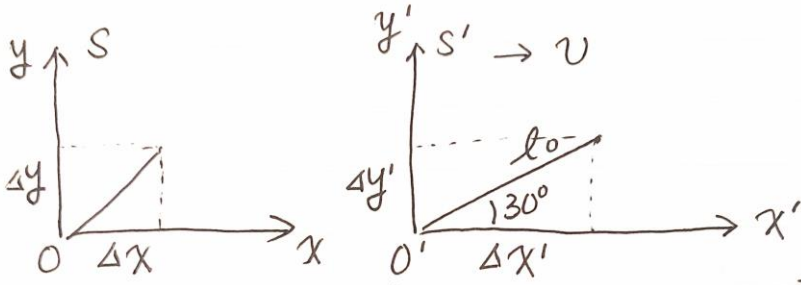
27. 狭义相对论

1. B. 2. A.

3. C.



S:

$$\begin{cases} \Delta x = \Delta x' \sqrt{1-(\frac{v}{c})^2} \\ \Delta y = \Delta y' \end{cases}$$

$$\begin{cases} \Delta x' = l_0 \cos 30^\circ = \frac{\sqrt{3}}{2} l_0 \\ \Delta y' = l_0 \sin 30^\circ = \frac{1}{2} l_0 \end{cases}$$

$$\Rightarrow \begin{cases} \Delta x = \frac{\sqrt{3}}{2} l_0 \sqrt{1-(\frac{v}{c})^2} \\ \Delta y = \frac{1}{2} l_0 \end{cases}$$

45°, $\Delta x = \Delta y \Rightarrow \sqrt{1-(\frac{v}{c})^2} = \frac{1}{\sqrt{3}} \Rightarrow v = \sqrt{\frac{2}{3}} c$

4. C

5. ①相对性原理 ②光速不变原理. 运动. 相对收缩. 慢.

6. 电子：S'：$v = 0.5c$

$u_x' = 0.8c$

S：$u_x = \dfrac{u_x' + v}{1 + \frac{v}{c^2}u_x'} = \dfrac{0.8c + 0.5c}{1 + \frac{0.5c}{c^2} \times 0.8c} = 0.93c$

光子：$u_x = c$

7. S：$t_1 = 2.0 \times 10^{-7}\,s$，$x = 60m$，$y = z = 0$.

S'：$v = 0.6c$

$x' = \dfrac{x - vt_1}{\sqrt{1 - (\frac{v}{c})^2}} = 30\ m$，$y' = y = 0$，$z' = z = 0$

$t_1' = \dfrac{t_1 - \frac{v}{c^2}x}{\sqrt{1 - (\frac{v}{c})^2}} = 1.0 \times 10^{-7}\,s$

8. S：$\Delta x = x_2 - x_1 = 100\ km$，$\Delta t_1 = t_2 - t_1 = 0$

S'：$v = 0.6c$

$\Delta x' = \dfrac{\Delta x - v\Delta t_1}{\sqrt{1 - (\frac{v}{c})^2}} = 125\ km$

$\Delta t' = \dfrac{\Delta t_1 - \frac{v}{c^2}\Delta x}{\sqrt{1 - (\frac{v}{c})^2}} = -2.5 \times 10^{-4}\,s$

9、

$$t' = \frac{t - \frac{v}{c^2}x}{\sqrt{1-\beta^2}}, \quad t_2' - t_1' = \frac{(t_2 - t_1) - \frac{v}{c^2}(x_2 - x_1)}{\sqrt{1-\beta^2}}$$

$$\Rightarrow 3 = \frac{2 - \frac{v}{c^2}\times 0}{\sqrt{1-\beta^2}}, \quad \beta = \frac{\sqrt{5}}{3}, \Rightarrow v = \frac{\sqrt{5}}{3}c = 2.236\times 10^8\ \mathrm{m/s}$$

$$x' = \frac{x - vt}{\sqrt{1-\beta^2}}, \quad x_2' - x_1' = \frac{(x_2 - x_1) - v(t_2 - t_1)}{\sqrt{1-\beta^2}}$$

$$x_2' - x_1' = \frac{0 - c\beta\times 2}{\sqrt{1-\beta^2}} = -3\sqrt{5}\times 10^8\ \mathrm{m} = -6.71\times 10^8\ \mathrm{m}$$

10、

$$E_{\mathrm{k}} = mc^2 - m_0c^2, \quad W = \Delta E_{\mathrm{k}}$$

$$W = E_{\mathrm{k}2} - E_{\mathrm{k}1} = \left(m_2c^2 - m_0c^2\right) - \left(m_1c^2 - m_0c^2\right)$$

$$= m_2c^2 - m_1c^2 = \frac{m_0c^2}{\sqrt{1 - v_2^2/c^2}} - \frac{m_0c^2}{\sqrt{1 - v_1^2/c^2}}$$

$$= (0.51\mathrm{eV})\left(\frac{1}{\sqrt{1-0.8^2}} - \frac{1}{\sqrt{1-0.4^2}}\right) = 2.95\times 10^5\ \mathrm{eV} = 4.7\times 10^{-14}\ \mathrm{J}$$