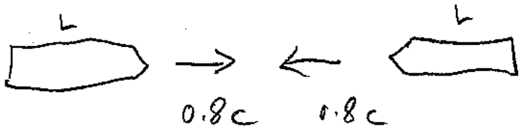
Physics 262 Practice Exam 2 Solutions

(1.)

$L = 100\,m$



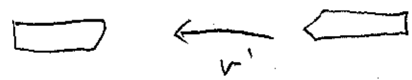

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-0.64}} = \frac{1}{\sqrt{0.36}} = \frac{1}{0.6}$$

$$\gamma = \frac{5}{3}$$

Length in space ship rest frame is $L_0 = \frac{5}{3}L \approx 167\,m$

velocity of second ship in first ship's reference frame.

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



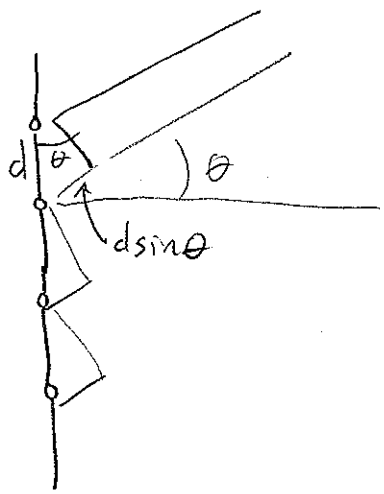

$$v' = \frac{-0.8c - 0.8c}{1 + \frac{(0.8c)(0.8c)}{c^2}} = -\frac{1.6\,c}{1+0.64} = -\frac{1.6\,c}{1.64}$$

Length of Second Spaceship

$$L_2 = \frac{L_0}{\gamma} = \frac{5/3\,L}{\gamma} = \frac{5L}{3}\left(1 - \frac{v'^2}{c^2}\right)^{1/2}$$

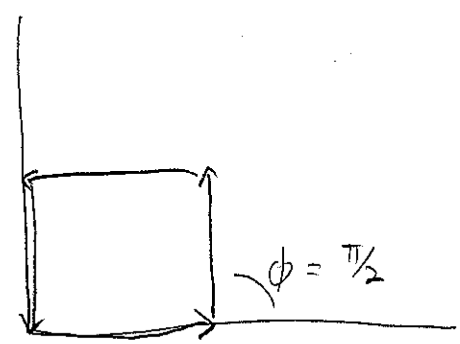
$$\boxed{L_2 = \frac{5(100m)}{3}\left(1 - \left(\frac{1.6}{1.64}\right)^2\right)^{1/2} = 37\,m}$$

(2.)




$$\phi = \frac{2\pi}{\lambda} d \sin\theta$$

Phasor approach

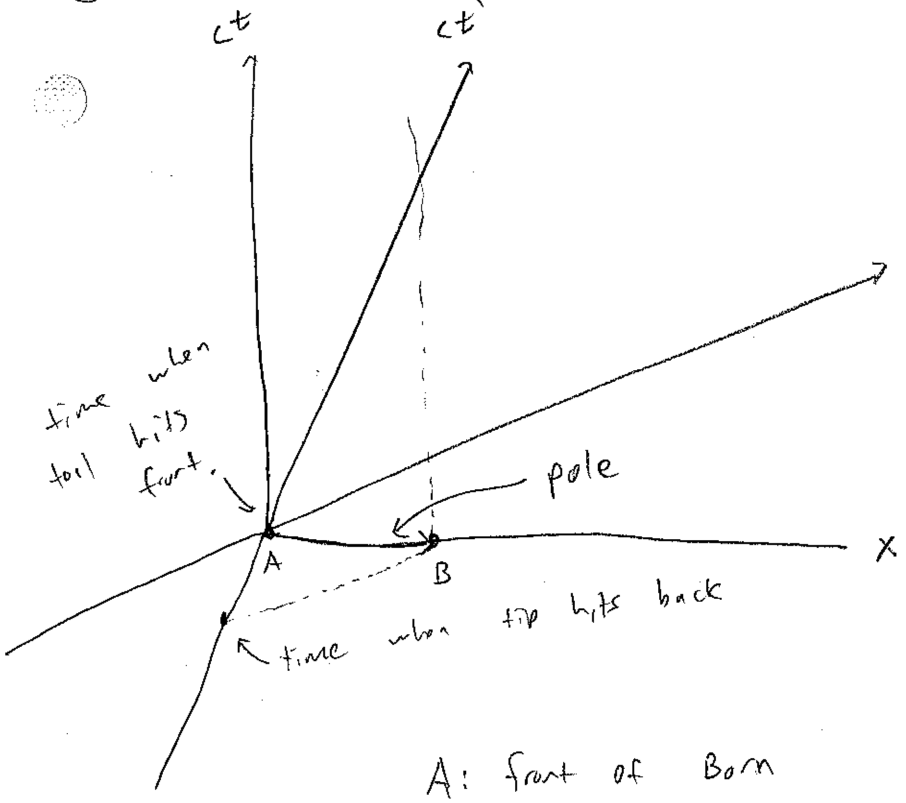



$$\pi/2 = 2\pi/\lambda \, d \sin\theta$$

$$\sin\theta = \frac{\lambda}{4d}$$

$$\theta = \sin^{-1}\left[\frac{\lambda}{4d}\right]$$

(3.)

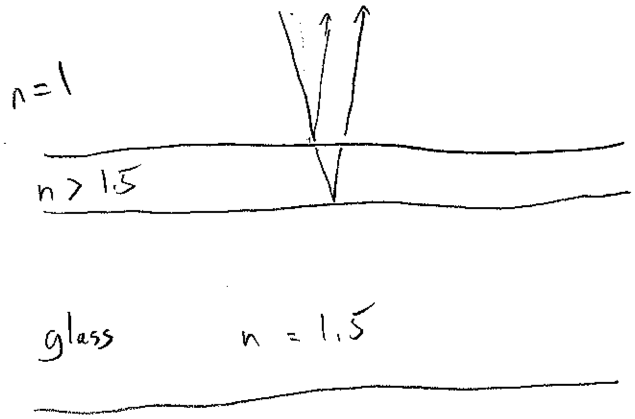



A: front of Barn

B: back of Barn

In pole's ref. frame, tip of pole hits back of barn before tail hits front of barn

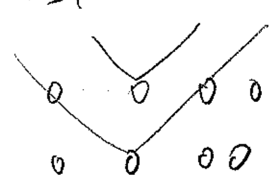
(4.)




A thicker film can allow a larger phase difference between $\lambda = 500$ nm and $\lambda = 600$ nm, ideally giving $\pi$ phase shift difference

(5.)

The wavelength of x-rays are similar to the spacing of the atoms.



(6.) The laws of physics are identical in all inertial reference frames.