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Mk : Fisika Modern.

1). $x'_1 = 0$ hingga $x'_2 = l_0$

$$L = x_2 - x_1$$

$$x' = \gamma (x - ut)$$

$$t' = \gamma \left(t - \frac{ux}{c^2} \right)$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$$

waktu sama ($t_1 - t_2$)

$$x'_1 = \gamma (x_1 - ut)$$

$$x'_2 = \gamma (x_2 - ut)$$

$$l_0 = x'_2 - x'_1$$

$$l_0 = \gamma (x_2 - ut) - \gamma (x_1 - ut)$$

$$* l_0 = \gamma (x_2 - x_1) \text{ atau}$$

$$l = \frac{l_0}{\gamma} \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}$$

$$l = l_0 \sqrt{1 - \frac{u^2}{c^2}}$$

2). Diketahui:

$$E = 25 \text{ GeV}$$

$$d = 300 \text{ m}$$

$$m_0 = 0.511 \text{ MeV}/c^2$$

$$c = 3 \times 10^8 \text{ m/s}$$

ditanya:

a. $v \dots ?$

b. $t \dots ?$

c. $L' \dots ?$

d. $t' \dots ?$

Jawab:

a). $E = \gamma m_0 c^2$

$$\gamma = \frac{E}{m_0 c^2}$$

$$\gamma = \frac{25 \times 10^9 \text{ eV}}{0.511 \times 10^6 \text{ eV}}$$

$$\gamma = 4.89 \times 10^4$$

$$1 - \frac{v^2}{c^2} = \frac{1}{\gamma^2}$$

$$\frac{v^2}{c^2} = 1 - \frac{1}{(4.89 \times 10^4)^2}$$

$$v = c \sqrt{1 - \frac{1}{(4.89 \times 10^4)^2}}$$

$$v \approx c (1 - 1.05 \times 10^{-10})$$

$$v \approx 2.9999 \times 10^8 \text{ m/s}$$

Selisih dengan kecepatan cahaya

$$c - v \approx 0.031 \text{ m/s}$$

Jadi elektron hampir bergerak dg kecepatan cahaya.

b). $t = \frac{d}{v}$

$$t = \frac{300 \text{ m}}{2.9999 \times 10^8 \text{ m/s}}$$

$$t \approx 1.000000001 \times 10^{-3} \text{ s}$$
$$= 10 \text{ } \mu\text{s}$$

c). $L' = L \sqrt{1 - \frac{v^2}{c^2}}$

karena $\gamma = 4.89 \times 10^4$, maka

$$L' = \frac{300}{4.89 \times 10^4}$$

$$L' = 0.061 \text{ m} \Rightarrow 6.1 \text{ cm}$$

d). $t' = \frac{t}{\gamma}$

$$t' = \frac{10^{-3}}{4.89 \times 10^4}$$

$$t' = 2.04 \times 10^{-4} \text{ s}$$
$$= 0.204 \text{ } \mu\text{s}$$

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3). diketahui

ditanya : $v = ?$ dan $\lambda'' = ?$

$$\lambda_0 = 122 \text{ nm}$$

$$\lambda_1 = 366 \text{ nm}$$

$$c = 3 \times 10^8 \text{ m/s}$$

Jawab:

$$a) \frac{\lambda_1}{\lambda_0} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$

$$\frac{366 \text{ nm}}{122} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$

$$3 \text{ nm} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$

$$9 = \frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}$$

$$9(1 - \frac{v}{c}) = 1 + \frac{v}{c}$$

$$9 - 9\frac{v}{c} = 1 + \frac{v}{c}$$

$$8 = 10\frac{v}{c}$$

$$v = \frac{8}{10} c$$

$$v = 0.8 c$$

$$v = 0.8 (3 \times 10^8 \text{ m/s})$$

$$v = 2.4 \times 10^8 \text{ m/s}$$

$$b) \frac{\lambda''}{\lambda_0} = \sqrt{\frac{1 - \frac{v}{c}}{1 + \frac{v}{c}}}$$

$$\lambda'' = \lambda_0 \times \sqrt{\frac{1 - 0.8}{1 + 0.8}}$$

$$= \lambda_0 \times \sqrt{\frac{0.2}{1.8}}$$

$$= 122 \times \sqrt{0.1111}$$

$$= 122 \times 0.3323$$

$$\lambda'' = 40.69 \text{ nm}$$

4). diketahui

$$E_{\text{latom}} = 200 \text{ mpv}$$

$$A = 235$$

$$1 \text{ mev} = 1.602 \times 10^{-13} \text{ J}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$m_{\text{atom}} = \frac{235g}{6.022 \times 10^{23}}$$

