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1. C

6. $\beta = \frac{v}{c} = 0.6$

$x = \frac{x' + vt'}{\sqrt{1-\beta^2}} = 93\ m$

$y = y' = 0$

$z = z' = 0$

$t = \frac{t' + \frac{vx'}{c^2}}{\sqrt{1-\beta^2}} = 2.5 \times 10^{-7} s$

12. 以地面为S系，运动粒子为S'系

$u_x' = 0 \quad u_y' = c \quad u_z' = 0$

$u_x = \frac{u_x' + v}{1 + \frac{v}{c^2}u_x'} = v$

$u_y = \frac{u_y'\sqrt{1-\frac{v^2}{c^2}}}{1 + \frac{v}{c^2}u_x'} = \sqrt{c^2 - v^2}$

$u_z = \frac{u_z'\sqrt{1-\frac{v^2}{c^2}}}{1 + \frac{v}{c^2}u_x'} = 0$

$\therefore u = \sqrt{u_x^2 + u_y^2 + u_z^2} = c$

$\theta = \arctan\frac{u_y}{u_x} = \arctan\frac{\sqrt{c^2 - v^2}}{v}$

2. C

3. B

4. C

8. $x_1 = \frac{x_1 - vt}{\sqrt{1-\frac{v^2}{c^2}}}$ $x_2 = \frac{x_2 - vt}{\sqrt{1-\frac{v^2}{c^2}}}$

$t_1' = \frac{t_1 - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$ $t_2' = \frac{t_2 - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

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

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

(1) $\Delta x' = 0$ 即 $\Delta x - v\Delta t = 0$

$\therefore v = \frac{\Delta x}{\Delta t} = 1.5 \times 10^8\ m$

(2) $\Delta t' = \frac{\Delta t - \frac{v\Delta x}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} = 1.73 \times 10^{-6}\ s$

13. $t_1 = \frac{t_1' + \frac{vx_1'}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

$t_2 = \frac{t_1' + \frac{vx_2'}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

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

$\Delta x' = 0$

$\Delta t' = 10s$

$\therefore \Delta t = 12.5s$

$\therefore t = \Delta t + \frac{v\Delta t}{v_1} = 37.5s$

15. $x_1' = \frac{x_1 - vt}{\sqrt{1-\frac{v^2}{c^2}}}$ $\quad x_2' = \frac{x_2 - vt}{\sqrt{1-\frac{v^2}{c^2}}}$

$t_1' = \frac{t_1 - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$ $\quad t_2' = \frac{t_2 - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

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

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

$\Delta t' = 6.0\,s$

$\Delta t = 4.0\,s$

$\Delta x = 0\,m$

$\therefore \Delta x' = 1.34 \times 10^9\,m$

17.

$l = l_0\sqrt{1-\frac{v^2}{c^2}}$

$u' = \frac{u - v}{1 - \frac{v}{c^2}u}$

$\therefore l = \frac{l_0\sqrt{(c^2-u^2)(c^2-v^2)}}{c^2 - uv}$

18.

$l = l_0\sqrt{1-\frac{v^2}{c^2}}$

$l = \frac{1}{2}l_0$

$\therefore v = \frac{\sqrt{3}}{2}c$

22.

$E_0 = m_0c^2 = 0.512\,MeV$

$E_k = E - E_0 = 4.488\,MeV$

$E^2 = E_0^2 + p^2c^2$

$\therefore p = \frac{1}{c}\sqrt{E^2 - E_0^2} = 2.66 \times 10^{-21}\,kg \cdot m \cdot s^{-1}$

$E = \frac{m_0c^2}{\sqrt{1-v^2/c^2}}$

$\therefore v = 0.995c$

26.

(1) $qvB = \frac{mv^2}{R}$

$E = E_0 + E_k$

$E^2 = E_0^2 + p^2c^2$

$p = mv$

$\therefore B = 0.146T$

(2) $E = mc^2$

$E_0 = m_0c^2$

$\therefore \frac{m_0}{m} = 1.98$

27. $W = E_{k2} - E_{k1} = (E_2 - E_0) - (E_1 - E_0) = E_2 - E_1$

$E = \frac{m_0c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$

$\therefore W = m_0c^2\left(\frac{1}{\sqrt{1 - \frac{v_2^2}{c^2}}} - \frac{1}{\sqrt{1 - \frac{v_1^2}{c^2}}}\right)$

当 $v_1 = 0$, $v_2 = 0.10c$ 时, $W = 2.58 \times 10^3$ eV

当 $v_2 = 0.80c$, $v_3 = 0.90c$ 时, $W = 3.12 \times 10^5$ eV

28. $\frac{m_0v}{\sqrt{1 - \frac{v^2}{c^2}}} - \frac{m_0v}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{m_0'v'}{\sqrt{1 - \frac{v'^2}{c^2}}}$

$\therefore v' = 0$

$\frac{m_0c^2}{\sqrt{1 - \frac{v^2}{c^2}}} + \frac{m_0c^2}{\sqrt{1 - \frac{v'^2}{c^2}}} = \frac{m_0'c^2}{\sqrt{1 - \frac{v'^2}{c^2}}}$

$\therefore m_0' = \frac{2m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$