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Mk : fismod.

$$1. X_1' = 0 \text{ hingga } X_2' = l_0$$

$$L = X_2 - X_1$$

$$X' = \gamma (X - vt)$$

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

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

$$t_1 = t_2$$

$$X_1' = \gamma (X_1 - vt)$$

$$X_2' = \gamma (X_2 - vt)$$

$$L_0 = X_2' - X_1'$$

$$L_0 = \gamma (X_2 - vt) - \gamma (X_1 - vt)$$

$$L_0 = \gamma (X_2 - X_1)$$

$$L = \frac{L_0}{\gamma} \rightarrow \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

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

$$2. \text{ Dik } = E = 25 \text{ GeV} = 25 \cdot 10^9 \text{ eV}$$

$$d = 3000 \text{ m}$$

$$M_0 = 0,511 \text{ MeV}/c^2$$

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

$$\text{Dit} = a). \text{ } C = v \dots ? \quad c). \text{ } l' \dots ?$$

$$b). \text{ } t \dots ? \quad d). \text{ } t' \dots ?$$

$$\text{Jawab:}$$

$$a). E = \gamma M_0 c^2$$

$$\gamma = \frac{E}{M_0 c^2}$$

$$M_0 c^2$$

$$= \frac{25 \cdot 10^9 \text{ eV}}{0,511 \cdot 10^6 \text{ eV}}$$

$$= 4,89 \cdot 10^4$$

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

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

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

$$v = c \left(1 - 1,05 \cdot 10^{-10} \right)$$

$$v \approx 2,9999 \times 10^8 \text{ m/s}$$

$$\text{Selisih} = c - v$$

$$= (3 - 2,9999) \cdot 10^8 \text{ m/s}$$

$$= 0,0001 \text{ m/s}$$

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

$$t = \frac{3000 \text{ m}}{2,9999 \cdot 10^8 \text{ m/s}}$$

$$t \approx 1,0000000001 \cdot 10^{-5} \text{ s}$$

$$t \approx 10 \text{ ns}$$

$$c \cdot t' = L \sqrt{1 - \frac{v^2}{c^2}}$$

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

$$t' = \frac{t}{\gamma}$$

$$t' = \frac{10^{-5}}{4,89 \cdot 10^4}$$

$$t' = 3000$$

$$\frac{3000}{4,89 \cdot 10^4} = 2,04 \cdot 10^{-4} \text{ s}$$

$$= 0,204 \text{ ns}$$

جواب:

$$L \approx 0,061 \text{ M}$$

$$3. \text{ Dik: } \lambda_0 = 122 \text{ nm}$$

$$\lambda' = 366 \text{ nm}$$

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

$$\text{Dit: a) } v \dots ?$$

$$b) \lambda'' \dots ?$$

Jawab:

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

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

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

$$g = \frac{1 + v/c}{1 - v/c}$$

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

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

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

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

$$v = 0,8 c$$

$$= 0,8 (3 \cdot 10^8 \text{ m/s})$$

$$= 2,4 \cdot 10^8 \text{ m/s}$$

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

$$\lambda'' = \lambda_0 \sqrt{\frac{1 - 0,8}{1 + 0,8}}$$

$$= \lambda_0 \sqrt{\frac{0,2}{1,8}}$$

$$= 122 \sqrt{0,1111}$$

$$= 122 \cdot 0,3323$$

$$\lambda'' \approx 40,61 \text{ nm}$$

$$4. \text{ Dik: } E \text{ per atom} = 200 \text{ MeV}$$

$$M \text{ uranium} = 1 \text{ kg} = 1000 \text{ gr}$$

$$n = 235$$

$$1 \text{ MeV} = 1,602 \cdot 10^{-13} \text{ J}$$

$$\text{Dit: } \Delta M \dots ?$$

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

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

$$M_{\text{atom}} = 235 \text{ gr}$$

$$6,022 \cdot 10^{23}$$

Jawab:

