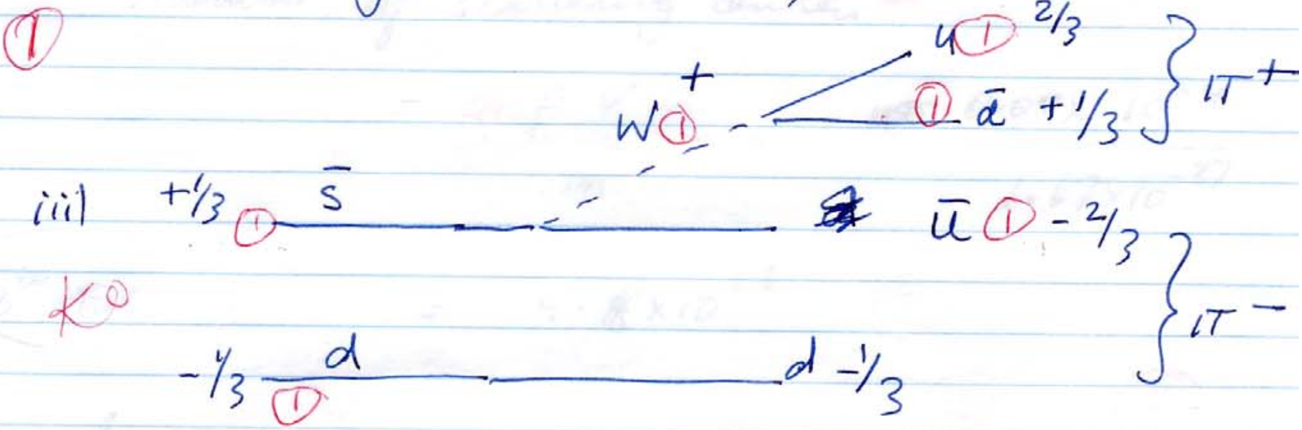
Mid Term Solutions and Marking Scheme

12^{03}

(2) i) Strong interaction (3) / weak. (3)

(1)



iii) they are produced strongly (1); but take a long time (1) to decay. So they do not decay via the strong (1) interaction. They decay (1) weakly. This decay must violate conservation of a quantum number conserved in strong interaction (1). So they must "contain" equal and opposite amounts (1) of this quantum number.

12^{14}

, work'.

number of scattering centers ⑫

$$= ② \frac{\rho V}{m} = \frac{0.08 \times 10^{-4}}{1.67 \times 10^{-27}}$$

(12^{20} start)

$$= 4.8 \times 10^{21} \quad ②.$$

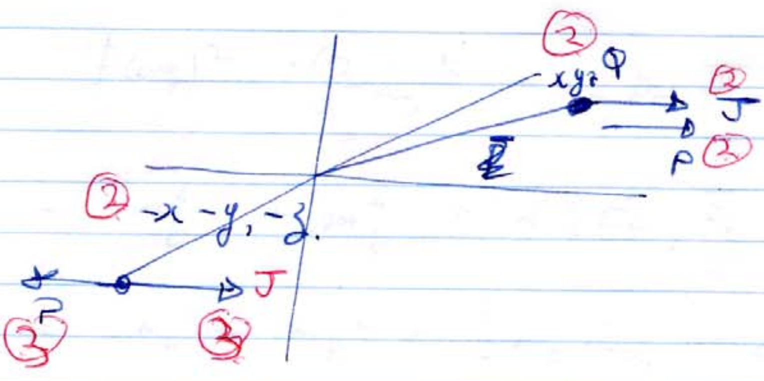
Interaction rate ② = Flux ② × Scatters ② × σ_{TOT} ②

$$= 10^{3} \times 4.8 \times 10^{21} \times 0.4 \times 10^{-31}$$

$$= 2 \times 10^{-7} \text{ /sec.}$$ ① correct calculation

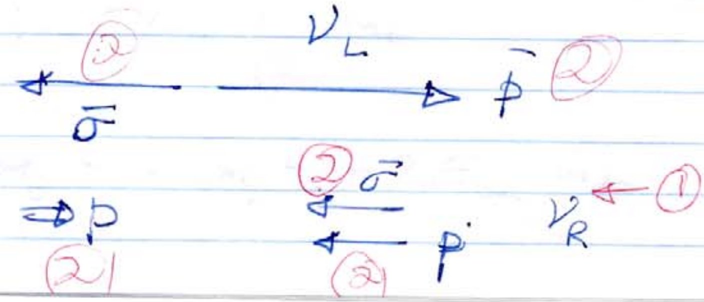
(12^{25})

2)a)

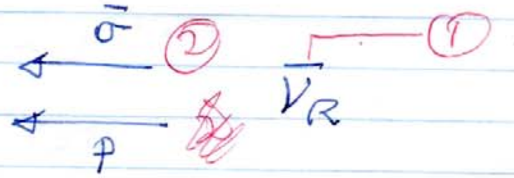


① completion

2)b)



Neutrino / weak interactions do not conserve parity (2)



It suggests that weak interactions ~~conserve~~ violate parity. (2)

12^{25}

4) a) (3) W^2 is invariant

$W^2 = (p_{targ} + p_{beam})^2$ (2)

$(p_{targ})^2 + (p_{beam})^2 + 2 p_t \cdot p_b$ (2)

↕(2) ↕(2)

$= m_t^2 + m_b^2 + 2(E_t, \vec{p}_t)(E_b, \vec{p}_b)$ (2)

$= m_t^2 + m_b^2 + 2E_t E_m - 2\vec{p}_t \cdot \vec{p}_b$

$\vec{p}_t = 0$ (2) ; $E_t = m_t$ (2),

$= m_t^2 + m_b^2 + 2E_{beam} m_t$ (2) (2)

3b)

~~For a)~~ In each case we have to produce the mass (3) of Higgs at rest in CMS.

$\therefore W^2 = (150\ GeV/c^2)^2$ (2).

$W = 2 p_{beam} \quad \therefore W^2 = 4 p_b^2$.

(2)

$\therefore p_b^2 = \frac{W^2}{4}$ (2)

$p_b = W/2 = 70\ GeV/c^2$. (2)

In fixed ~~target~~ case.

$(150\ GeV/c^2)^2 = 2E_b \cdot 1 + 1 + 1$ (2).

$= 2$

$\frac{(150)^2 - 2}{2} = E_b = 11\ TeV$ (2)

12^{35}