Q. No. 2 Part (i) ...of (Time Period) on.

- **Time Period Of Simple Pendulum In Islamabad:** As time period of simple pendulum is inversely proportional to value of g. Since value of g is greater at Islamabad as it is at sea level so time period of simple pendulum will be less. $T = 2\pi\sqrt{\frac{l}{g}}$

- **Time Period Of Simple Pendulum In Mount Everest:** Since mount Everest is located at altitude so value of g decreases at Mount Everest due to which time period of simple pendulum increases in Mount Everest due to relation. $\left(T \propto \frac{1}{\sqrt{g}}\right)$ $\therefore T = 2\pi\sqrt{\frac{l}{g}}$

- **RESULT:** Time period in Islamabad will be less due to large value of g and it will be more in Mount Everest due to small g value.

Q. No. 2 Part (ii) **LOUDNESS OF SOUND**: "The characteristic of sound by which we can distinguish between loud and faint sound."

- **FACTORS AFFECTING LOUDNESS:**

(i) **SURFACE AREA OF VIBRATING BODY**: Loudness of sound varies directly with area of vibrating body. e.g; sound produced by larger drom is louder than that of small one.

(ii) **AMPLITUDE OF VIBRATING BODY**: Loudness of sound increase with increase in amplitude and vice versa. e.g: if you beat the drom forcefully, the amplitude of its membrane increases and we hear a louder sound. (iii) **DISTANCE FROM VIBRATING BODY**: Loudness of sound varies inversely with distance from vibrating body. (iv) **PHYSICAL CONDITION OF EARS**: Loudness depends on physical condition of ears. Sound appears louder to sensitive ears than defective ones.

Q. No. 2 Part (iii)

Given Data:

Diamond's Refractive index = $n = 2.42$

Speed of light in air = $c = 3 \times 10^8 ms^{-1}$

To Find;

Speed of light in diamond (medium) = v = ?

As we know that;

Refractive index (n) = speed of light in air (c) / speed of light in medium (v)

→ putting values;

$$2.42 = \frac{3 \times 108}{v}$$

$$v = \frac{3 \times 108}{2.42}$$

$v = 12396692.1 ms^{-1}$.

★ NOTE: Hence speed of light in diamond is $12397\ ms^{-1}$.

Q. No. 2 Part (iv)

Given Data:

Current = $I = 12A$

Voltage = $V = 210V$.

To Find;

Power = $P = ?$

→ As we know that;

$$P = \frac{W}{t} = \frac{QV}{t} = \frac{It \cdot IR}{t} = I^2R.$$

$$P = I^2R = I^2\left(\frac{V}{I}\right)$$

$$P = IV \quad \text{— (i)}$$

putting values in above equation;

$$P = 12 \times 210.$$

$$\boxed{P = 2520 \text{ watt}}$$

Hence power dielievered to conditioner is 2520W.

Q. No. 2 Part (v)

Given Data:

Glass's Refractive index = $n = 1.55$

Angle of incidence = $\angle i = 35°$

To Find:

Angle of refraction = $\angle r = ?$

As we know that from Snell's law;

$$n = \frac{\sin\angle i}{\sin\angle r}$$

$$\sin\angle r = \frac{\sin\angle i}{n}$$

putting values in above equation;

$$\sin\angle r = \frac{\sin(35)}{1.55}$$

$$\sin\angle r = \frac{0.57357}{1.55}$$

$$\sin\angle r = 0.370049$$

$$\boxed{\angle r = 21.72°}$$

Hence, angle of refraction is 21.72°.

Q. No. 2 Part (vi)

Given Data:

Potential difference = V = 240 V

Current = I = 30 A

Time = t = 90 minutes

= (90 × 60) seconds = 5400 s

To Find; Electrical energy = W = ?

As we know that;

$W = I^2Rt$ — (i)

- For finding resistance (R) we use;

$V = IR$, $R = \frac{V}{I}$

$R = \frac{240}{30}$, $\boxed{R = 8 \text{ ohm}}$

- Now putting values in (i);

$W = (30)^2(8)(5400)$

$\boxed{W = 38880000 \text{ J}}$ or.

$W = 3.8 \times 10^6 \text{ J}$ or.

$W = 3.8 \text{ MJ}$.

→ Hence amount of energy would be 3.8 MJ or 38880000 J.

