

PHYS 225 HW 2

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1. a) $C = 2\pi r = 2\pi \times 7.5 = 47.1239 \text{ m}$
 $S = 0.9994 \times 2.998 \times 10^8 \times 3 \times 10^{-6} = 898.86 \text{ m}$
 $n = S/C = 898.86 \div 47.1239 = \boxed{19.0744}$
- b) $\gamma = \left(\sqrt{1 - \frac{v^2}{c^2}} \right)^{-1} = \left(\sqrt{1 - 0.9994^2} \right)^{-1} = 28.8718$
 $t = \gamma t' = 28.8718 \times 3 \times 10^{-6} = 8.6615 \times 10^{-5}$
 $S = 0.9994 \times 2.998 \times 10^8 \times 8.6615 \times 10^{-5} = 2.5951 \times 10^4 \text{ m}$
 $n = S/C = 2.5951 \times 10^4 \div 47.1239 = \boxed{550.713}$
- c) $\gamma = \left(\sqrt{1 - \frac{v^2}{c^2}} \right)^{-1} = \left(\sqrt{1 - 0.9999^2} \right)^{-1} = 5000.25$
 - i) In moving muons reference frame with length contraction:
 $L = \frac{1}{\gamma} L_0 = 2 \times 10^{-4} \times 20 \times 10^3 = 4 \text{ m}$
 $T = S/v = 2 \div 0.9999c = 1.33429 \times 10^8 \text{ s}$
 $P(1.33429 \times 10^8) = \boxed{99.6922\%}$
 - ii) In the ground reference frame with time dilation:
 $t = S/v = 2 \times 10^4 \div 0.9999c = 6.67178 \times 10^{-5} \text{ s}$
 $t' = t \div \gamma = 6.67178 \times 10^{-5} \div 5000.25 = 1.33429 \times 10^{-8}$
 $P(1.33429 \times 10^8) = \boxed{99.6922\%}$
- d) $t = S/v = 2 \times 10^4 \div 0.9999c = 6.67178 \times 10^{-5} \text{ s}$
 $P(6.67178 \times 10^{-5}) = \boxed{2.019 \times 10^{-7}} = 0.00002019\%$

$$2. \quad \gamma = \left(\sqrt{1 - \frac{v^2}{c^2}} \right)^{-1} = \left(\sqrt{1 - 0.6^2} \right)^{-1} = 1.25$$

$$a) \quad \frac{1}{\gamma} L' = 0.8L$$

$$S = 0.8L + L = 1.8L. \text{ Thus, } t = S/v = 1.8L \div 0.6C = \boxed{\frac{3L}{c}}$$

$$b) \quad v = S/t = 0.8L \div \frac{3L}{c} = \frac{4}{15}c$$

$$v_{final} = v_{train} - v = \frac{3}{5}c - \frac{4}{15}c = \boxed{\frac{1}{3}c}$$

$$c) \quad t' = t \times \frac{1}{\gamma} = \boxed{\frac{12L}{5c}}$$