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1) $x_1 = 0$ hingga $x_2' = L_0$

$L = x_2 - x_1$

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

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

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

$t_1 = t_2$

$x_1' = \beta(x_1 - vt)$

$x_2' = \beta(x_2 - vt)$

$L_0 = x_2' - x_1'$

$L_0 = \beta[(x_2 - ut) - \beta(x_1 - ut)]$

$L_0 = \beta(x_2 - x_1)$

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

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

2) Diketahui : $E = 25\ GeV = 25 \cdot 10^9\ eV$

$d = 3000\ m$

$m_0 = 0.511\ MeV/c^2$

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

Ditanya : a. c-v...? c. L...?

b. t...? d. t'...?

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

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

$= \frac{25 \cdot 10^9\ eV}{0.511 \cdot 10^6\ eV}$

$= 4.89 \cdot 10^4$

$1 = \frac{v^2}{c^2} + \frac{1}{\beta^2}$

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

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

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

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

Selisih $= c - v$

$= [3 - 2.9999] \cdot 10^8\ m/s$

$= 0.0001\ m/s$

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

$t = \frac{3000\ m}{2.9999 \cdot 10^8\ m/s}$

$t \approx 1.000000001 \cdot 10^{-5}\ s$

$t \simeq 10\ \mu s$

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

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

$l' = \frac{3000}{4,89 \cdot 10^4}$

$l' \approx 0,061$ m

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

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

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

$= 0,204$ ns

3) Diketahui : $\lambda_0 = 122$ nm

$\lambda' = 366$ nm

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

Ditanya : a. v...?

b. λ''...?

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

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

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

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

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

$\gamma - \gamma v/c = 1+v/c$

$\beta = 10^{v/c}$

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

$v = 0,8c$

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

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

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

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

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

$= 122\sqrt{0,1111}$

$= 122 \cdot 0,3333$

$\lambda'' \approx 40,67$ nm

1.) Diketahui : E peratom = 200 mev

m uranium = 1 Kg = 1000 gr

n = 235

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

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

$m_{atom} = \frac{235\ gr}{6,022 \cdot 10^{23}}$

Ditanya : Δm ?

» E = 200 mev . $1,602 \times 10^{-13}$ J/mev

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

$N = \frac{1000\ gr}{m_{atom}}$

$= \frac{1000\ gr}{\frac{235}{6,023 \cdot 10^{23}}}$

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

E total = $(3,204 \cdot 10^{-4}$ J/atom$)(2,56 \cdot 10^{24})$

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

$E = mc^2$

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

$= \frac{18,2 \cdot 10^{13}\ J}{(3 \cdot 10^8)^2}$

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

5) Diketahui : $m_p = 1,007276$ u
$m_n = 1,008665$ u
$m_{helium} = 4,001506$ u
$1u = 1,66054 \cdot 10^{-27}$ kg
$1uc^2 = 931,5$ mev

Ditanya : a.) energi ikat ?
b.) Δm kg ?

=> a. $m_{total} = 2m_p + 2m_n$
$= 2(1,007276) + 2(1,008665)$
$= 4,031882$ u

$\Delta m = m_{total} - m_{helium}$
$= 4,031882 - 4,001506$
$= 0,030376$ u

$E = \Delta mc^2$
$= (5,049 \cdot 10^{-29})(2,9979 \cdot 10^8)$
$= 4,533 \cdot 10^{-12}$
$= 28,3$ mev

b) $\Delta m_{kg} = (0,030376\ u) - (1,66054 \cdot 10^{-27})$
$= 5,09 \cdot 10^{-29}$ kg.

6) Diketahui : $V_A = 0,8c$
$V_B = 0,6c$

Ditanya : V' ... ?

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

7) Diketahui : $P = 20$ W
$\lambda = 589$ nm $= 589 \times 10^{-9}$ m
$h = 6,6 \cdot 10^{-34}$ Js
$c = 3 \cdot 10^8$ m/s

Ditanya : N ... ?

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

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

8) Diketahui : $W = 2,2\ eV$

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

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

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

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

Ditanya : EK ... ?

$\Rightarrow E = \frac{hc}{\lambda} = \frac{(6,6 \cdot 10^{-34})(3 \cdot 10^8)}{3,5 \cdot 10^{-7}}$

$= \frac{1,9178 \times 10^{-25}}{3,5 \times 10^{-7}}$

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

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

$= 3,55\ eV$

$EK = E - W$

$= 3,55\ eV - 2,2\ eV$

$= 1,35\ eV.$