$

$$= \frac{1}{2} m_a v_a^2 - \frac{1}{2} m_c v_c^2 .$$

$$= \frac{1}{2} m_a v_a^2 - \frac{1}{2}(m_a + m_x) \cdot \left(\frac{m_a}{m_a + m_x}\right)^2 \cdot v_a^2$$

$$= \frac{1}{2} m_a v_a^2 - \frac{1}{2} m_a v_a^2 \cdot \left(\frac{m_a}{m_a + m_x}\right)$$

$$= \frac{1}{2} m_a v_a^2 \left[1 - \frac{m_a}{m_a + m_x}\right]$$

$$-Q = \underbrace{\frac{1}{2} m_a v_a^2}_{E_{Th}} \cdot \left(\frac{m_x}{m_a + m_x}\right)$$

$$\Rightarrow E_{Th} = -Q \left(\frac{m_a + m_x}{m_x}\right)$$

$$\boxed{E_{Th} = -Q \left[1 + \frac{m_a}{m_x}\right]}$$

when, $a = \gamma$, $m_\gamma = 0$

$\therefore E_{Th} = -Q$

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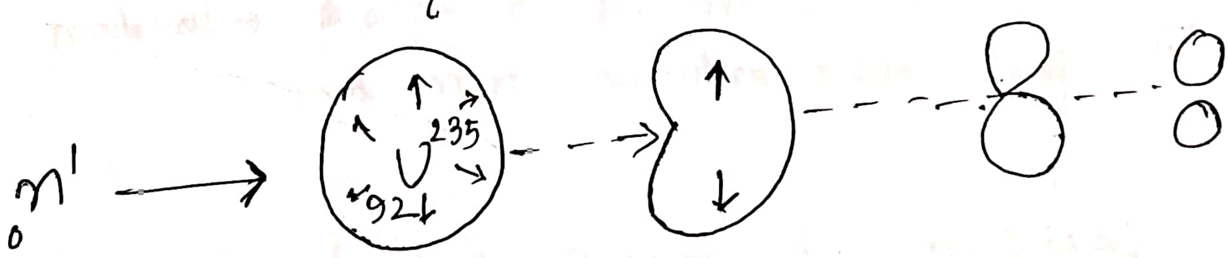
$$\boxed{\therefore \alpha = \frac{1}{Nt}\cdot\frac{n_r}{n_i^0}}$$

Nuclear Fission:

$$ {}_0n^1 + {}_{92}U^{235} \longrightarrow \underbrace{{}_{40}Zr^{98} + {}_{52}T^{135}}_{\text{Fission fragment}} + 3\,{}_0n^1 + \text{Energy}$$

Liquid Drop Model:

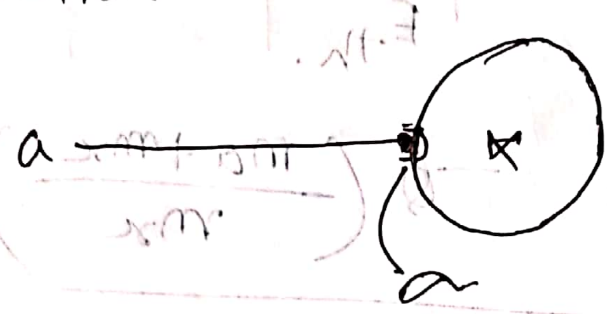
two force acting
surface tension + Repulsion force

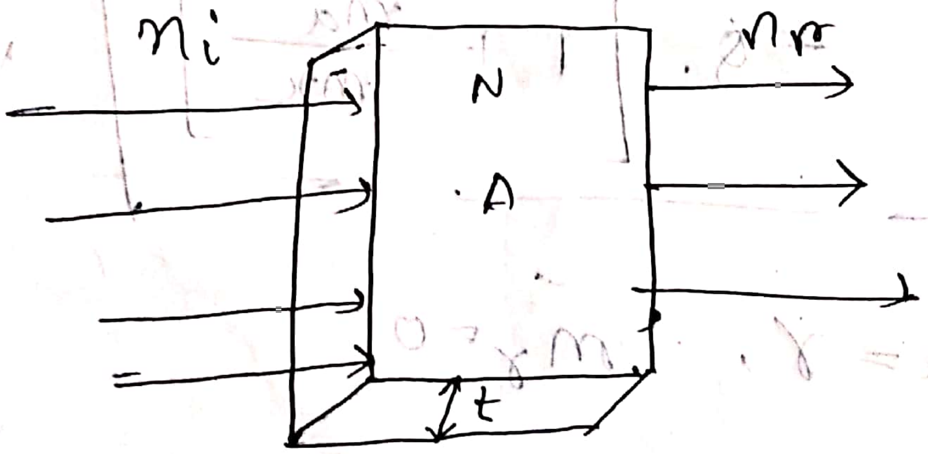


Cross section of a N.R, σ :

Explosing area of the nuclear reactant and that area is called the cross-section of a N.R.