Q. No. 2 Part (vii) ~~(NOR Gate)~~:

RIGHT-HAND RULE FOR SOLENOID: The right-hand rule in case of current carrying solenoid will be;

→ "Grasp a solenoid with your right hand such that the curling fingers of your right hand points in the direction of conventional current while thumb indicates the north pole of solenoid."

→ **SOLENOID:** "A coil of wire consisting of many loops is called a solenoid."

- When current passes through solenoid, it behaves like an electromagnet and repels the North pole of permanent bar magnet which means it has North and South pole also.
- The direction of current and magnetic field in current-carrying solenoid can be found by right-hand rule mentioned above.

Q. No. 2 Part (viii)

• **Increasing Force On Armature**: The force acting on the armature of DC motor can be increased by;

(i) By increasing the current in coil.
(ii) By increasing the strength of magnetic field.
(iii) By increasing the number of turns of coil.
(iv) By increasing the area of coil (armature).

Q. No. 2 Part (ix)

Given Data:

Voltage $= V = 24V$

Current $= I = 30 \times 10^{-3} A$

To Find;

Resistance $= R = ?$

From OHM's Law;

$$V = IR$$

$$R = \frac{V \text{ (voltage)}}{I \text{ (current)}}$$

putting values in above equation;

$$R = \frac{24}{30 \times 10^{-3}}$$

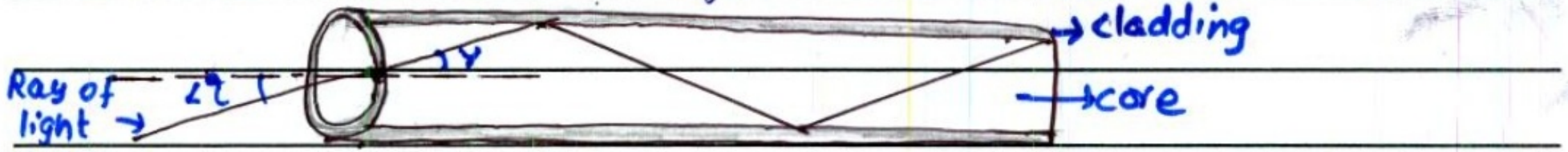
$$\boxed{R = 800 \text{ ohms}}$$

Hence Resistance of circuit is $800\ \Omega$.

Q. No. 2 Part (x) • **SIGNAL TRANSMISSION THROUGH OPTICAL FIBER:**

In optical fibre, signal is transmitted in accordance with the phenomenon of 'total internal reflection'.

• **WORKING / Explanation:** Optical fibre has outer concentric shell called cladding of relatively low index of refraction and inner portion called core having high index of refraction. When ray of light strikes the core-cladding boundary of optical fibre with angle of incidence greater than critical angle, light is reflected back in the core. In this way, light travels thousands of kilometers with small loss of energy. It is the effecient method of signal transmission.



Q. No. 2 Part (xi)

Given Data:

distance $= r = 4.8\,nm = 4.8 \times 10^{-9}\,m$

Proton charge $= q_1 = 7 \times 1.6022 \times 10^{-19} = 1.12154 \times 10^{-18}\,C$

Electron charge $= q_2 = 1.6022 \times 10^{-19}\,C.$

To Find;

Electrostatic Force $= F = ?$

→ From Coloumb's Law:

$$F = \frac{K q_1 q_2}{r^2}$$

$$F = \frac{(9 \times 10^9)(1.12154 \times 10^{-18})(1.6022 \times 10^{-19})}{(4.8 \times 10^{-9})^2}$$

$$F = \frac{1.61718057 \times 10^{-27}}{2.304 \times 10^{-17}}$$

$$F = -7.019013 \times 10^{-11}\,N$$

Since charges are oppositely charged so force between them will be of 'attraction.'

Use for rough work

$W = I^2 R t$

$W = QV$

$W = I t\, IR$

$W = I^2 R t$

$W = \frac{V^2}{R^2} R t + TC$

$W = \frac{V^2}{R} t.$

$V = IR$

$R = \frac{V}{I}$

$F_{res} = -mg \sin\theta$

$t =$

$r = 4.8 \times 10^{-2}\,m$

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

$ma = -mg \sin\theta$

$a = -g\left(\frac{x}{l}\right)$

$\omega^2 x = -g\left(\frac{x}{l}\right)$

$\frac{4\pi^2}{T^2} = \frac{g}{l}$

$T^2 = \frac{4\pi^2 l}{g}$

Th-234

$^{234}_{90}Th \rightarrow {}^{0}_{-1}e + {}^{234}_{91}X$

Q. No. 3 (Page 1) — Simple Pendulum

• **Definition:** A simple pendulum consists of metallic bob attached to an inextensible string.

