

1) $t_0 = 5.0 \text{ s}$

a) $t = \frac{5}{\sqrt{1 - \frac{(0.65c)^2}{c^2}}} = \frac{5}{\sqrt{1 - 0.4225}} = \frac{5}{\sqrt{0.5775}} = \boxed{6.58 \text{ s}}$

b) $t = \frac{5}{\sqrt{1 - \frac{(0.866c)^2}{c^2}}} = \boxed{10 \text{ s}}$ c) $t = \frac{5}{\sqrt{1 - \frac{(0.995c)^2}{c^2}}} = \boxed{50 \text{ s}}$

d) $t = \frac{5}{\sqrt{1 - \frac{(0.999c)^2}{c^2}}} = \boxed{250 \text{ s}}$

2) $l_0 = 100 \text{ m}$

a) $l = 100 \sqrt{1 - \frac{(0.63c)^2}{c^2}} = 100 \sqrt{1 - \frac{0.3969c^2}{c^2}} = \boxed{77.66 \text{ m}}$

b) $l = 100 \sqrt{1 - \frac{(0.866c)^2}{c^2}} = \boxed{50.00 \text{ m}}$

c) $l = 100 \sqrt{1 - \frac{(0.999c)^2}{c^2}} = \boxed{4.47 \text{ m}}$

$$3) \quad t = \frac{t_0}{\sqrt{1 - \frac{(0.5c)^2}{c^2}}} = \boxed{1.15 t_0}$$

$$* 4) \quad m = 46g = 0.046 \text{ kg}$$

$$\boxed{E = mc^2} \quad E = (0.046) (3.00 \times 10^8 \text{ m/s})^2$$

$$* \boxed{E = 4.14 \times 10^{14} \text{ J}}$$