Exposing section area





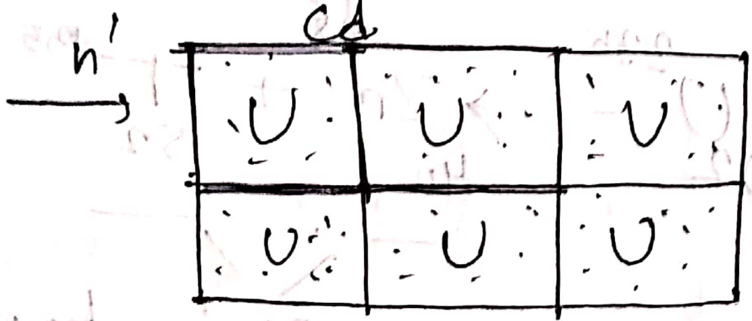
$$\frac{n_r}{n_i} = \frac{N\sigma A t}{A} = \sigma N t$$

Chain Reaction:

1. Uncontrolled chain Reaction.

2. controlled chain Reaction.

Nuclear Reactore



cd - rod to absorb n^1_0

Modaretore :- cd - rod, grafite, water.

10.10
7th P. day

Radioactivity.

The process of disintegration of the materials by giving out the α, β, γ - ray radiation.

Radioactive material $\longrightarrow$ radioactive rays (α, β, γ).

Radioactively:

① Natural Radioactivity.

② Artificial Radioactivity.

Natural Radioactivity: Process of spontaneous ~~continuous~~ disintegration of the heavy materials by giving out the α, β, γ ray. ~~atom~~

Heavy material → atomic number ≥ 82
and mass number $\geq$ ~~260~~ 206.

Artificial Radioactivity: Process of artificial disintegration of the lighter materials by giving out the α, β, γ rays.

Spontaneous: heavy materials have highere atomic number ~~and~~ and so the collusion between the ~~neutron~~nuclei is more and

characteristics of radioactive materials:

(i) Atomic number 82 or more than 82. or mass number 260 or more than 260.

(ii) Spontaneous

(iii) They make new material or ~~new~~ nucleus.

(iv) ~~It~~ The reaction does not depend on external system like heat, & pressure.

(v) Materials which radiate α, β, γ.

(vi) Rate of disintegration of the substance at instant is proportional to the number atoms present at that time.

Rate of disintegration of the substance at instant is proportional to the number of atoms present at that time.

$$\frac{dN}{dt} \propto N.$$

$$\Rightarrow \frac{dN}{dt} = -\lambda N.$$

$$\lambda = -\frac{dN/dt}{N}$$

λ is the reation of the substance ~~of~~ at instant and the number of atoms present at that time.

$$\frac{dN}{dt} = -\lambda N. \quad \text{---} (1)$$

$$\Rightarrow \frac{dN}{N} = -\lambda dt$$

After integration;

$$\Rightarrow \ln N = -\lambda t + c \quad \text{———— (ii)}$$

$t = 0, \; N = N_0$.

$$\ln N_0 = c. \quad \text{———— (iii)}$$

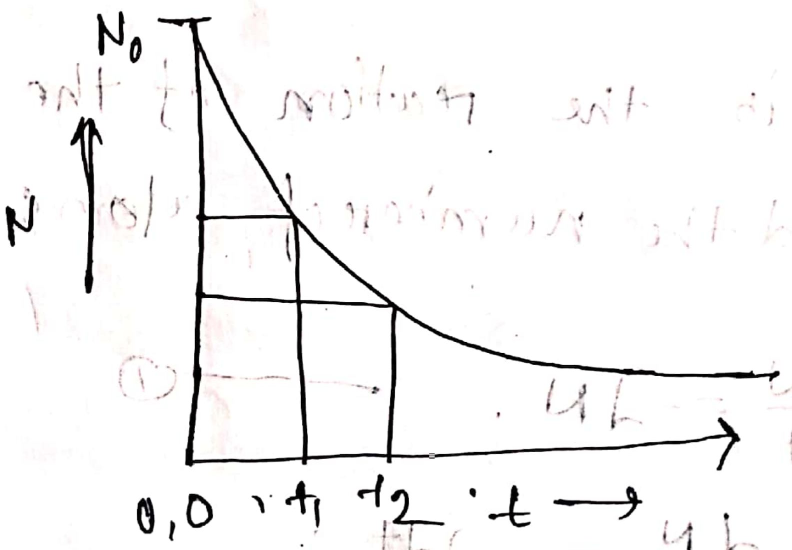
Now, (ii)

