Exam 2 Spring 06

(1) $W = \Delta\left(\frac{1}{2}MV^2\right)$

$W_{fric} + W_A = \frac{1}{2}MV_F^2 - \frac{1}{2}MV_I^2$

$-75 + W_A = \frac{1}{2} \times 10 \times (5)^2 - 0$

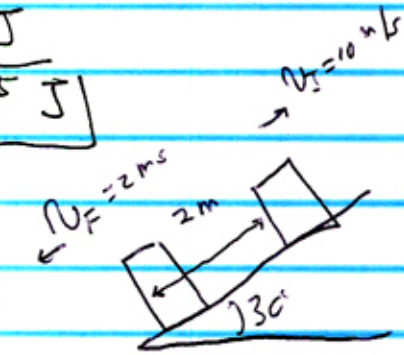
$W_A = 125 + 75 \text{ J} = \boxed{200 \text{ J}}$

(2) $W_{Motor} = \Delta E = \Delta\left(\frac{1}{2}MV^2 + Mgy\right)$

$= \frac{1}{2} \times 2 \times 10^3 \left(\cancel{25} - \cancel{49}\ 16\right) + 2 \times 10^3 \times 9.8 \times 15$

$= 2 \times 10^3 \left[-16.5 + 147\right] \text{ J}$

$= 261 \times 10^3 \text{ J} = \boxed{2.61 \times 10^5 \text{ J}}$



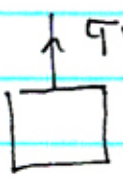
(3) $W_{Fric} = \Delta E = \Delta\left(\frac{1}{2}MV^2 + Mgh\right)$

$= \cancel{5\left(\frac{1}{2}(0)^2 + 9.8\right)}$

$= \frac{1}{2} \times 5 \times (4 - 100) + 5 \times 9.8 \left(-2 \sin 30^\circ\right)$

$= -240 - 49 = \boxed{-289 \text{ J}}$

(4) $a_y = 2 \text{ m/s}^2$



$T - Mg = Ma_y \Rightarrow T = 2 \times 10^3 \times 2 + 2 \times 10^3 \times 9.8 \text{ N}$

$= 4 \times 10^3 + 19.6 \times 10^3 \text{ N}$

$= 23.6 \times 10^3 \text{ N}$

$\text{Power} = T V_y = 2.36 \times 10^4 \times 10 = \boxed{2.36 \times 10^5 \text{ Watts}}$

(5) 

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

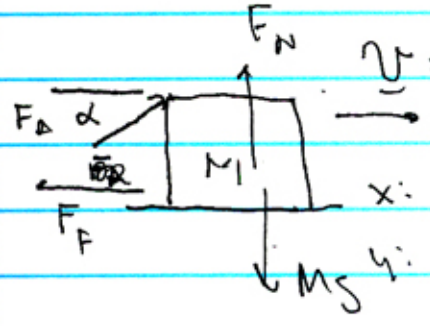
$a_y = \dfrac{F_{sc} - M_L g}{M_L} = \dfrac{40\times9.8 - 50\times9.8}{50}\ \dfrac{m}{s^2}$

$= -1.96\ m/s^2$

$T - M_{EL} g = M_{EL} a_y$

$T' = M_{EL}(g + a_y) = 2.5\times10^3 \times (9.80 - 1.96)\ N$

$= 19.6\times10^3\ N = \boxed{1.96\times10^4 N}$

(6) 

$\mu_K = 0.5$

$x: F_A\cos\alpha - F_f = Ma_x = 0$

$y: F_N + F_A\sin\alpha - Mg = 0$

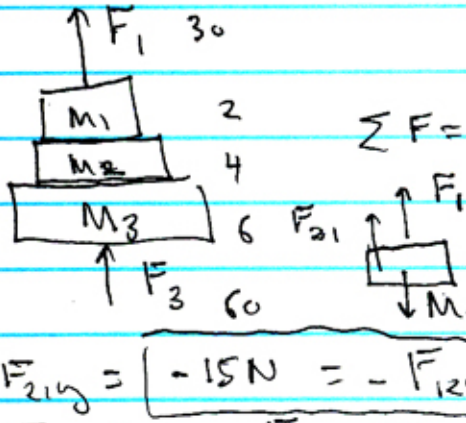
$F_f = \mu_K F_N = (Mg - F_A\sin\alpha)\mu_K$

$F_A\cos\alpha - \mu_K[Mg - F_A\sin\alpha] = 0$

$F_A[\cos\alpha + \mu_K\sin\alpha] = \mu_K Mg$

$F_A = \dfrac{\mu_K Mg}{\cos\alpha + \mu_K\sin\alpha} = \dfrac{0.5\times50\times9.8}{0.9(1+0.5)}\ N$

$= \dfrac{245}{1.06}\ N = \boxed{231\ N}$

(7) 

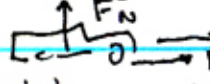
$\sum F = M_{tot} a_y \Rightarrow 30 + 60 - 12\times9.8 = 12a_y$

$a_y = -27.6/12 = -2.3\ m/s^2$

$F_1 + F_{21y} - M_1 g = M_1 a_y$

$F_{21y} = M_1(a_y + g) - F_1 = 2(-2.3 + 9.8) - 30$

$F_{21y} = \boxed{-15N = -F_{12y}}$

(8) 

$F_N = Mg \qquad F_x = Ma_x = 2\times10^3 \times 5\ m/s^2 = 10^4 N$

$F_N = 2\times10^3\times9.8\ N = 1.96\times10^4\ N$

$F_{Total} = \sqrt{(0.98)^2 + (1)^2} \times 10^4 N$

$= \boxed{2.2\times10^4 N}$ by third Law