Physics 160

Extra Credit ± 20

Impulse & Momentum Ranking

Part a)

$p = mv \Rightarrow p_1 = (500\,kg)(10\,m/s) = 5{,}000\,kg\cdot m/s$

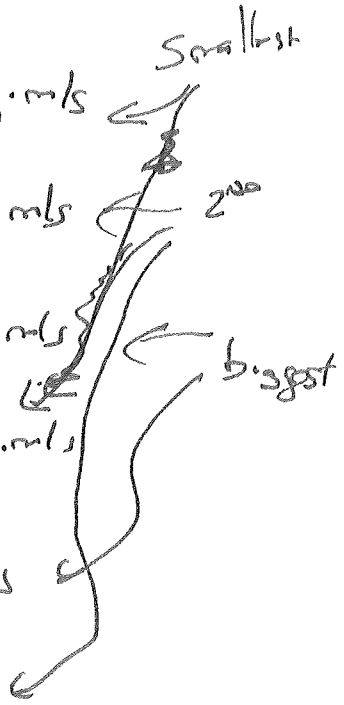
$p_2 = (2000\,kg)(5\,m/s) = 10{,}000\,kg\cdot m/s$

$p_3 = (1000\,kg)(20\,m/s) = 20{,}000\,kg\cdot m/s$

$p_4 = (500\,kg)(20\,m/s) = 10{,}000\,kg\cdot m/s$

$p_5 = (4000\,kg)(5\,m/s) = 20{,}000\,kg\cdot m/s$

$p_6 = (1000\,kg)(10\,m/s) = 10{,}000\,kg\cdot m/s$



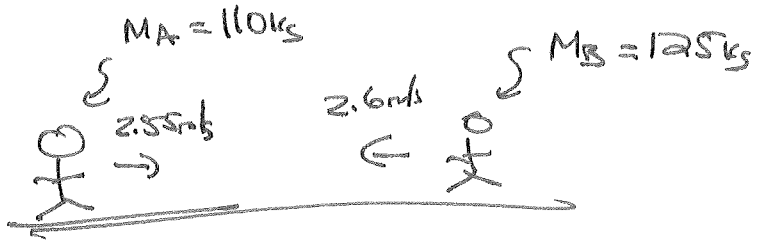
Part b) Rank Impulse needed to stop

$J = \Delta p = p_2 - p_1$. $p_2 = 0$ for all $\Rightarrow$ Same Ranking as Mom.

Part c) Rank Force

$J = F_{av}\Delta t$ so without Δt can't rank

8.5



a) Magnitude of net Momentum. $\vec{P_T} = \vec{P_A} + \vec{P_B}$

$\vec{P} = m\vec{v} \Rightarrow P_{A,x} = m_A v_{A,x} \quad P_{B,x} = m_B v_{B,x}$

$\Rightarrow P_{net,x} = m_A v_{A,x} + m_B v_{B,x} = 110kg(+2.55m/s) + 125kg(-2.6m/s)$

$= 280.5kg\cdot m/s - 325kg\cdot m/s = -44.5kg\cdot m/s$

$\Rightarrow$ Magnitude of 44.5 kg·m/s

Direction to left

Total Kinetic: Kinetic Always Positive

$\Rightarrow K = \frac{1}{2}m_A v_A^2 + \frac{1}{2}m_B v_B^2 = \frac{1}{2}(110kg)(2.55m/s)^2 + \frac{1}{2}(125kg)(2.6m/s)^2$

$= 357.6J + 422.5J = 780.1J$

8.9

$\Delta t = 6 \times 10^{-3} s$

$m = 0.16 kg$

Constant force $\Rightarrow J_x = F_x \Delta t$

And $J_x = \Delta p_x = m v_{2,x} - m v_{1,x}$

$= m(v_{2,x} - v_{1,x})$

$\therefore \quad \frac{F_x \Delta t}{m} = \frac{m(v_{2,x} - v_{1,x})}{m} \Rightarrow \frac{(24.9 N)(6 \times 10^{-3} s)}{0.16 kg} = v_{2,x} - 5.02 m/s$

$\Rightarrow v_{2,x} = 3.02 m/s + 9.3375 m/s = 12.3575 m/s = 12.4 m/s$

F_x to RIGHT $\Rightarrow$ still moving to the Right

c) $F_x = -12.7 N$ (12.7 N to left) $\Delta t = 6 \times 10^{-3} s$

$\therefore \quad \frac{(-12.7 N)(6 \times 10^{-3} s)}{0.16 kg} = v_{2x} - 3.02 m/s$

$\Rightarrow v_{2,x} = 3.02 m/s - 4.7625 m/s = -1.7425 m/s = -1.7 m/s$

1.7 m/s to left