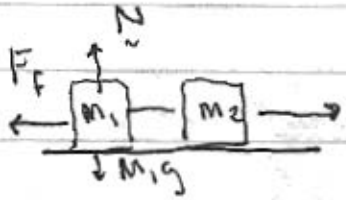
Solutions: Exam 2 Spring '08

(1)



$F = 35\,N \rightarrow x$

$$F - \mu_K m_1 g = (m_1 + m_2) a_x$$

$$a_x = 2\,m/s^2$$

$$\mu_K = \frac{F - (m_1 + m_2) a_x}{m_1 g} = \frac{35 - 10 \times 2}{5 \times 9.8} = \boxed{0.306}$$

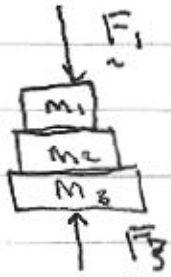
(2)

$$F_{sc} - m_2 g = m_2 a_y$$

$$F_{sc} = m_2 (g + a_y)$$

$$= 50\left(9.8 + \frac{10}{3}\right) N = \boxed{655\,N}$$

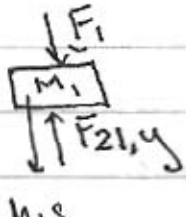
(3)



$$F_3 - F_1 - (m_1 + m_2 + m_3) g = (m_1 + m_2 + m_3) a_y$$

$$100 - 50 - (12) \times 9.8 = 12\, a_y$$

$$a_y = -5.63\,m/s^2$$



$$F_{21,y} - F_1 = m_1 a_y$$

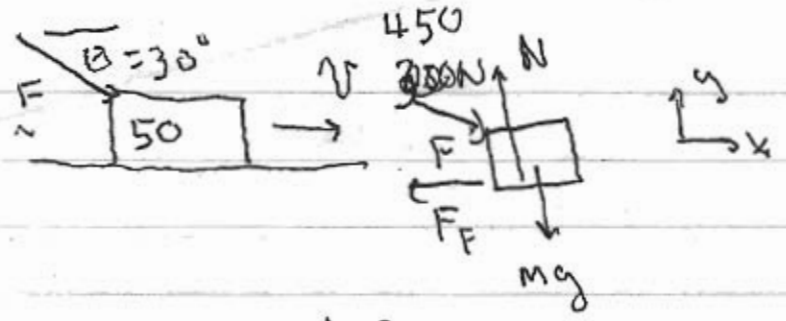
$-2g$ $\quad +2\times9.8$ $\quad +2\times9.8$

$$F_{21,y} = F_1 + m_1 a_y = 50 - 2 \times 5.63\ N$$

$$F_{21,y} = \boxed{39\,N} + \boxed{19.6\,N} = \boxed{58.6\,N}$$

Solutions: Exam 2 Spring '08 (2)

(4)



Σ FORCES $= ma$

x: $F\cos\theta - F_f = Ma_x$ $\quad y$: $N - F\sin\theta - mg = 0$

$F_F = \mu_k N$

$N = F\sin\theta + mg$

$F\cos\theta - \mu_k(F\sin\theta + mg) = ma_x$

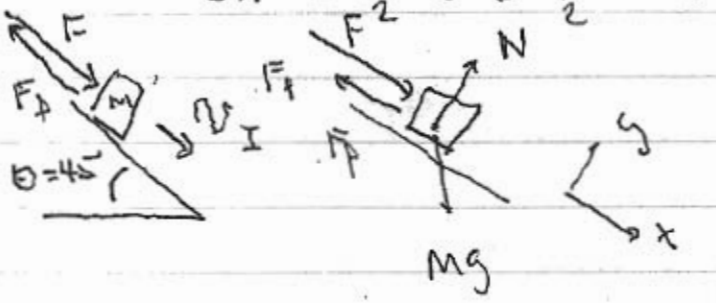
$$\frac{F(\cos\theta - \mu_k\sin\theta) - \mu_k mg}{m} = a_x$$

$$\frac{450(0.866 - 0.5\times 0.5) - 0.5\times 50\times 9.8}{50} = a_x$$

$$\frac{277.2 - 245}{50} = a_x \qquad a_x = 0.644\ m/s^2$$

$$\Delta x = \frac{1}{2}at^2 = \frac{1}{2}\times 0.644\times 9\ m = \boxed{2.9\ m}$$

(5)



x: $F - F_f + Mg\sin\theta = Ma_x$

y: $N - Mg\cos\theta = 0$

$F_f = \mu_k N$

$[F - \mu_k(Mg\cos\theta) + Mg\sin\theta]/M = a_x$

$[250 - 0.6(25\times 9.8\times 0.707) + 25\times 9.8\times 0.707]/25 = a_x$

$[250 - 103.9 + 173.2]/25 = a_x \Rightarrow a_x = 12.8\ m/s^2$

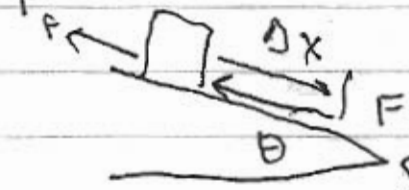
$a_x = (v_F - v_I)/t \Rightarrow t = (v_F - v_I)a_x = 10/12.8\ s = \boxed{0.78\ s}$

(6) $W_{NC} = \Delta\left(\frac{1}{2}mv^2 + mgy\right)$

$$W_{NC} = \Delta\left(\tfrac{1}{2}mv^2\right) + mg\Delta y$$
$$= \tfrac{1}{2} \times 2\times10^3 (64 - 4) + 2\times10^3 \times 9.8 \times (-10)$$
$$= 6.0\times10^4 - 1.96\times10^5 \text{ J}$$

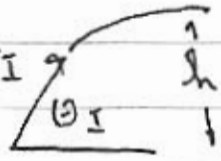
$$\boxed{W_{NC} = -1.36\times10^5 \text{ J}}$$

(7)



$$-|F|\Delta x - F_f\Delta x = \Delta\left(\tfrac{1}{2}mv^2\right) + \Delta(mgh)$$
$$= \Delta\left(\tfrac{1}{2}mv^2\right) - mg\Delta x \sin\theta$$
$$\{|F| + F_f - mg\sin\theta\}\Delta x = -\Delta\left(\tfrac{1}{2}mv^2\right)$$
$$\{150 + \mu_k mg\cos\theta - mg\sin\theta\}\Delta x = \tfrac{1}{2}mv_I^2$$
$$\{150 + 0.7\times25\times9.8\times0.866 - 25\times9.8\times0.5\}\Delta x = \tfrac{1}{2}mv_I^2$$
$$\Delta x\{150 + 148.5 - 122.5\} = 0.5\times25\times100$$
$$176\,\Delta x = 1250$$
$$\boxed{\Delta x = 7.1 \text{ m}}$$

(8)



$$0 = \Delta\left(\tfrac{1}{2}mv^2 + mgy\right)$$
$$0 = \tfrac{1}{2}(v_I\cos\theta_I)^2 - \tfrac{1}{2}v_I^2 + mgh$$
$$v_I^2(1 - \cos^2\theta_I) = 2gh$$
$$v_I = \left[2gh/(1 - \cos^2\theta_I)\right]^{1/2}$$
$$= \left[2\times9.8\times10/0.75\right]^{1/2}$$
$$\boxed{v_I = 16.2 \text{ m/s}}$$