作业十

Noflowerzzk

2025.4.27

5.4

$$l' = l_0\sqrt{\left(1-\frac{u^2}{c^2}\cos^2\theta+\sin^2\theta\right)},\ \theta = \arctan\frac{\sin\theta}{\sqrt{1-\left(\frac{u^2}{c^2}\right)}\cos\theta}$$

5.5

u 至少为 $c\sqrt{1-\dfrac{a^2}{l_0^2}}$

5.6

(1) 时间为 4.33×10^{-8} s.

(2) $l = 10.4$m.

5.8

显然为 $0.8c$

5.10

$$t_1' = \frac{t_1-\frac{u}{c^2}x_1}{\sqrt{1-u^2/c^2}} = \frac{0-\frac{0.96c}{c^2}\times100}{\sqrt{1-0.96^2}} = -1.14\times10^{-6}\,\mathrm{s}$$

$$x_1' = \frac{x_1-ut_1}{\sqrt{1-u^2/c^2}} = \frac{100-0.96c\times0}{\sqrt{1-0.96^2}} = 357\,\mathrm{m}$$

$$t_2' = \frac{t_2-\frac{u}{c^2}x_2}{\sqrt{1-u^2/c^2}} = \frac{10-\frac{0.96c}{c^2}\times9.8c}{\sqrt{1-0.96^2}} = 2.11\,\mathrm{s}$$

$$x_2' = \frac{x_2-ut_2}{\sqrt{1-u^2/c^2}} = \frac{9.8c-0.96c\times10}{\sqrt{1-0.96^2}} = 2.14\times10^8\,\mathrm{m}$$

$$v_x' = \frac{v_x-u}{1-\frac{u}{c^2}v_x} = \frac{0.98c-0.96c}{1-\frac{0.96c}{c^2}\times0.98c} = 1.01\times10^8\,\mathrm{m/s}$$

5.11

$v_m = 0.213c$, $v_M = 0.992c$

5.12

(1) $v_1 = 0.89c$

(2) $\Delta t = 2 \times 10^{-6}\text{s}$.

5.13

$W = 3.92 \times 10^{-13}\text{J}$.

5.14

$E_k = m_0c^2\left(\frac{1}{\sqrt{1-\beta^2}} - 1\right) = nmc^2$, $v = c\sqrt{1 - \frac{1}{(n+1)^2}}$, $p = \sqrt{n(n+2)}m_0c$

5.15

$m = 725m_e, E_k = 518m_ec^2$

5.16

以 A 为参考系，$v_B = \frac{2\beta c}{1+\beta^2}$, 故总能量为 $\frac{1+\beta^2}{1-\beta^2}m_0c^2$

5.18

$\Delta E = \Delta mc^2 = 5.5\text{MeV}$

5.19

显然两个光子动量相同，又 $E = pc$ 光子能量相同.

由 $\frac{m_0c^2}{\sqrt{1-k^2}} = 2pc$, $\frac{m_0v}{\sqrt{1-k^2}} = 2p\cos\theta$, 得 $\cos\theta = k$