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MK : Fisika Modern

Quiz Fisika Modern

(1.) Lo dari $x'_1 = 0$
$x'_2 = L_0$

$L = x_2 - x_1$

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

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

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

Syarat pengukuran dalam O dilakukan pada waktu yang sama ($t_1 = t_2$) : $x' = \gamma (x_1 - ut)$
$x'_2 = \gamma (x_2 - ut)$

$L_0 = x'_2 - x'_1$
$L_0 = \gamma (x_2 - ut) - \gamma (x_1 - ut)$
$L_0 = \gamma (x_2 - x_1)$ atau $L = \frac{L_0}{\gamma}$

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

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

(2.) Dik : $E = 25$ GeV
$d = 3000$ m
$m_0 = 0{,}511$ MeV/c^2
$c = 3 \times 10^8$ m/s

Dit : a. v^2 d. t'
b. t
c. L'

Jawab :
→ a. $E = \gamma m_0 c^2$

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

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

$= 4{,}89 \times 10^4$.

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

$$\frac{V^2}{c^2} = 1 - \frac{1}{(4{,}89 \times 10^4)^2}$$

$$V = c\sqrt{1 - \frac{1}{(4{,}89 \times 10^4)^2}}$$

$$V \approx c\,(1 - 1{,}05 \times 10^{-10})$$

$$v \approx 2{,}99999 \times 10^8 \text{ m/s}$$

Selisih kecepatan cahaya

$c - v \approx 0{,}031$ m/s

→ b. $t = \frac{d}{v}$

$$= \frac{3000 \text{ m}}{2{,}99999 \times 10^8 \text{ m/s}}$$

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

$t \approx 10$ ms

→ c. $L' = L\sqrt{1 - \frac{V^2}{c^2}}$

$\gamma \approx 4{,}89 \times 10^4$, maka

$$L' = \frac{3000}{4{,}89 \times 10^4}$$

$L' \approx 0{,}061$ m

$= 6{,}1$ cm

→ d. $t' = \frac{t}{\gamma}$

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

$t' \approx 2{,}04 \times 10^{-4}$ s

$= 0{,}204$ ms

(3.) Dik: $\lambda = 122$ nm

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

$\lambda_{teramati} = 366$ nm

Dit: a. V ... ?

b. λ ... ?

Jawab:

→ a. $\frac{\lambda_{teramati}}{\lambda_{asal}} = \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$

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

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

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

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

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

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

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

$$\frac{v}{c} = \frac{8}{10} = 0{,}8$$

→ $v = 0{,}8c \rightarrow 2{,}4 \times 10^8$ m/s

→ b. $\lambda_{teramati} = \lambda_{asal}\sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$

$$\lambda_{teramati} = 122 \times \sqrt{\frac{1 - 0{,}8}{1 + 0{,}8}}$$

$$= 122 \times \sqrt{\frac{0{,}2}{1{,}8}}$$

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

$$= 122 \times 0{,}3333$$

$\approx 40{,}7$ nm

4. Dik : Uranium melepaskan energi : 200 Mev

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

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

$= 3,204 \times 10^{-11}\ J.$

Massa atom uranium : 235 g/mol

1 mol dalam 1 kg uranium : 1000 g

$= \frac{1000\ g}{235\ g/mol} = 4,26\ mol.$

Bilangan avogadro : $6,022 \times 10^{23}$ atom/mol.

Jumlah atom dalam 1 kg uranium

$= 4,26\ mol \times 6,022 \times 10^{23}$ atom/mol

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

Dit : m ... ?

Jawab : E tot yang dilepaskan 1 kg uranium

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

$= 8,20 \times 10^{13}\ J.$

$E = mc^2$

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

$= \frac{(8,20 \times 10^{13}\ J)}{(3 \times 10^8\ m/s)^2} = 9,11 \times 10^{-4}\ kg.$

5. Dik : Minti Helium : 4,001506 u.

Dit : a. Energi ikat ... ?

b. Δm ... ?

Jawab : Massa proton : 1,007276 u

Massa neutron : 1,008665 u

Massa total : 2mp + 2mn

: 2 (1,007276 u) + 2 (1,008665 u)

= 4,031882 u.

→ b. Δm = M tot proton neutron − Minti Helium

= 4,031882 u − 4,001506 u

= 0,030376 u

1 u = $1,66054 \times 10^{-27}$ kg

$\Delta m = 0,030376\ u\ .\ (1,66054 \times 10^{-27}\ kg/u)$

$= 5,044 \times 10^{-29}$ kg

→ a. $E = mc^2$. E

$= (5,044 \times 10^{-29}\ kg) . (2,9979 \times 10^8\ m/s)^2$

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

1 J → MeV $= 6,242 \times 10^{12}$ MeV/J

$= 4,533 \times 10^{-12}$ J . $6,242 \times 10^{12}$ MeV/J

$= 28,3$ MeV

6. Dik : $V_A = V_1 = 0,8\,c$

$V_B = V_2 = 0,6\,c$

Dit : V ... ?

Jawab : $V = \dfrac{V_1 + V_2}{1 + \frac{V_1 . V_2}{c^2}}$

$V_{12} = \dfrac{V_1 + V_2}{1 + \frac{V_1 . V_2}{c^2}} = \dfrac{0,8\,c + 0,6c}{1 + \frac{0,8c . 0,6c}{c^2}} = \dfrac{1,4\,c}{1 + 0,48}$

$= 0,945\,c$

7. Dik : $P = 20$ w

$\lambda = 589$ nm

Dit : n ... ?

Jawab : $P = \dfrac{nhc}{\lambda t}$

$n = \dfrac{P\lambda t}{hc} = \dfrac{(20) \times (589 \times 10^{-9}) \times (1)}{(6,63 \times 10^{-34}) \times (3 \times 10^{8})}$

$n = 592,3 \times 10^{17}$ foton

$n = 5,923 \times 10^{19}$ foton

8. Dik : $\phi = 2,2$ eV

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

Dit : Ek ... ?

Jawab : $E = \dfrac{hc}{\lambda} = \dfrac{(6,63 \times 10^{-34}) . (3 \times 10^{8})}{3,5 \times 10^{-7}}$

$= 5,68 \times 10^{-19}$ J

$= 3,6$ eV

$Ek = E - \phi$

$= 3,6 - 2,2$

$= 1,4$ eV