$$\ln N = -\lambda t + \ln N_0.$$

$$\Rightarrow \ln \frac{N}{N_0} = -\lambda t.$$

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

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



$\cancel{t}$ $t = \frac{1}{\lambda}$.

$\cancel{\lambda}$

$$N = N_0 e^{-\lambda \cdot \frac{1}{\lambda}}$$

$$\Rightarrow \frac{N}{N_0} = \frac{1}{e}$$

যদি $t = \frac{1}{\lambda}$ হয় তবে $\boxed{\frac{N}{N_0} = \frac{1}{e}}$

Instaneous decay of any materials is equal to $\frac{1}{e}$.

Half life time; $T_{1/2}$

Average / Mean lifetime, τ or T_a or T_m.

Half life time, $T_{1/2}$

$$\frac{N_0}{\cancel{2}} = N_0 e^{-\lambda t} \qquad \left| \; N = \frac{N_0}{2}, \; t = T_{1/2} \right.$$

$$\Rightarrow \frac{N_0}{2} = N_0 e^{-\lambda T_{1/2}}$$

$$\Rightarrow 2 = e^{\lambda T_{1/2}}$$

$\Rightarrow \ln 2 = \lambda T_{1/2}$.

$\Rightarrow T_{1/2} = \dfrac{\ln 2}{\lambda}$.

$\therefore T_{1/2} = \dfrac{0.693}{\lambda}$.

2. Mean life time, τ :

The sumation of the lifetime of all atoms and number of original atoms.

$-dN = \lambda N dt$.

$= \lambda N_0 e^{-\lambda t} dt$.

$\int_0^{\infty} -dN \cdot t$ $\rightarrow$ total life time.

$\therefore \tau = \dfrac{\int_0^{\infty} \lambda N_0 e^{-\lambda t} dt \, t}{N_0}$

$= \lambda \cdot \int_0^{\infty} t \, e^{-\lambda t} dt$.

$$= \lambda \left[\frac{e^{-\lambda t}}{-\lambda} - \int \left\{ \frac{e^{-\lambda t}}{-\lambda} \right\} dt \right]_0^{\alpha}$$

$$= \lambda \left(\frac{e^{-\lambda t}}{-\lambda} t - \frac{e^{-\lambda t}}{\lambda^2} \right)_0^{\alpha}$$

$$= -\frac{1}{\lambda} \left[t e^{-\lambda t} \cdot (\lambda t + 1) e^{-\lambda t} \right]_0^{\alpha}$$

$$= -\frac{1}{\lambda} \left[0 + -1 \right]$$

$$\tau = \frac{1}{\lambda}$$

$$\boxed{\tau = \frac{1}{\lambda} = \frac{T_{1/2}}{0.693}}$$

Activity: Activity is the rate of disintegration of the radioactive material.

