PHYS 225 HW 1

James Liu

Due:Sep 5 Edit: September 2, 2024

1. Measure and find a mid point between the 2 lights, put a machine that will turn two clocks on when it detected that the light emitted from the bulb arrives. Turn on the bulb.

2. A travels at speed 4c/5 toward B, who is at rest. C is between A and B. How fast should C travel so that she sees both A and B approaching her at the same speed?

Set the speed of C as v_c, the direction to B is positive and B's position is origin. Therefore, we have:

$$\begin{aligned}
\frac{\frac{4}{5}c - v_c}{1 + \frac{0.8c \times v_c}{c^2}} &= v_c \\
0.8c - v_c &= v_c + \frac{0.8 \times v_c^2}{c} \\
0.8c^2 - v_c c &= v_c c + 0.8 \times v_c^2 \\
-0.8v_c^2 - 2v_c c &= -0.8c^2 \\
v_c^2 + 2.5v_c c &= c^2 \\
v_c &= 0.3507c
\end{aligned}$$

3. Relative speeds in different frames.

a) $v_t = \dfrac{v'_t + v_d}{1 + \frac{v'_t v_d}{c^2}} = \dfrac{\frac{5}{6}c}{1 + \frac{\frac{c}{6}}{c^2}} = \dfrac{5c^2}{6c+1}$ Thus, the difference is:

$$\frac{v_c - v_t}{1 + \frac{v_c v_t}{c^2}} = \frac{\frac{3}{4}c - \frac{5c^2}{6c+1}}{1 + \frac{\frac{3}{4}c \cdot \frac{5c^2}{6c+1}}{c^2}} = -\frac{c(2c-3)}{39c+4}$$

b)

$$\begin{aligned}
v_c &= \frac{v_d + v'_c}{1 + \frac{v_d v'_c}{c^2}} \\
\frac{3}{4}c &= \frac{0.5c + v'_c}{1 + \frac{0.5c \cdot v'_c}{c^2}} \\
\frac{3}{4}c &= \frac{0.5c + v'_c}{1 + \frac{0.5 \cdot v'_c}{c}} \\
\frac{3}{4}c + \frac{3v'_c}{8c} &= 0.5c + v'_c \\
\frac{1}{4}c &= \frac{8v'_c c - 3v'_c}{8c} \\
2c^2 &= 8v'_c c - 3v'_c \\
2c^2 &= v'_c(8c-3) \\
v'_c &= \frac{2c^2}{8c-3}
\end{aligned}$$

Thus, difference in the Destroyer's reference frame is:

$$\begin{aligned}
v'_{dif} &= \frac{v'_c - v'_t}{1 + \frac{v'_t v'_c}{c^2}} \\
v'_c - v'_t &= \frac{2c^2}{8c-3} - \frac{1}{3}c < 0
\end{aligned}$$

Thus, $v'_{diff} < 0$ and the Corvette cannot escape.