• **Explanation:**

Consider a mass m is attached to an inextensible string of length L. At mean position O, the bob is stationary so net force acting on it is zero.

→ Now, if we bring the bob to extreme position A and then release it, the bob will start moving towards mean position O due to restoring force. At mean position, the speed of bob becomes maximum and due to inertia the bob will not stop at mean position rather continues its motion towards extreme position B. During its motion towards B, the speed of bob decreases due to restoring force and bob comes at rest for instant at extreme position B and then continues its motion towards mean position due to restoring force. This motion of bob continues till all of its energy is used up.

• **Resolving Weight Into Its Perpendicular Components:**

$T = mg\cos\theta$.

• **Hence the restoring force will be;**

$F_{Res} = -mg\sin\theta$ — (i)

• But according to Newtons 2nd law of motion;

$F = ma$ — (ii)

→ Comparing (i) and (ii);

$ma = -mg\sin\theta$

$a = -g\sin\theta$. — (iii)

Q. No. 3 (Page 2) From the figure; $\sin\theta = \frac{\text{Perpendicular}}{\text{hypotenuse}} = \frac{x}{l}$

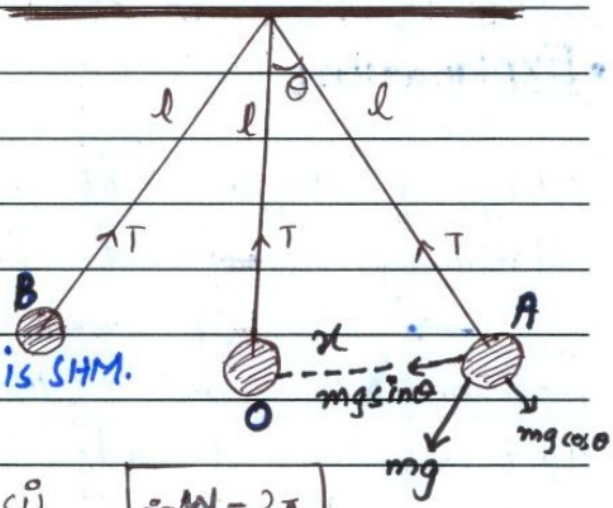
putting value of $\sin\theta$ in (iii);

$$a = -g\left(\frac{x}{l}\right)$$

$$a = -x \cdot \frac{g}{l} \quad \therefore \frac{g}{l} = \text{constant}$$

$$\boxed{a \propto -x}$$

∴ Hence motion of simple pendulum is SHM.



- **DERIVATION OF TIME PERIOD;**
- Angular frequency $= a = -\omega^2 x$ — (i)
- But from equ (iii);

$$a = -g\sin\theta$$

- Comparing both equations; we get:

$$-\omega^2 x = -g\sin\theta$$

$$+\omega^2 x = +g\frac{x}{l}$$

$$\omega^2 = \frac{g}{l}$$

- putting value of ω in above equation;

$$\left(\frac{2\pi}{T}\right)^2 = \frac{g}{l}$$

$$\frac{4\pi^2}{T^2} = \frac{g}{l}$$

$$4\pi^2 l = T^2 g$$

$$T^2 g = 4\pi^2 l$$

$$T^2 = \frac{4\pi^2 l}{g}$$

- Taking $\sqrt{}$ on bls of above equation;

$$\sqrt{T^2} = \sqrt{\frac{4\pi^2 l}{g}}$$

$$\therefore \boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

Since frequency is reciprocal of time period, so frequency is;

$$\therefore \boxed{f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}}$$

(Capacitor)

→ **Capacitor:** "A device used to store charge is called capacitor."

→ **Formula:** The charges on plate Q is directly proportional to potential difference.

$$Q \propto V.$$

$$Q = CV$$

C is constant of proportionality called capacitance having unit Farad.

(Parallel Combination Of Capacitors)

→ **Introduction:** In parallel combination of capacitors, one end of each capacitor is connected with positive terminal of battery while the other end of each capacitor is connected with negative terminal of battery.

→ **Characteristics:**

The parallel combination of capacitors has following characteristics:

(i) The ~~(voltage x V)~~ potential difference V across each capacitor is same which is equal to total voltage supplied by the battery.

$$V = V_1 = V_2 = V_3 \quad \text{— (i)}$$

(ii) The charges developed across each capacitor is different due to different values of capacitances.

