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Kelas : Z3B

Tugas Pert 7

1. $x'_1 = 0 \rightarrow x'_2 = l_0$

$$l = x_2 - x_1$$

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

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

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

waktu sama ($t_1 = t_2$)

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

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

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

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

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

atau

$$l = \frac{l_0}{\gamma}$$

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

2. Diket: $E = 25 \text{ GeV}$

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

$$m_0 = 0,511 \text{ MeV}/c^2$$

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

Ditanya: v ? l ?
 t ? t' ?

Jawab

a. $v = ?$

$$E = \gamma m_0 c^2$$

$$\gamma = \frac{E}{m_0 c^2} = \frac{25 \times 10^9}{0,511 \times 10^6} = 4,89 \times 10^4$$

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

$$v = c \sqrt{1 - \frac{1}{(4,89 \times 10^4)^2}}$$
$$= 2,999 \times 10^8 \text{ m/s}$$

SIDU

$$b. t = \frac{d}{v} = \frac{3000 \text{ m}}{2,997 \times 10^8 \text{ m/s}} = 1,000001 \times 10^{-5} \text{ s}$$

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

$$l' = \frac{l}{\gamma} = \frac{3000}{4,09 \times 10^4} = 0,061 \text{ m}$$

$$d. t' = \frac{t}{\gamma} = \frac{10^{-5}}{4,09 \times 10^4} = 2,04 \times 10^{-9}$$

$$5. \text{ Diket: } \lambda_0 = 122 \text{ nm}$$

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

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

Ditanya: ~~ke~~ a. v ketika $\lambda_0 \rightarrow \lambda'$

b. λ' jika kecepatan galaksi sama

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

$$\frac{366}{122} = 3$$

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

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

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

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

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

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

$$\lambda'' = 122 \text{ nm} \sqrt{\frac{1 + 0,8}{1 - 0,8}}$$

$$\lambda'' = 40,67 \text{ nm}$$

$$4. \text{ Diket: } E = 200 \text{ MeV}$$

$$M_u \Rightarrow A = 235$$

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

$$M_{atom} = 235 \times 1,6022 \times 10^{-23}$$

Ditanya: ~~Berapa~~ Δm hasil reaksi 1 kg uranium

Jawab:

$$E = 200 \text{ MeV} = 3,204 \times 10^{-11} \text{ J}$$

$$N = \frac{1000}{235} \times 6,022 \times 10^{23} = 2,56 \times 10^{24}$$

$$\Delta E = 3,204 \times 10^{-11} \times 2,56 \times 10^{24} = 8,2 \times 10^{13}$$

$$m = \frac{E}{c^2} = \frac{8,2 \times 10^{13}}{(3 \times 10^8)^2} = 9,11 \times 10^{-4} \text{ kg}$$

5. Diket: $M_p = 1,007276 \text{ u}$

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

$M_{\text{helium}} = 4,00151 \text{ u}$

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

$hc = 9,31 \text{ MeV}$

Ditanya: Energi kecer dari atom helium E_b

b. $\Delta mc^2 = (M_{\text{helium}} - M_{\text{partikel}})c^2 = ?$

Jawab:

a. $2M_p + 2M_n$

$= 2(1,007276) + 2(1,008665) = 4,031882 \text{ u}$

$\Delta M = M_{\text{helium}} - M_{\text{helium}} = 4,031882 - 4,00151 = 0,030376 \text{ u}$

$E = \Delta mc^2$

$= 3,004 \times 10^{-24} \times (2,99 \times 10^8)^2 = 4,633 \times 10^{-12} \text{ J}$

b. $\Delta m = 0,030376 \text{ u} \times 1,66054 \times 10^{-27} \text{ kg} = 5,04 \times 10^{-29} \text{ kg}$

6. Diket: $u_a = 0,8c$

$u_b = 0,6c$

Ditanya: u_a'

Jawab: $u_a' = \frac{u_a + u_b}{1 + \frac{u_a u_b}{c^2}} = \frac{0,8 + 0,6}{1 + (0,8)(0,6)} = \frac{1,4}{1,48} = 0,946c$

7. Diket: $P = 20$

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

$h = 6,626 \times 10^{-34} \text{ Js}$

Ditanya: Jumlah atom yg tapancah?

Jawab:

$E = \frac{hc}{\lambda} = \frac{6,626 \times 10^{-34} (3 \times 10^8)}{589 \times 10^{-9}} = 3,37 \times 10^{-19} \text{ J}$

$N = \frac{20}{3,37 \times 10^{-19}} = 5,94 \times 10^{19}$

8. Diket: $u = 2,2 \text{ eV}$

$f = 3500 \text{ A}$

$h = 6,626 \times 10^{-34} \text{ Js}$

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

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

Ditanya: $E_{\text{maks}} \text{ (eV)}$

Jawab: $E = \frac{hc}{\lambda} = \frac{6,626 \times 10^{-34} (3 \times 10^8)}{3500 \times 10^{-10}} = 5,68 \times 10^{-19} \text{ J} = 3,53 \text{ eV}$

$E_k = E - u = 3,53 - 2,2 = 1,35 \text{ eV}$