$$A = \frac{dN}{dt} = -\lambda N$$

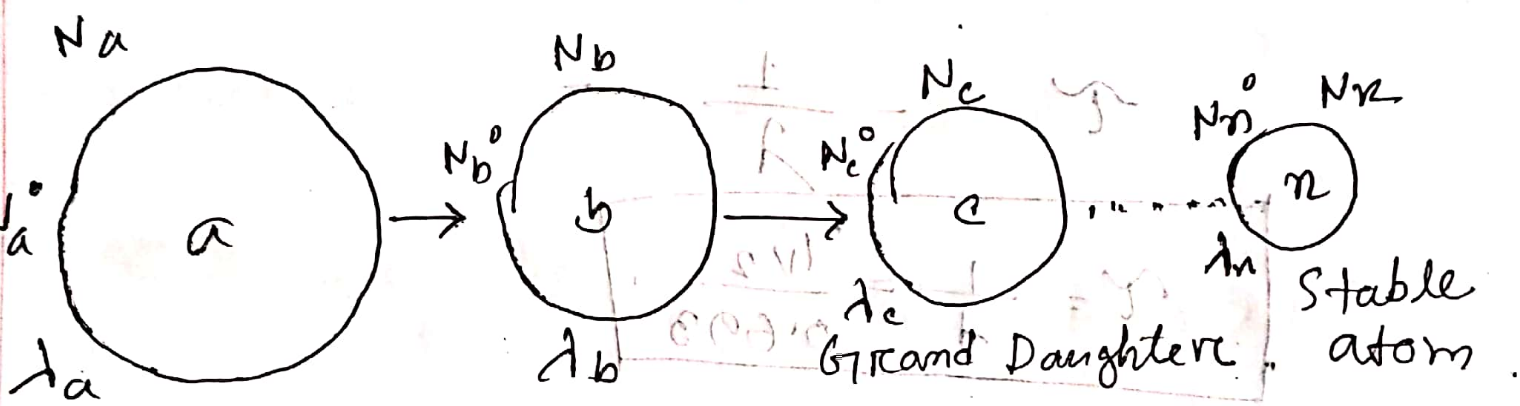
$t_0 = 0$, $A_0 = -\lambda N_0$

$$\frac{A}{A_0} = \frac{-\lambda N}{-\lambda N_0} = \frac{N_0 e^{-\lambda t}}{N_0}$$

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

Radioactive Equilibrium:

radioactive equilibrium is the process of radioactive material which maintance ~~the reale~~ equilibrium rate of disintegration of the radioactive material between parents and product atoms.



Parent atom   Product atom

Daughter atom

Production of b

$$\frac{d}{dt}(N_b) = \frac{d}{dt}(N_a) - \frac{d}{dt}(N_b).$$

$$= \lambda_a N_a - \lambda_b N_b$$

$$= \lambda_a N_a^0 e^{-\lambda_a t} - \lambda_b N_b.$$

$$\frac{dN_b}{dt} + \lambda_b N_b = \lambda_a N_a^0 e^{-\lambda_a t}. \quad \text{——— (I)}$$

after multiplication with $e^{-\lambda_b t}$.

$$\Rightarrow \frac{dN_b}{dt} \cdot e^{-\lambda_b t} + \lambda_b N_b e^{-\lambda_b t} = \lambda_a N_a^0 \cdot e^{(\lambda_b - \lambda_a)t}.$$

$$\Rightarrow \frac{d}{dt}\left(N_b e^{-\lambda_b t}\right) = \lambda_a N_a^0 e^{(\lambda_b - \lambda_a)t}.$$

after integration

$$N_b e^{\lambda_b t} = \cancel{\lambda_a N_a^0} \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 \cdot e^{(\lambda_b - \lambda_a)t} + C, \quad \text{——— (II)}$$

$$\Rightarrow \cancel{N_b = \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 \cdot e^{(\lambda_b - \lambda_a)t}} + C,$$

$t = 0$, $N_b = 0$.

$$\text{(II)} \Rightarrow \quad c = -\frac{\lambda_a}{\lambda_b - \lambda_a} \cdot N_a^0. \quad \text{——— (III)}$$

Now,
$$N_b = \frac{\lambda_a}{\lambda_b} N_a^0 \left[e^{-\lambda_a t} - 0 \right].$$

$$= \frac{\lambda_a}{\lambda_b} N_a^0 e^{-\lambda_a t}.$$

$$N_b = \frac{\lambda_a}{\lambda_b} \cdot N_a.$$

$$\Rightarrow \lambda_a N_a = \lambda_b N_b = \lambda_c N_c = \cdots\cdots = \lambda_n N_n.$$

$\cancel{\lambda_c N_c = \lambda}.$

2 of.

Now
$$N_b = \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 e^{-\lambda_a t}.$$

$$N_b = \frac{\lambda_a}{\lambda_b - \lambda_a} \cdot N_a.$$

$$\therefore \lambda_a N_a = (\lambda_b - \lambda_a) N_b = (\lambda_c - \lambda_b) N_c = \cdots\cdots (\lambda_n - \lambda_{n-1}) N_n.$$

(11) $\Rightarrow N_b e^{\lambda_b t} = \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 e^{(\lambda_b - \lambda_a)t} - \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0$

$\Rightarrow N_b e^{\lambda_b t} = \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 \left[e^{(\lambda_b - \lambda_a)t} - 1 \right]$.