(iii) The total charge Q supplied by the battery divides among individual capacitors i.e

$$Q = Q_1 + Q_2 + Q_3. \quad \text{— (ii)}$$

since $Q = CV$ so above equation (ii) becomes;

$$Q = C_1V_1 + C_2V_2 + C_3V_3.$$

FROM (i); since $V = V_1 = V_2 = V_3$ so above equation becomes;

$$Q = C_1V + C_2V + C_3V$$

$$Q = V(C_1 + C_2 + C_3) \qquad \because Q = CV$$

$$\frac{Q}{V} = C_1 + C_2 + C_3 \qquad \frac{Q}{V} = C.$$

(iv) Thus, we can replace the parallel combination of capacitors with one capacitor called equivalent capacitance, above equation becomes;

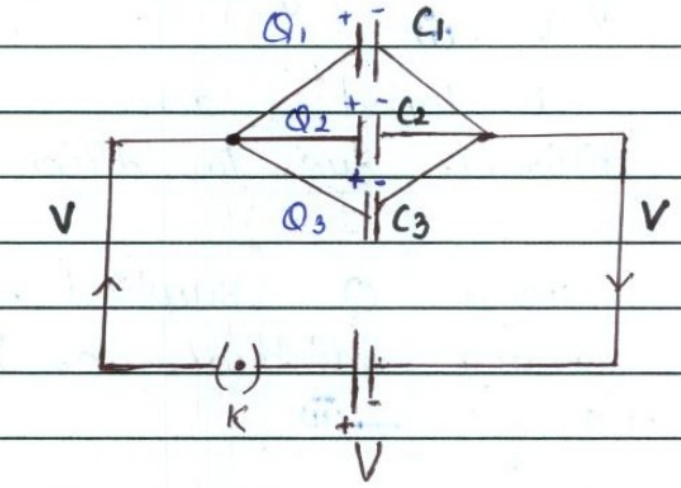
$$C_{eq} = C_1 + C_2 + C_3.$$

(v) In case of n capacitors connected in parallel, the equivalent capacitance is given by;

$$C_{eq} = C_1 + C_2 + C_3 + \cdots + C_n.$$

(vi) Hence, the equivalent capacitance of parallel combination of capacitor is greater than any of the individual capacitances.

⇒ **Diagram:**



Compound Microscope

• **Definition:** "An optical device which consists of two converging lens (objective and eyepiece) and is used to get the minor details of smaller object."

• **Construction:** Compound microscope consists of two converging lens i.e objective and eye piece. The converging lens set towards object is called the objective lens whose focal length is smaller ($f_o < 1cm$). The converging lens set towards viewers eye is called eyepiece whose focal length is larger (f_e = few cm). The two convex lens are placed parallel and coaxial with eachother.

• **Working:-** Compound microscope is a higher magnifying optical device. Its working is illustrated in following steps:

(i) Objective lens (convex lens) forms the image I_1 of object OP inside the focal point of eye piece. This image is real and inverted.

