PHYS 225 HW 2

James Liu

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1. a) $C = 2\pi r = 2\pi \times 7.5 = 47.1239$ m
   $S = 0.9994 \times 2.998 \times 10^8 \times 3 \times 10^{-6} = 898.86$ m
   $n = S/C = 898.86 \div 47.1239 = \boxed{19.0744}$

   b) $\gamma = \left(\sqrt{1 - \frac{v^2}{c^2}}\right)^{-1} = \left(\sqrt{1 - 0.9994^2}\right)^{-1} = 28.8718$
   $t = \gamma t' = 28.8718 \times 3 \times 10^{-6} = 8.6615 \times 10^{-5}$
   $S = 0.9994 \times 2.998 \times 10^8 \times 8.6615 \times 10^{-5} = 2.5951 \times 10^4$m
   $n = S/C = 2.5951 \times 10^4 \div 47.1239 = \boxed{550.713}$

   c) $\gamma = \left(\sqrt{1 - \frac{v^2}{c^2}}\right)^{-1} = \left(\sqrt{1 - 0.9999^2}\right)^{-1} = 70.7124$

      i) In moving muons reference frame with length contraction:
      $L = \frac{1}{\gamma} L_0 = 0.014142 \times 20 \times 10^3 = 282.836$ m
      $T = S/v = 282.836 \div 0.9999c = 9.43414 \times 10^{-7}$s
      $P(9.43414 \times 10^{-7}) = \boxed{80.4146\%}$

      ii) In the ground reference frame with time dilation:
      $t = S/v = 2 \times 10^4 \div 0.9999c = 6.67178 \times 10^{-5}$ s
      $t' = t \div \gamma = 6.67178 \times 10^{-5} \div 70.7124 = 9.43414 \times 10^{-7}$ s
      $P(9.43414 \times 10^{-7}) = \boxed{80.4146\%}$

   d) $t = S/v = 2 \times 10^4 \div 0.9999c = 6.67178 \times 10^{-5}$ s
   $P(6.67178 \times 10^{-5}) = \boxed{2.019 \times 10^{-7}} = 0.00002019\%$

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

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

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

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

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

c) $\gamma = \frac{1}{\sqrt{1-\frac{1}{9}}}$ $t' = t \times \frac{1}{\gamma} = \boxed{\frac{\sqrt{8}L}{c}}$