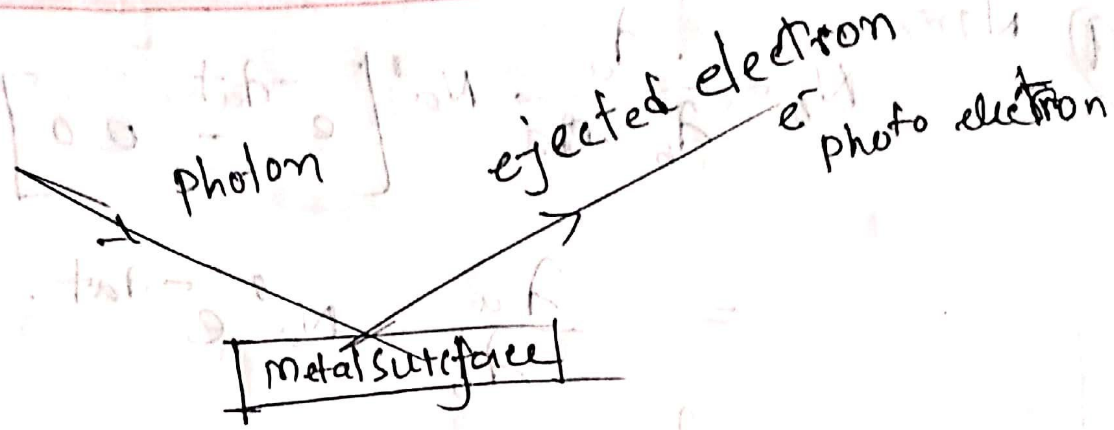
$\Rightarrow N_b \cancel{e^{\lambda_b t}} = \frac{\lambda_a}{\lambda_b - \lambda_a} N_a^0 \left[e^{-\lambda_a t} - e^{-\lambda_b t} \right]$ → (11)

Rate of production of .

1. Seculare Equilibrium: $t_a >> t_b$
$\lambda_b >> \lambda_a$.

2. Tangent Equilibrium.
$t_a > t_b$; $\lambda_b > \lambda_a$.

Photoelectric Effect.



When a photon of certain frequency incident on a metal surface and eject electron then it is called photoelectric effect.

$E = h\nu.$

$E_0 = \phi_0 = h\nu_0.$

- Threshold frequency,
- Threshold energy
- Photo electron.
- Photo electric current.

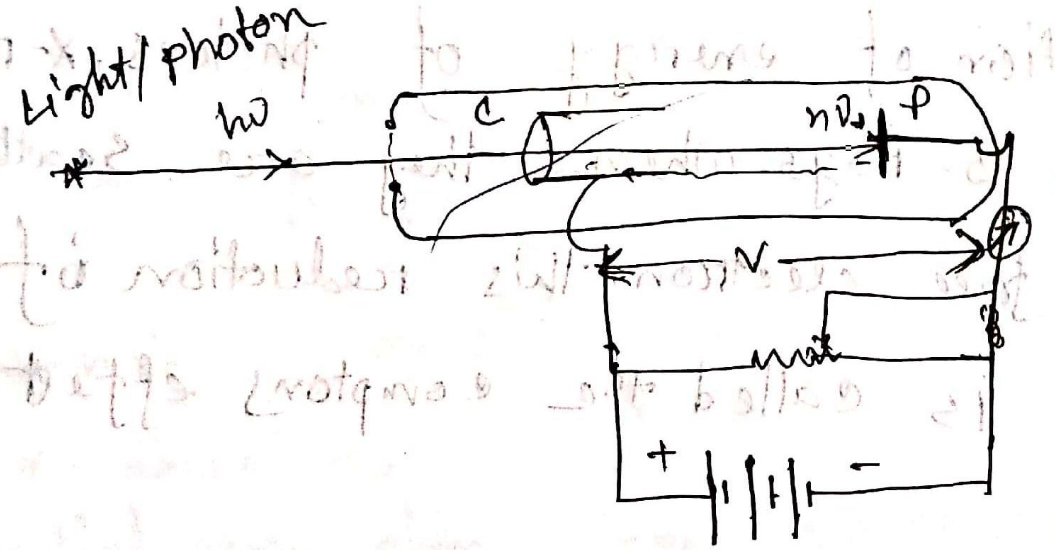
Photoelectric laws:

1. $h\nu = h\nu_0$ frequency

2. Higher the energy of photon higher the kinetic energy of electron.

3. Intensity of Photon if higher then the number ejected electron is increased.

Millikan's Experiment:



(A) Stopping potential, V_0.
In which voltage the ejection of electron is stopped.

