

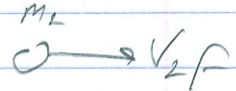
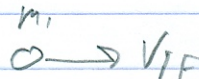
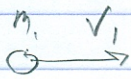
Chapter 10.

P15, P17, P21

PHYS 1311

4-28-2018

Prob P15 (Same as online notes)



Momentum principle
(x-direction only)

$$m_1 v_1 = m_1 v_{1f} + m_2 v_{2f}$$

Energy principle
(No PE or rest mass)

$$\frac{1}{2} m_1 v_1^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

Solve for $m_1 \rightarrow v_{1f}$: $v_{2f} = \frac{m_1 (v_1 - v_{1f})}{m_2}$

chpta 10

4-28-2017

P17 $m_1 = 3 \text{ kg}$, $\vec{V}_{1i} = \langle 3900, -2900, 3000 \rangle \text{ m/s}$
 $m_2 = 13 \text{ kg}$, $\vec{V}_{2i} = \langle 220, -260, 300 \rangle \text{ m/s}$

$\vec{V}_{1f} = \langle 3500, -2300, 3500 \rangle \text{ m/s}$

a) $V_{1f} = ?$, apply momentum principle

$$m_1 \vec{V}_{1i} + m_2 \vec{V}_{2i} = m_1 \vec{V}_{1f} + m_2 \vec{V}_{2f}$$

$$\begin{aligned} \vec{V}_{2f} &= \frac{m_1}{m_2} (\vec{V}_{1i} - \vec{V}_{1f}) + \vec{V}_{2i} \\ &= \frac{3}{13} [\langle 3900 - 3500, -2900 + 2300, 3000 - 3500 \rangle] + \langle 220, -260, 300 \rangle \\ &= \frac{3}{13} [\langle 400, -600, -500 \rangle] + \langle 220, -260, 300 \rangle \\ &= \langle 312.3, -398.5, 184.8 \rangle \text{ m/s} \end{aligned}$$

b) $E = K_1 + K_2 + E_{int}$ (no PE, no change in rest mass)

$$E_f = E_i + \Delta E_{int}$$

$$K_{f1} + K_{f2} = K_{i1} + K_{i2} + \Delta E_{int}$$

$$\Delta E_{int} = (K_{f1} + K_{f2}) - (K_{i1} + K_{i2})$$

$$= \left[\frac{1}{2} (3) (5458)^2 + \frac{1}{2} (13) (538.97)^2 \right]$$

$$- \left[\frac{1}{2} (3) (5711.4)^2 + \frac{1}{2} (13) (453.9)^2 \right] = \boxed{-3.70 \times 10^6 \text{ J}}$$

c) (1) $Q = 0$ from surrounding

Chap. 10

4-28-2018

Prob P21 $m_1 = 2300 \text{ kg}$, $m_2 = 4300 \text{ kg}$
 $\vec{v}_{1i} = \langle 38, 0, 0 \rangle \text{ m/s}$, $\vec{v}_{2i} = \langle -16, 0, 27 \rangle \text{ m/s}$

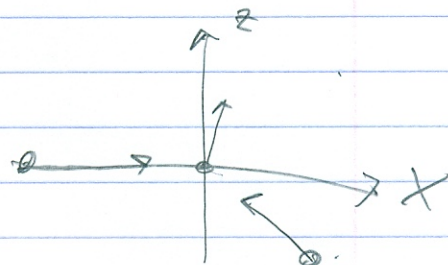
b) $m_p = m_1 + m_2$

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = m_p \vec{v}_p$$

$$\vec{v}_p = \frac{m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i}}{m_p}$$

$$= \frac{2300 \langle 38, 0, 0 \rangle + 4300 \langle -16, 0, 27 \rangle}{6600}$$

$$= \frac{\langle 18,600, 0, 116,100 \rangle}{6600} = \boxed{\langle 2.82, 0, 17.59 \rangle \text{ m/s}}$$



g) car + truck, momentum principle

c) car-truck, truck-car forces are internal, they do not affect the total momentum

d) $\Delta E_{\text{int}} = (K_{1i} + K_{2i}) - (K_f)$

$$v_{1i} = 38, v_{2i} = 31.4 \text{ m/s} \quad v_p = 17.8 \text{ m/s}$$

$$\Delta E_{\text{int}} = \left[\frac{1}{2} (2300) (38)^2 + \frac{1}{2} (4300) (31.4)^2 \right] - \frac{1}{2} (6600) (17.81)^2$$

$$= \boxed{2.73 \times 10^6 \text{ J}}$$

e) Inelastic