Zadanie 4A $\boxed{c=1}$

(1) Liczba K^+ która pozostaje po czasie $t \cong \frac{L}{v_K} \approx \frac{L}{c} \cong 2\cdot 10^{-6}\,s$

$$N = N_0 \exp\left(-ct/c\tau\gamma_K\right)$$

$$\gamma_K = \frac{E_K}{m_K} \approx 405 \qquad \beta_K = 0.999997 = \frac{\sqrt{E_K^2 - m_K^2}}{E_K}$$

$$N = N_0 \exp\left(-\,2\cdot 10^{-6}/405\cdot 1.24\cdot 10^{-8}\right) = N_0 \exp(-0.4) = N_0 \cdot 0.67$$

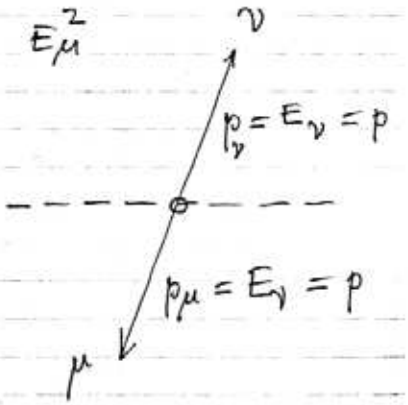
Nie rozpada się więc 67%, a rozpadnie się ~33% K^+.

(2) Rozpad w locie $K^+ \to \mu^+ \nu_\mu$

w układzie K^+ prawo zachowania energii

$$m_K^2 = (E_\mu + E_\nu)^2 - (\underbrace{\vec{p}_\mu + \vec{p}_\nu}_{\to 0})^2 = (E_\mu + E_\nu)^2$$

$\boxed{c=1}$



Czyli $m_K = E_\mu + E_\nu$ lub $(m_K - E_\nu)^2 = E_\mu^2$

$$E_\mu^2 = m_\mu^2 + p^2 = m_\mu^2 + E_\nu^2$$

$$\Downarrow$$

$$m_K^2 - 2m_K E_\nu + \cancel{E_\nu^2} = m_\mu^2 + \cancel{E_\nu^2}$$

$$E_\nu = \frac{m_K^2 - m_\mu^2}{2m_K} = 235.6\ \text{MeV}$$

$$E_\mu = \left(E_\nu^2 + m_\mu^2\right)^{1/2} = 258.4\ \text{MeV} \quad \text{i} \quad p_\mu = E_\nu = p$$

Transformacja do układu LAB żeby obliczyć $E_{\mu^+}^{min}$

$$E_{\mu^+ LAB}^{min} = \gamma_K\left(E_\mu - E_\nu \beta_K\right) \approx \gamma_K\left(E_\mu - E_\nu\right) =$$

$$\cong 405\,(258.4 - 235.6)\ \text{MeV} = 9.23\ \text{GeV}$$