$$6.022 \times 10^{23}$$

ditanya : $m = ?$

Jawab:

$$E = 200 \text{ mev} \times 1.605 \times 10^{-13} \text{ J/mev}$$

$$= 3.209 \times 10^{-11} \text{ J}$$

Jumlah atom dalam uranium 1kg

$$N = \frac{1000g}{235}$$

$$m_{\text{atom}}$$

$$= \frac{1000g}{235}$$

$$235$$

$$6.022 \times 10^{23}$$

$$= 2.56 \times 10^{24} \text{ atom}$$



$$E_{\text{total}} = (3,209 \times 10^{-11} \text{ s} \mid \text{atom} (2,56 \times 10^{24})) \\ = 8,20 \times 10^{13} \text{ J}$$

$$E = mc^2 \rightarrow m = E/c^2 \\ m = (8,20 \times 10^{13} \text{ J}) / (3 \times 10^8 \text{ m/s})^2 \\ = 9,11 \times 10^{-14} \text{ kg}$$

5). diketahui:

$$m_p = 1,007276 \text{ u}$$

$$m_n = 1,008665 \text{ u}$$

$$M_{\text{helium}} = 4,001506 \text{ u}$$

$$1 \text{ u} = 1,66059 \times 10^{-27} \text{ kg}$$

$$1 \text{ u} c^2 = 931,5 \text{ MeV}$$

ditanya:

a). $E \dots ?$

b). $\Delta m \text{ kg} \dots ?$

Jawab:

$$\text{a). massa total} = 2m_p + 2m_n \\ = 2(1,007276) + 2(1,008665) \\ = 4,031824$$

$$\Delta m = M_{\text{total}} - M_{\text{helium}} \\ = 4,031824 - 4,001506 \\ = 0,030318 \text{ u}$$

$$E = \Delta m c^2 \\ = (3,04 \times 10^{-29} \text{ kg}) (2,9979 \times 10^8 \text{ m/s})^2 \\ = 2,73 \times 10^{-12} \text{ J} \\ = 28,3 \text{ MeV}$$

$$\text{b). } \Delta m \text{ kg} = (0,030318 \text{ u}) (1,66059 \times 10^{-27} \text{ kg}) \\ = 5,04 \times 10^{-29} \text{ kg}$$

6). diketahui:

$$V_A = 0,8 \text{ c}$$

$$V_B = 0,6 \text{ c}$$

ditanya:

$V' \dots ?$

Jawab:

$$V' = \frac{V_A + V_B}{1 + \frac{V_A V_B}{c^2}} = \frac{0,8 + 0,6}{1 + \frac{(0,8)(0,6)}{c^2}} = \frac{1,4 \text{ c}}{1 + 0,48} = \frac{1,4}{1,48} = 0,946 \text{ c}$$

7). diketahui

$$P = 20 \text{ W}$$

$$\lambda = 589 \text{ nm} = 589 \times 10^{-9} \text{ m}$$

$$h = 6,622 \times 10^{-34} \text{ Js}$$

$$c = 3 \times 10^8 \text{ m/s}$$

ditanya: $N \dots ?$



Jawab:

$$E = \frac{hc}{\lambda} = \frac{(6,626 \times 10^{-34}) (3 \times 10^8)}{589 \times 10^{-9}} = \frac{1,9878 \times 10^{-25}}{589 \times 10^{-9}} = 3,37 \times 10^{-9} \text{ J}$$

$$N = \frac{20}{3,37 \times 10^{-9}} = 5,94 \times 10^{19} \text{ foton / s}$$

B). diketahui

$$W = 2,2 \text{ eV}$$

$$\lambda = 3500 \text{ \AA} = 3500 \times 10^{-10} \text{ m} = 3,5 \times 10^{-7} \text{ m}$$

$$h = 6,626 \times 10^{-34} \text{ J/s}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$E_n = 1,6 \times 10^{-19} \text{ J}$$

ditanya: $k \dots ?$

Jawab:

$$E = \frac{hc}{\lambda} = \frac{(6,626 \times 10^{-34}) (3 \times 10^8)}{3,5 \times 10^{-7}} = \frac{1,9178 \times 10^{-25}}{3,5 \times 10^{-7}} = 5,68 \times 10^{-9} \text{ J}$$

$$E = \frac{5,68 \times 10^{-19}}{1,6 \times 10^{-19}} = 3,35 \text{ eV}$$

$$k = E - W$$

$$= 3,35 - 2,2$$

$$= 1,35 \text{ eV}$$