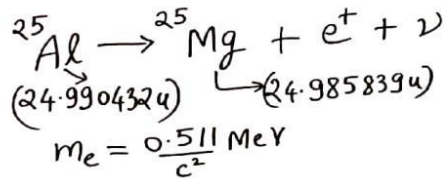


Session - 36th - Modern Physics - III
(Radioactive Decay & Nuclear Fission)

We will switch to other room

Recap: - Q.1 Find Q-value

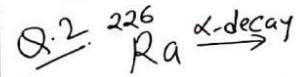


$$Q = [\sum m_R - \sum m_P] c^2$$

$$= [(24.99 - (24.98))u - 2 \times \frac{0.511 \text{ MeV}}{c^2}] c^2$$

$$= [(24.99 - 24.98) \times \frac{931.5}{c^2} - 2 \times \frac{0.511}{c^2}] c^2 \text{ MeV}$$

$$= 3.254 \text{ MeV}$$



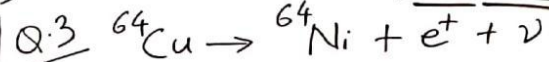
$$(K)_\alpha = 4.78 \text{ MeV}$$

Find Q-value

$$K_\alpha = \frac{m_\alpha}{m_\alpha + m_Y} Q$$

$$4.78 = \frac{222}{226} \times Q$$

$$\Rightarrow Q = \frac{4.78 \times 226}{222} \text{ MeV} = 4.866 \text{ MeV}$$



$$(K_{\text{max}})_{\text{positron}} = 0.68 \text{ MeV} \rightarrow \boxed{\text{Q value}}$$

Find energy of neutrino which emitted with positron of 0.18 MeV.

$$K_{\text{positron}}^{\text{max}} \approx Q$$

$$K_{\text{neutrino}} = Q - 0.18$$

$$= 0.68 - 0.18 = 0.50 \text{ MeV}$$

Q.4 Comment on sign of Q-value.

- isolated proton → n
- " - neutron → proton

Q.6 Can we get γ photons in β-decay also?

Q.5. What is the difference b/w β-rays, cathode rays, thermions, photoelectrons?

Q.7 Can there be other kinds of radioactive processes other than α-β-γ decays?

Q.4. Q-value \rightarrow sign?

isolated proton \rightarrow ${}^1_0\text{n}$ —
—||— neutron \rightarrow proton +

Q.6 Can we have γ photons
in β -decay?

Ans. Yes.

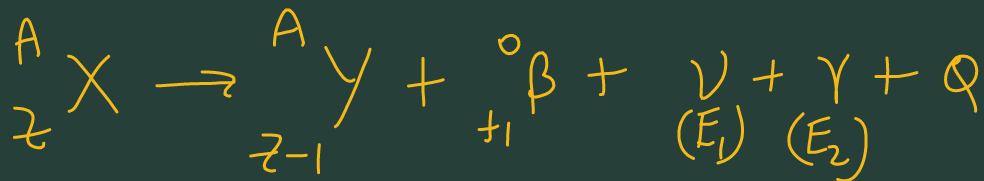
Q.5. what is the diff. b/w
 β -rays, thermions, photoelectrons
& cathode rays.

ORIGIN

Q.7. Other kinds of RA
processes except
 α - β - γ decays.

Ans. Yes \rightarrow Nuclear fission
 \rightarrow || — fusion

β^+ -decay



$$p_y = p_\beta$$

$$K_y = \frac{(m_\beta)}{m_y + m_\beta} Q^*$$

$$K_\beta = \frac{(m_y)}{m_y + m_\beta} Q^*$$

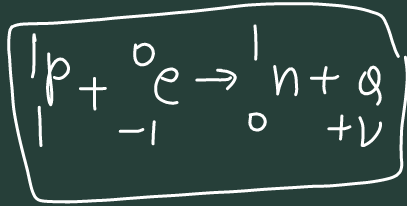
$$m_y \gg m_\beta$$

$$\Rightarrow K_\beta \gg K_y$$

$$Q^* = Q - (E_1 + E_2)$$

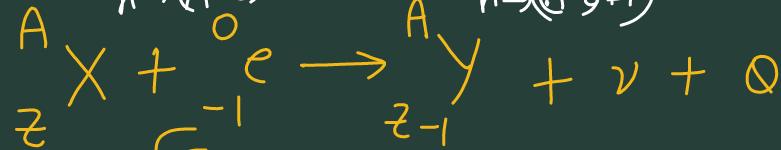
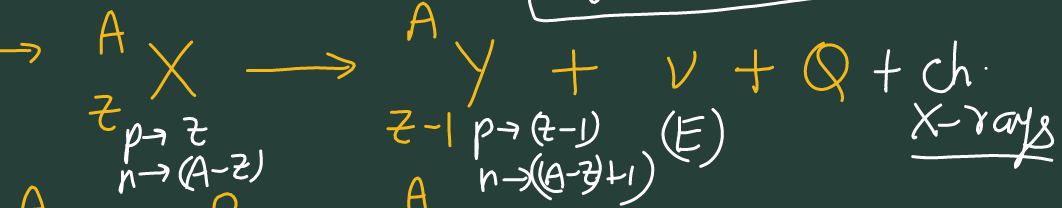
Radioactive Decay

Electron Capture →
(excess protons)



Note → Q-value
is distributed
b/w γ & ν .

$$\boxed{K_y = (Q - E)}$$

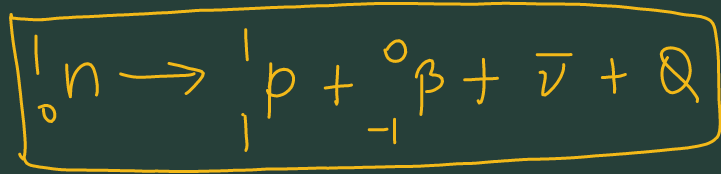


$$Q = \underbrace{\left[(m_x - z m_e) + m_e \right]}_{m_{\text{reactants}}} - \underbrace{\left(m_y - (z-1) m_e \right)}_{m_{\text{products}}} c^2$$

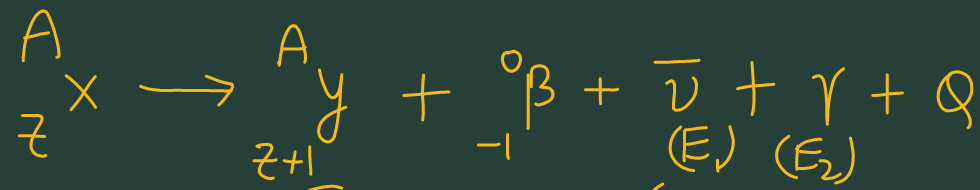
$$= (m_x - z m_e + m_e - m_y + z m_e - m_e) c^2$$

$$= (m_x - m_y) c^2$$

β^- decay
(excess neutrons)



$$Q^* = Q - (E_1 + E_2)$$



$$K_{\beta^-} = \left(\frac{m_Y}{m_Y + m_{\beta}} \right) Q^*$$

$$Q = \left[\underbrace{(m_x - z m_e)}_{m_{\text{reactants}}} - \underbrace{\{ [m_y - (z+1)m_e] + m_e \}}_{m_{\text{products}}} \right] c^2$$

$$= \overset{\Delta m}{(m_x - z m_e - m_y + z m_e + m_e - m_e)} c^2$$

$$= (m_x - m_y) c^2$$