حل تمرین های جلسه دهم و یازدهم درس فیزیک

سؤال ۱:

$\frac{h\nu}{c} = \gamma m_0 u \rightarrow$ بقای تکانه

$h\nu + m_0c^2 = \gamma m_0 c^2 \rightarrow$ بقای انرژی

$\Rightarrow h\nu = \frac{h\nu}{cu} c^2 - m_0c^2 \Rightarrow \frac{h\nu c}{u} = h\nu + m_0c^2 \Rightarrow \boxed{u = \frac{h\nu c}{h\nu + m_0c^2}}$

↓ جایگذاری از بقای تکانه

$m = \gamma m_0$

$$\gamma = \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}} = \frac{1}{\sqrt{1 - \frac{(h\nu)^2 c^2}{(h\nu + m_0c^2)^2 c^2}}} = \frac{1}{\sqrt{\frac{(h\nu + m_0c^2)^2 - h^2\nu^2}{(h\nu + m_0c^2)^2}}}$$

$$= \frac{h\nu + m_0c^2}{\sqrt{m_0^2c^4 + 2m_0c^2h\nu}} = \frac{c^2\left(\frac{h\nu}{c^2} + m_0\right)}{c^2\sqrt{m_0^2 + \frac{2m_0h\nu}{c^2}}}$$

$$\Rightarrow m = \frac{\frac{h\nu m_0}{c^2} + m_0^2}{\sqrt{\frac{2m_0h\nu}{c^2} + m_0^2}} \simeq \boxed{\left(m_0^2 + \frac{2m_0h\nu}{c^2}\right)^{1/2}}$$

سؤال ۲:

$\frac{\lambda}{\lambda_0} = \left(\frac{1-\beta}{1+\beta}\right)^{1/2}$ $\quad \lambda_{green} = \lambda = 5 \times 10^{-5}\,cm$, $\lambda_{red} = \lambda_0 = 7 \times 10^{-5}\,cm$

$\Rightarrow \frac{5}{7} = \left(\frac{1-\beta}{1+\beta}\right)^{1/2} \Rightarrow \frac{25}{49} = \frac{1-\beta}{1+\beta} \rightarrow (1+\beta)\frac{25}{49} = 1-\beta$

$\Rightarrow \beta = \frac{24}{74} = 0.32 \Rightarrow \boxed{v = 0.32\,c}$