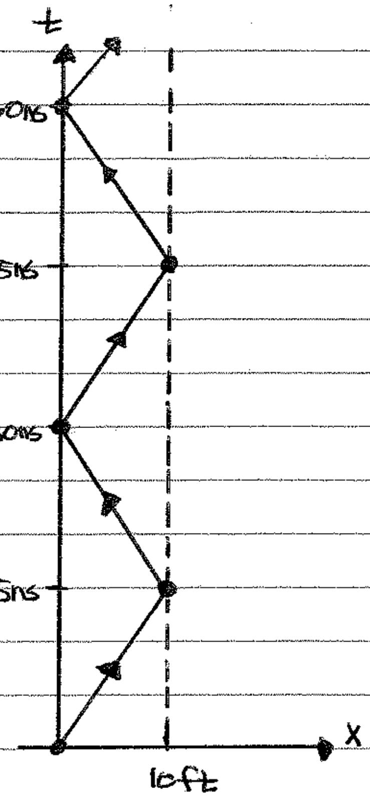
11/9/13
R.P. Woodard

Solution to Problem 12.22



ⓐ * I'm assuming the ball moves at $v = \frac{2}{3}c$

* Of course they communicate by exchanging signals which are delayed by the transit time of $10\text{ft}/c \simeq 15\text{ ns}$

* NB any physical signal moves with $v \le c$

ⓑ * Suppose Miss Bright moves right at $u > c$
$\to x(t) = ut$

* In the frame O' of an observer with $v < c$

$$\left\{ \begin{array}{l} ct' = \gamma(ct - \beta ut) = \gamma(1 - \frac{uv}{c^2})ct \\ x' = \gamma(ut - \beta ct) = \gamma(u - v)t \end{array} \right\}$$

* NB for $\frac{uv}{c^2} > 1$ the O' observer sees Miss Bright move <u>backwards</u> <u>in time</u>

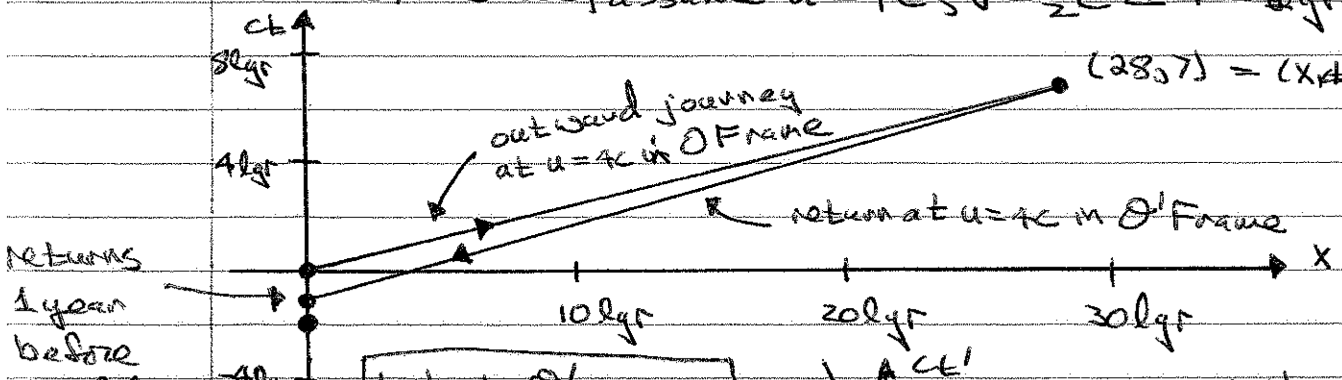
* Suppose she stops at $t = T$ & moves left at u <u>in</u> <u>the</u> <u>O'</u> <u>Frame</u>

$$\to x'(t') = X' - u(t' - T') = \gamma\left(2u - v - \frac{u^2 v}{c^2}\right)T - ut'$$

* Now the O observer sees her moving backwards in time

$$\left\{ \begin{array}{l} ct = \gamma(ct' + \beta x') \\ x = \gamma(x' + \beta ct') \end{array} \right\} \to \text{she reaches } x = 0 \text{ at } \left\{ \begin{array}{l} t' = \frac{\gamma(2u - v - \frac{u^2 v}{c^2})T}{u - v} \\ x' = -\beta ct' \end{array} \right\} \to t = \frac{t'}{\gamma} = \left(\frac{2u - v - \frac{u^2 v}{c^2}}{u - v}\right)T$$

* For definiteness, assume $u = 4c$, $v = \frac{1}{2}c$ & $T = 7\text{ yrs}$



What O' sees