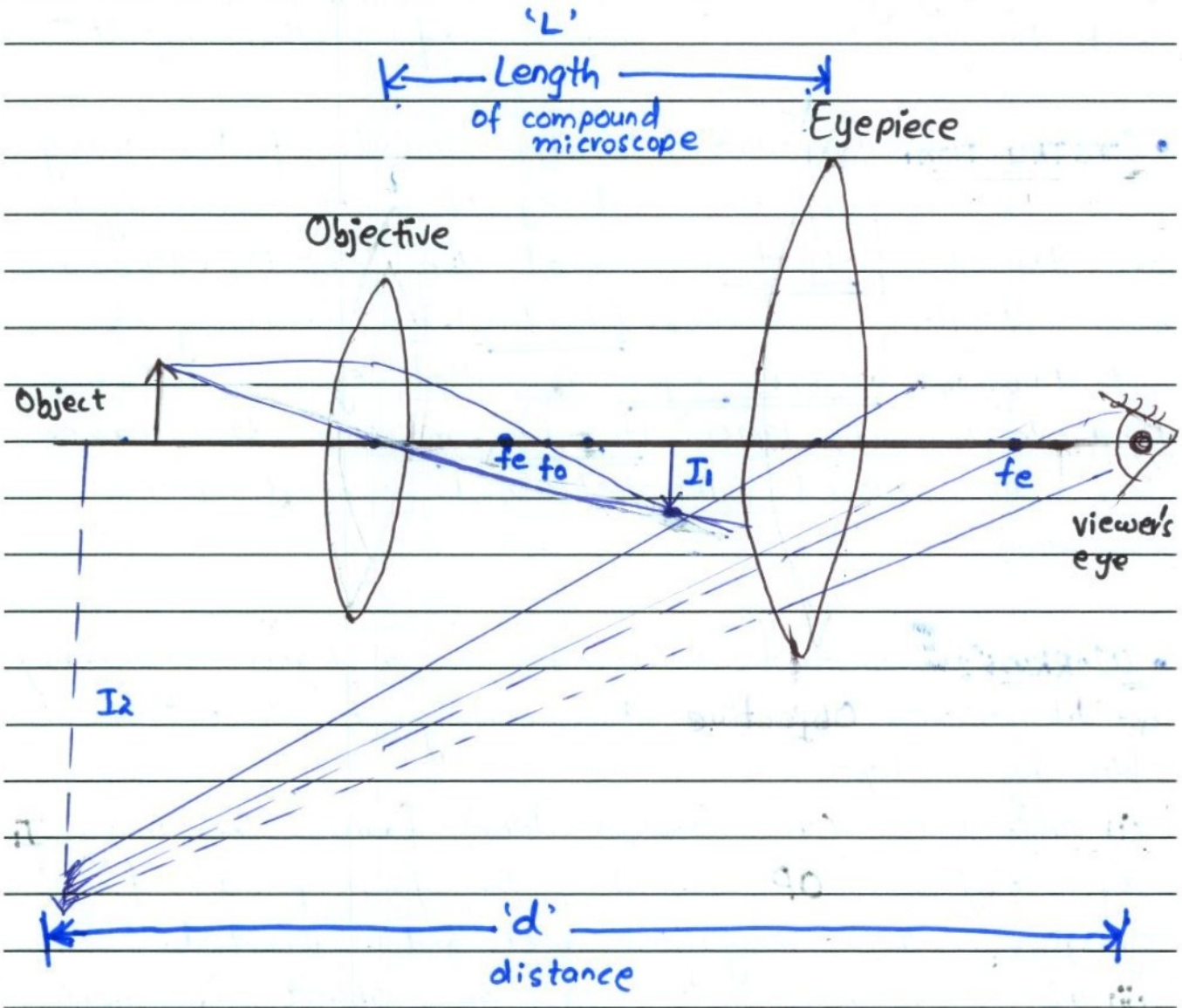
(ii) This image acts as an object for eyepiece and a final larger image I_2 of I_1 is formed at a point far away from the focal point of objective.

(iii) This final image I_2 of small object (I_1) is erect, magnified and virtual.

⇒ Further explanation will be given with the help of ray diagram.

→ **Ray Diagram:**

→ Ray Diagram:-



• Magnification of Convex Lens:-

$$\therefore \text{Magnification} = \frac{L}{f_o}\left(1 + \frac{d}{f_e}\right)$$

→ where L is the length of compound microscope which is equal to distance between objective and eyepiece, d is the distance between observer's eye and final larger image (I_2). and f_o and f_e are the focal lengths of objective and eyepiece respectively.

Q. No. 6 (Page 1) — Nuclear Fission Reaction

→ **Definition:** "In nuclear fission reaction, a heavy nucleus such as Uranium-235 splits into two daughter nuclei with emission of energy" after absorbing slow moving neutron.

• General equation :-

$${}^{1}_{0}n + {}^{A}_{Z}X \longrightarrow {}^{A}_{Z}X^{*} \longrightarrow Y + Z + 3{}^{1}_{0}n + \text{energy}.$$

