HW 9/11

1.22) S: frame of earth → $u = 0.4c$

S': frame of ship → $v = 0.5c$

$$\beta_{u'} = \frac{\beta_v + \beta_u}{1 + \beta_u \beta_v} = \frac{0.5 + 0.4}{1 + (0.5)(0.4)} = 0.75 \rightarrow \boxed{u' = 0.75c}$$

1.24) S: rest frame of ship

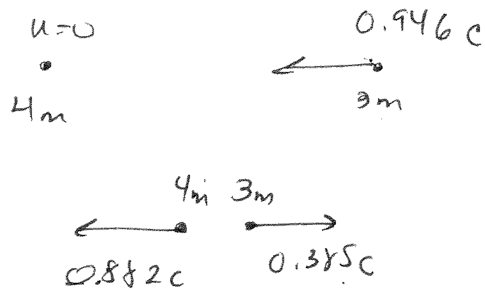
S': rest frame of earth

$$\beta_{u'} = \frac{\beta_v + \beta_u}{1 + \beta_u \beta_v} = \frac{0.8 + (-0.9)}{1 + 0.8(-0.9)} = 0.75 \rightsquigarrow \boxed{u' = -0.357c}$$

1.27) $m_e c^2 = 8.199 \cdot 10^{-14}\ J = 0.511\ MeV \approx 0.5\ MeV$

$m_p c^2 = 1.505 \cdot 10^{-10}\ J = 938.3\ MeV \approx 1000\ MeV$

ep 3/



does $\vec{p}_i \stackrel{?}{=} \vec{p}_f$?

using classical momentum.

$$p_i \stackrel{?}{=} p_f$$

$$m_A v_{Ai} + m_B v_{Bi} \stackrel{?}{=} m_A v_{Af} + m_B v_{Bf}$$

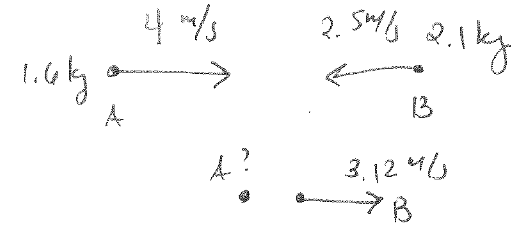
$$4m(0) + (3m)(-0.946c) \stackrel{?}{=} 4m(-0.882c) + 3m(+0.385c)$$

$$-2.84mc = -2.38mc$$

no!

not conserved using classical p.

ep 4/



(a) $p_i = p_f$

$$m_A V_{Ai} + m_B V_{Bi} = m_A V_{Af} + m_B V_{Bf}$$

$$\frac{m_A V_{Ai} + m_B V_{Bi} - m_B V_{Bf}}{m_A} = V_{Af}$$

$$\frac{(1.6)(4) + (2.1)(-2.5) - (2.1)(3.12)}{1.6} = -3.38 \text{ m/s}$$

3.38 m/s to the left.

(b) $K_i = K_f$

$$K_i = \tfrac{1}{2} m_A V_{Ai}^2 + \tfrac{1}{2} m_B V_{Bi}^2 = \tfrac{1}{2}(1.6)(4)^2 + \tfrac{1}{2}(2.1)(2.5)^2$$

$$= 19.36 \text{ J}$$

$$K_f = \tfrac{1}{2}(1.6)(-3.38)^2 + \tfrac{1}{2}(2.1)(3.12)^2$$

$$= 19.36 \text{ J}$$

$K_i = K_f$ ✓ it's elastic

ep 5/ $p = \gamma_u m u$ where $\gamma_u = \dfrac{1}{\sqrt{1-(\frac{u}{c})^2}}$

so $p = \dfrac{mu}{\sqrt{1-(\frac{u}{c})^2}}$

$$\lim_{\frac{u}{c} \ll 1} p \rightarrow \frac{mu}{\sqrt{1-(\frac{u}{c})^2}} \rightarrow mu$$ classical p!

$(\frac{u}{c})^2 \ll 1$, negligible