$$E = 200 \text{ MeV} \cdot 1,602 \times 10^{-13} \text{ J/MeV}$$

$$= 3,204 \cdot 10^{-11} \text{ J}$$

$$N = 1000 \text{ gr}$$

$$M_{\text{atom}}$$

$$= 1000 \text{ gr}$$

$$235$$

$$6,022 \cdot 10^{23}$$

$$= 2,56 \times 10^{24} \text{ atom}$$

$$E_{\text{total}} = (3,204 \cdot 10^{-11} \text{ J/atom}) (2,56 \cdot 10^{24})$$

$$= 8,20 \cdot 10^3 \text{ J}$$

$$E = Mc^2$$

$$M = \frac{E}{c^2}$$

$$= \frac{8,2 \cdot 10^3 \text{ J}}{(3 \cdot 10^8)^2}$$

$$= 9,11 \cdot 10^{-4} \text{ kg}$$

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$$S. \text{ Dik} = m_p = 1,607276 \text{ u}$$

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

$$\text{Dit} = \text{a) energi kat?}$$

$$\text{b) } \Delta M \text{ kg} \dots ?$$

$$\text{Jwb} =$$

$$\text{a. } M_{\text{total}} = 2m_p + 2m_n$$

$$= 2(1,007276) + 2(1,008665)$$

$$= 4,031882 \text{ u}$$

$$\Delta m = M_{\text{total}} - m_{\text{helium}}$$

$$= 4,031882 - 4,001506$$

$$= 0,030376 \text{ u}$$

$$E = \Delta mc^2$$

$$= (0,030376 \cdot 10^{-29}) (2,9979 \cdot 10^8)^2$$

$$= 4,533 \cdot 10^{-12}$$

$$= 28,3 \text{ MeV}$$

$$\text{b. } \Delta M \text{ kg} = (0,030376 \text{ u}) (1,66054 \cdot 10^{-27})$$

$$= 5,04 \cdot 10^{-29} \text{ kg}$$

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$$6. \text{ Dik} = v_A = 0,8 \text{ c}$$

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

$$\text{Dit} = v' \dots ?$$

Jawab:

$$v' = \frac{v_A + v_B}{1 + \frac{v_A v_B}{c^2}} = \frac{0,8c + 0,6c}{1 + \frac{(0,8)(0,6)}{1 \cdot 1}}$$

$$= \frac{1,4c}{1 + 0,48} = \frac{1,4c}{1,48} = 0,946 \text{ c}$$

$$= 0,946 \text{ c}$$

$$7. \text{ Dik} = P = 20 \text{ W}$$

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

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

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

$$\text{Dit} = N \dots ?$$

Jawab :

$$E = \frac{hc}{\lambda} (6.6 \cdot 10^{-34}) (3 \cdot 10^8) \\ = 1.9878 \cdot 10^{-25} \\ = 3.32 \cdot 10^{-19} \text{ J}$$

$$N = \frac{20}{3.17 \cdot 10^{-19}} \\ = 6.34 \cdot 10^9 \text{ foton/s}$$

$$8. \text{ Dik} = w = 2,2 \text{ eV}$$

$$\lambda = 5500 \text{ \AA} = 3.5 \cdot 10^{-7} \text{ m}$$

$$h = 6.6 \cdot 10^{-34} \text{ Js}$$

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

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

$$\text{Dit} = E_k = \dots ?$$

Jawab :

$$E = \frac{hc}{\lambda} = (6.6 \cdot 10^{-34}) (3 \cdot 10^8) (3.5 \cdot 10^{-7})$$

$$= 1.9178 \times 10^{-25}$$

$$= 3.5 \times 10^{-7}$$

$$= 5.68 \times 10^{-19}$$

$$E = 5.68 \times 10^{-19}$$

$$1.6 \times 10^{-19}$$

$$= 3.55 \text{ eV}$$

$$E_k = E - w$$

$$= 3.55 \text{ eV} - 2.2 \text{ eV}$$

$$= 1.35 \text{ eV}$$