Solutions: H.W. CH. #7, Fall (011)

4.

$$K_{Father} = \frac{1}{2} K_{son} \Rightarrow \frac{1}{2} m_F v_F^2 = \frac{1}{2}\left(\frac{1}{2} m_s v_s^2\right)$$

$$m_F = 2 m_s \quad (1) \Rightarrow 2 m_s v_F^2 = \frac{1}{2} m_s v_s^2$$

$$\therefore \quad v_F^2 = \frac{1}{4} v_s^2 \Rightarrow v_F = v_s/2 \quad (2)$$

Now $\frac{1}{2} m_F (v_F + 1)^2 = \frac{1}{2} m_s v_s^2$

Substitute from (1) and (2), we obtain

$$\frac{1}{2} * 2 m_s \left(\frac{v_s}{2} + 1\right)^2 = \frac{1}{2} m_s v_s^2$$

$$\frac{v_s}{2} + 1 = \frac{v_s}{\sqrt{2}}$$

$$\therefore -0.5 v_s + 0.707 v_s = 1 \Rightarrow 0.207 v_s = 1$$

$$v_s = \underline{4.8 \text{ m/s}} \;; \quad v_F = \underline{2.4 \text{ m/s}}$$

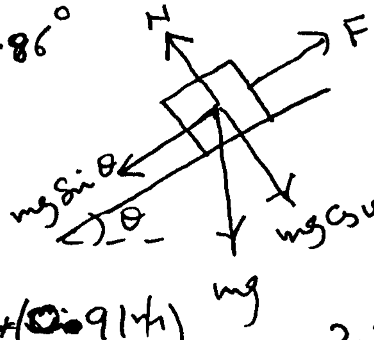
12. $m = 2.0\text{ kg}$, $F = 5.0\text{ N}$ (this is the only force acting)

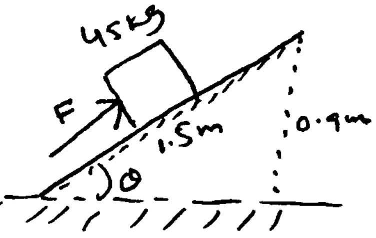
$v_0 = 5\hat{i}$ m/s $\qquad v_f = 6.0\hat{j}$ m/s

$$W_{net} = W_F = \frac{1}{2} m v^2 - \frac{1}{2} m v_0^2 = \frac{1}{2} * 2.0\text{kg} * 36 \frac{m^2}{s^2} - \frac{1}{2} * 2.0\text{kg} * 25 m^2/s^2$$

$$= (36 - 25)\text{ J} = \underline{11\text{ J}}$$

16. $\theta = \sin^{-1} \frac{0.9}{1.5} = 36.86°$





a) Constant velocity $\Rightarrow$

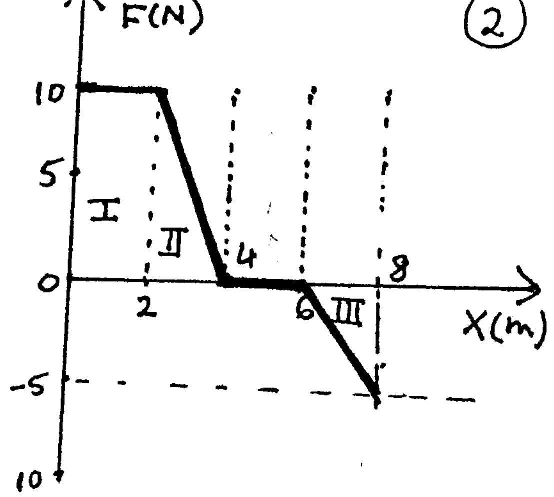
$$F - mg\sin\theta = 0$$

$$F = mg\sin\theta = 45 * 9.8 * \left(\frac{0.9 m}{1.5 m}\right) = \underline{2.7 * 10^2 \text{ N}}$$

b) $W_F = -FS = -2.7 * 10^2 * 1.5 = -4.0 * 10^2$ J $\qquad$ d) $W_N = 0$

c) $W_{mg} = mg\sin\theta * S = +4.0 * 10^2$ J

e) $W_{net} = W_F + W_{mg} + W_N = 0 \longrightarrow$ e) $W_{net} = 0$



24: $m = 5.0\,kg$

$$W(0 \to 8m) = A_{I} + A_{II} - A_{III}$$
$$= 20 + 10 - \frac{10}{2}$$
$$= 20 + 10 - 5 = 25\,J$$

32: $\vec{F} = (4.0\hat{i} - 2.0\hat{j} + 9.0\hat{k})\,N$

$\vec{v} = (-2.0\hat{i} + 4.0\hat{k})\,m/s$

a) $P_{inst} = \vec{F} \cdot \vec{v} = (4.0)*(-2.0) + (9.0)*(4.0) = -8 + 36 = 28\,W$

b) Let the velocity be $\vec{v} = v\hat{j}$, then

$$P_{inst} = \vec{F} \cdot \vec{v} = F_y v_y = (-2.0)(v_y) = -12\,W$$
$$\therefore v_y = 6\,m/s \Rightarrow \vec{v} = (6.0\hat{j})\,m/s$$

40: $m = 2.0\,kg$

$v_0 = 0$

$v = 10\,m/s$

$t = 3.0\,s$

$$a = \frac{v - v_0}{t} = \frac{10 - 0}{3} = \frac{10}{3}\,m/s^2$$

a) $W = \Delta K = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 = \frac{1}{2}(2.0) * 100 - 0 = 100\,J$

c) $P_{in}(\text{at } t = 1.5\,s) = \vec{F} \cdot \vec{v}$ (Both $\vec{F}$ and $\vec{v}$ at $t = 1.5\,s$)

now $\vec{F} = m\vec{a}$ ($\vec{a}$ is uniform so $\vec{F}$ is Constant)

$v(1.5s) = v_0 + at = 0 + \frac{10}{3} * 1.5 = 5\,m/s$

$P_{in}(t = 1.5s) = ma * v = 2.0 * \frac{10}{3} * 5 = \frac{100}{3}\,W = 33\,W$

b) $P_{inst}(t = 3s) = mav = 2 * \frac{10}{3} * 10$

$= \frac{200}{3}\,W = 67\text{ Watts}$