$h\nu - h\nu_0 = $ Kinetic energy.

$= \frac{1}{2} m v_0^2$.

$= eV_0$.

$$\boxed{h\nu - h\nu_0 = eV_0}$$

Einstein photoelectric equation;

Compton's Effect:

A reduction of energy of photons, X-rays, γ-rays, β-rays when they are scattered by the free electron. this reduction of energy is called the comptons effect.

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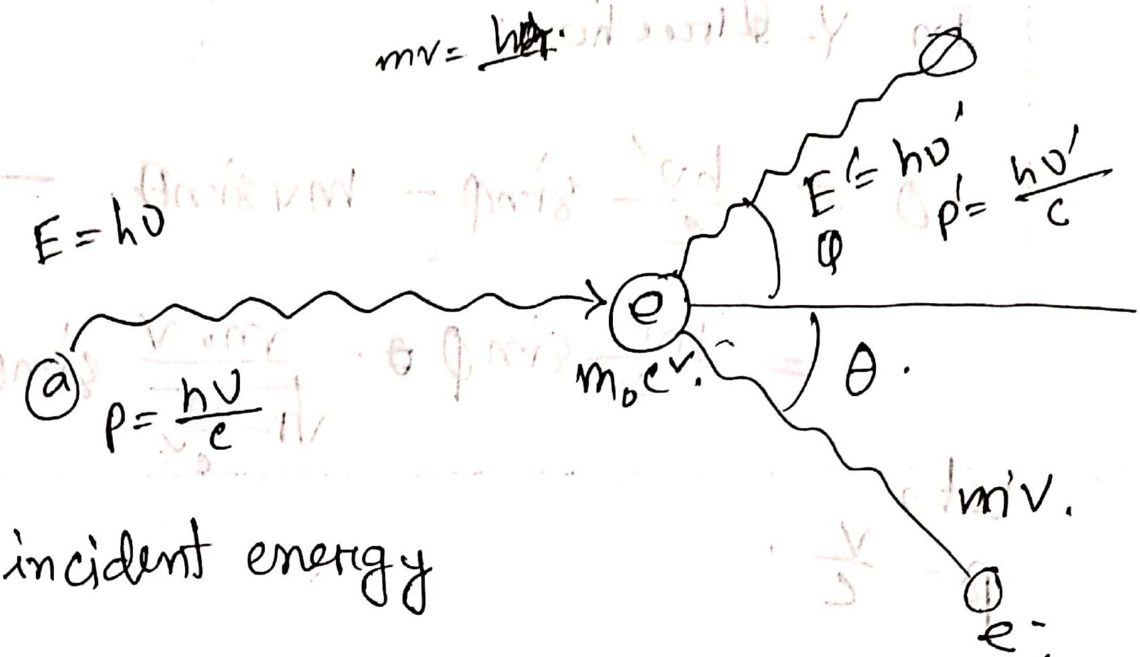

Loss in incident energy

= Gain in electron energy.

$$h\nu - h\nu_0 = mc^2 - m_0c^2$$

$$= \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \cdot c^2 - m_0c^2$$

$$h\nu - h\nu_0 = m_0 c^2\left(\frac{1}{\sqrt{1-v^2/c^2}} - 1\right) \longleftarrow (1)$$

In x- direction;

Initial momentum = Final momentum.

$$\Rightarrow \frac{h\nu}{c} + 0 = \frac{h\nu'}{c}\cos\varphi + mv\cos\theta \longleftarrow (ii)$$

$$= \frac{h\nu'}{c}\cos\varphi \cdot \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} v\cos\theta \longrightarrow (ii)$$

In Y- direction;

$$0 = \frac{hv'}{c} \sin\phi - mv\sin\theta \quad \text{--- (iii)}$$

$$0 = \frac{hv'}{c} \sin\phi - \frac{m_0 v}{\sqrt{1-\frac{v^2}{c^2}}} \sin\theta \quad \text{--- (i)}$$

et,

$\beta = \frac{v}{c}$.

again

$$\lambda_1 = \frac{c}{\nu}, \quad \lambda' = \frac{c}{\nu'}.$$

$$\boxed{\lambda' - \lambda = \frac{h}{m_0 c}(1-\cos\theta)}$$

compton wave length when $\theta = 90^0$.

* Show Scattered wave length is greater than Incident wavelength.
* D Show compton wave length.