

EJERCICIOS DE RELATIVIDAD

(46.) $v = 2,7 \cdot 10^8 \text{ m/s}$ a) $m = \gamma \cdot m_0$; $\beta = \frac{v}{c} = \frac{2,7 \cdot 10^8}{3 \cdot 10^8} = 0,9$
 $\gamma = \frac{1}{\sqrt{1-\beta^2}} = \frac{1}{\sqrt{1-0,9^2}} = 2,29$; $m = \gamma \cdot m_0 = 2,29 \cdot 1,67 \cdot 10^{-27} = 3,83 \cdot 10^{-27} \text{ kg}$
 $p = mv = 3,83 \cdot 10^{-27} \cdot 2,7 \cdot 10^8 = 1,03 \cdot 10^{-18} \text{ kg m/s}$

b) $E_c = E_1 - E_0$; $E_2 = E_2 - E_0$ $E_2 - E_1 = E_2 - E_1 = \gamma_2 m_0 c^2 - \gamma_1 m_0 c^2 = (\gamma_2 - \gamma_1) m_0 c^2$

$\gamma_2 = \frac{1}{\sqrt{1-\beta_2^2}}$; $\beta_2 = \frac{v}{c} = 0,95$; $\gamma_2 = \frac{1}{\sqrt{1-\beta_2^2}} = \frac{1}{\sqrt{1-0,95^2}} = 3,20$;

$\Delta E_c = (\gamma_2 - \gamma_1) m_0 c^2 = (3,20 - 2,29) 1,67 \cdot 10^{-27} (3 \cdot 10^8)^2 = 1,37 \cdot 10^{-10} \text{ J}$

(49.) a) $m = \gamma \cdot m_0$ $\gamma = \frac{1}{\sqrt{1-\beta^2}}$; $\beta = \frac{v}{c} = \frac{2 \cdot 10^8}{3 \cdot 10^8} = 0,667$; $\gamma = \frac{1}{\sqrt{1-0,667^2}} = 1,34$
 $m = \gamma \cdot m_0 = 1,34 \cdot 9,11 \cdot 10^{-31} = 1,22 \cdot 10^{-30} \text{ kg}$

b) $\beta = 0,8$; $\gamma = \frac{1}{\sqrt{1-\beta^2}} = \frac{1}{\sqrt{1-0,8^2}} = 1,67$; $E = m \cdot c^2 = \gamma \cdot m_0 c^2 = \gamma \cdot E_0$

$E = \gamma \cdot m_0 c^2 = 1,67 \cdot 9,11 \cdot 10^{-31} (3 \cdot 10^8)^2 = 1,37 \cdot 10^{-13} \text{ J}$

(58.) $v = 0,6c$; $\beta = \frac{v}{c} = \frac{0,6c}{c} = 0,6$ $m = \gamma \cdot m_0$; $\gamma = \frac{1}{\sqrt{1-\beta^2}} = \frac{1}{\sqrt{1-0,6^2}} = 1,25$

a) $m = \gamma \cdot m_0 = 1,25 \cdot 1 = 1,25 \text{ mg}$

b) $E_c = E - E_0 = (\gamma - 1) m_0 c^2 = (1,25 - 1) \cdot 10^{-6} (3 \cdot 10^8)^2 = 2,25 \cdot 10^{10} \text{ J}$

(78.) $E_0 = 0,511 \text{ MeV}$ $v = 0,8c$

a) $m = \gamma m_0$; $m_0 c^2 = E_0$; $m_0 = \frac{E_0}{c^2}$; $E_0 = 0,511 \text{ MeV} \cdot \frac{10^6 \text{ eV}}{1 \text{ MeV}} \cdot \frac{1,6 \cdot 10^{-19} \text{ J}}{1 \text{ eV}} = 8,18 \cdot 10^{-14} \text{ J}$

$m_0 = \frac{E_0}{c^2} = \frac{8,18 \cdot 10^{-14}}{(3 \cdot 10^8)^2} = 9,08 \cdot 10^{-31} \text{ kg}$; $m = \gamma \cdot m_0$; $\gamma = \frac{1}{\sqrt{1-\beta^2}} = \frac{1}{\sqrt{1-0,8^2}} = 1,67$

$m = \gamma \cdot m_0 = 1,67 \cdot 9,08 \cdot 10^{-31} = 1,51 \cdot 10^{-30} \text{ kg}$

b) $E = m \cdot c^2 = 1,51 \cdot 10^{-30} (3 \cdot 10^8)^2 = 1,36 \cdot 10^{-13} \text{ J}$

$E = 1,36 \cdot 10^{-13} \text{ J} \cdot \frac{1 \text{ eV}}{1,6 \cdot 10^{-19} \text{ J}} \cdot \frac{1 \text{ MeV}}{10^6 \text{ eV}} = 0,85 \text{ MeV}$