neutron — Parent nuclide — Intermediate states — Daughter nuclei — neutrons

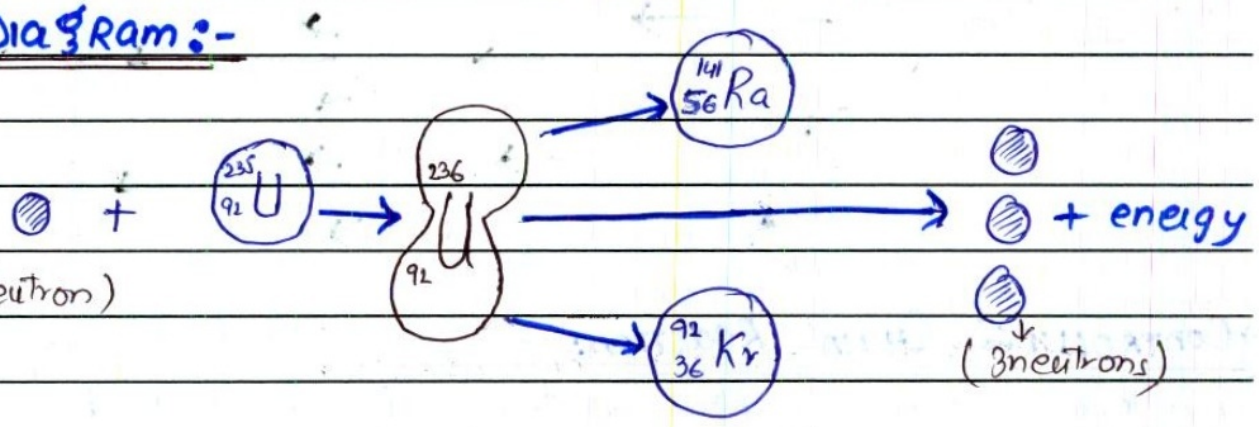
• **Nuclear Equation:**

$${}^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{236}_{92}U^{*} \longrightarrow {}^{141}_{56}Ra + {}^{92}_{36}Kr + 3{}^{1}_{0}n + \text{energy}$$

neutron — Uranium-235 — Uranium-236 — Radium — Krypton — neutrons.

→ where Uranium-236 is an intermediate state which splits into two daughter nuclei.

• **Diagram :-**



→ **Explanation/Details About Nuclear Fission Reaction:**

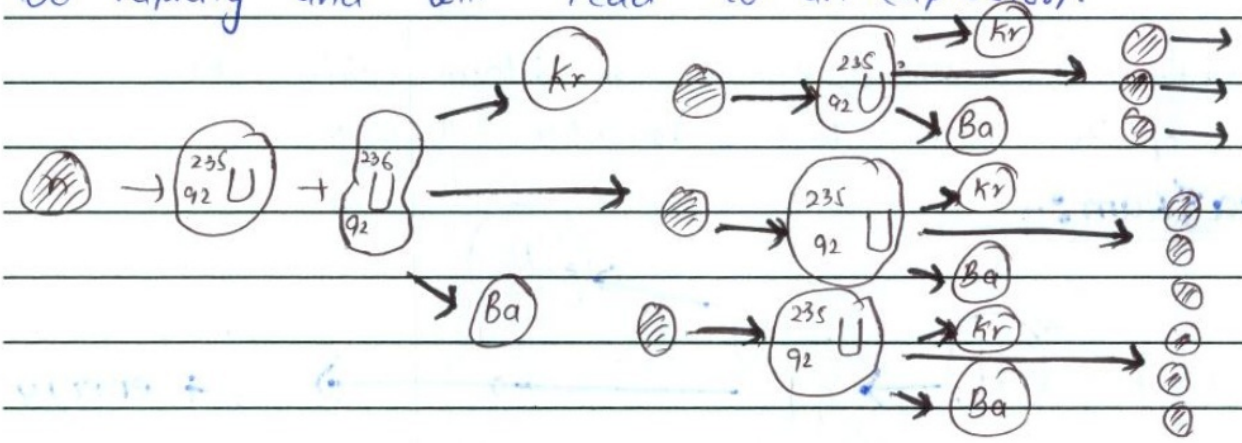
(i) **Mass of Products:** In nuclear fission reaction, the total mass of products is always less than the original mass of heavier nuclei.

(ii) Energy produced in Nuclear Fission reaction:- About 200 MeV energy is released in nuclear fission reaction which is more than energy released by burning coal (i.e during chemical reactions)

(iii) Chain Reaction: In nuclear fission reaction, a chain reaction starts.

→ **Chain Reaction:** In nuclear fission reaction, neutron from previous step continues to propagate and repeat the reaction. It is called nuclear fission chain reaction.

• **Hazards Of Chain Reaction:** Calculations show that if chain reaction is not controlled, it will proceed too rapidly and will lead to an explosion.



→ **Controlling Chain Reaction:** It is controlled in nuclear reactors where extra neutron is absorbed by using some material such as Boron.

Reaction:- $^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{7}_{3}Li + {}^{4}_{2}He$

⇒ Nuclear fission reaction takes place when heavy nucleus splitts.