Serway + Vuille 8th Edition

Chapter 4 homework

3) $m = 6.0\,kg$ a) $F = ma = (6.0\,kg)(2.0\,m/s^2) = 12\,N$

$a = 2.0\,m/s^2$ b) $m' = 4.0\,kg$ ∴ $a = F/m' = 12\,N / 4.0\,kg = 3.0\,m/s^2$

5) $W_E = 5.00\,lb$ The mass is location independent. It will be the same at all three locations.

$g_E = 9.80\,m/s^2$

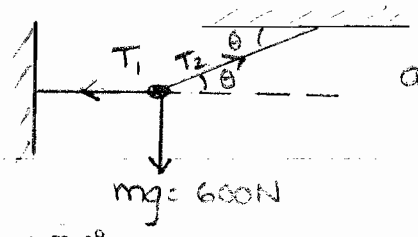
$g_m = \frac{1}{6} g_E$

$g_J = 2.64\, g_E$ $W_E = 5.00\,lb \left(\frac{1\,N}{.2248\,lb}\right) = 22.2\,N$

∴ $m = \frac{22.2\,N}{9.80\,m/s^2} = 2.27\,kg$ $W_m = \frac{1}{6} W_E = 3.70\,N$

$W_J = 2.64\, W_E = 58.6\,N$

17)



$\theta = 37.0°$

a) $\Sigma F_x = 0 = T_2 \cos 37.0° - T_1$

① $T_1 = 0.799\, T_2$

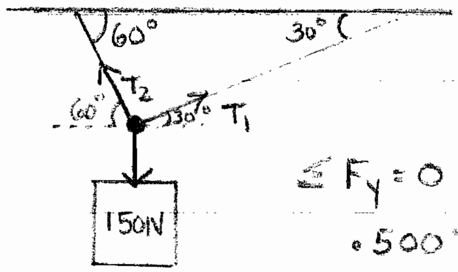
$\Sigma F_y = 0 = T_2 \sin 37.0° - 600\,N$

$.602\, T_2 = 600\,N$ ∴ $T_2 = 997\,N$ ②

Substitute T_2 into ① ⇒ $0.799(997\,N) = 796\,N$

b) If the now horizontal cable is attached higher on the wall, it will have an upward "y component" that will help support the weight of the burglar. ∴ the tension in the other cable will decrease

19)



$\Sigma F_x = 0 = T_1 \cos 30° - T_2 \cos 60°$

$.866\, T_1 = .500\, T_2$

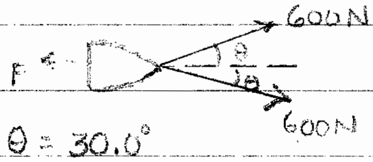
∴ $T_2 = 1.73\, T_1$ ①

$\Sigma F_y = 0 = T_1 \sin 30° + T_2 \sin 60° - 150\,N$

$.500\, T_1 = 150\,N - .866\, T_2 = 150\,N - .866\,[1.73\, T_1]$

$.500\, T_1 = 150\,N - 1.50\, T_1$ ∴ $2.00\, T_1 = 150\,N$

$T_1 = 75.0\,N$ and $T_2 = 1.73(75.0\,N) = 130\,N$

24) 

$\theta = 30.0°$

By symmetry: $\Sigma F_y = 0$, cancel

$\Sigma F_x = 0 \Rightarrow F = 2(600\,N \cos 30.0°)$

$F = 1.04 \times 10^3\,N$ to the left

30) $m = 2.0\,kg$

$V_0 = 0$

$X = 80\,cm = 0.80\,m$

$t = 0.50\,s$

$F_{net} = ?$

$x = V_0 t + \frac{1}{2} a t^2$

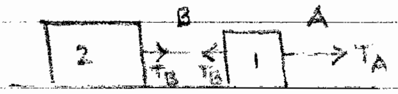
$0.80\,m = \frac{1}{2} a (0.50\,s)^2$

$\therefore a = 6.4\,m/s^2$

$F_{net} = ma$

$= (2.0\,kg)(6.4\,m/s^2) = 13\,N$ down the incline

34)

a) 

$m_2 > m_1$

① $\Sigma F_{system} = m_{system}\, a$

$T_A = (m_1 + m_2) a$

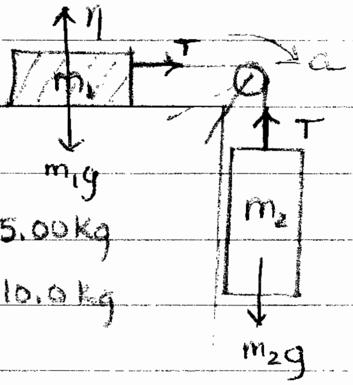
② $\Sigma F = m_2 a$

$T_B = m_2 a$

$\therefore T_A > T_B$

b) The blocks move as a system and the cord remains taut. $\therefore a_1 = a_2 = a$

c) Yes, T_B acts on block 1. Block 1 pulls on the cord with an = but opposite force

36) 

$m_1 = 5.00\,kg$

$m_2 = 10.0\,kg$

For m_1: $\Sigma F_x = m_1 a \therefore T = m_1 a$ ①

For m_2: $\Sigma F_y = m_2 a \therefore m_2 g - T = m_2 a$ ②

Add ① + ② $\Rightarrow$

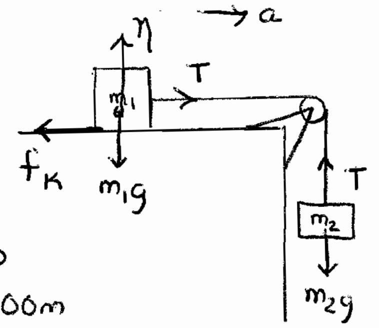
$m_2 g = m_1 a + m_2 a = (m_1 + m_2) a$

$a = \frac{(10.0\,kg)(9.8\,m/s^2)}{(15.0\,kg)} = 6.53\,m/s^2$

Substitute "a" into ① to calculate "T"

$T = (5.00\,kg)(6.53\,m/s^2) = 32.7\,N$

45)



$V_0 = 0$
$x = 1.00m$
$t = 1.20s$
$m_1 = 10.0kg$
$m_2 = 5.00kg$

$x = V_0 t + \frac{1}{2}at^2$ (with $V_0 = 0$)

$1.00m = \frac{1}{2}a(1.20s)^2$

$a = 1.39 m/s^2$

For m_1:

① $T - f_k = m_1 a$

$T - \mu_k \eta = m_1 a$

$T - \mu_k(m_1 g) = m_1 a$

② $\Sigma F_y = 0 = \eta - m_1 g$

$\therefore \eta = m_1 g$

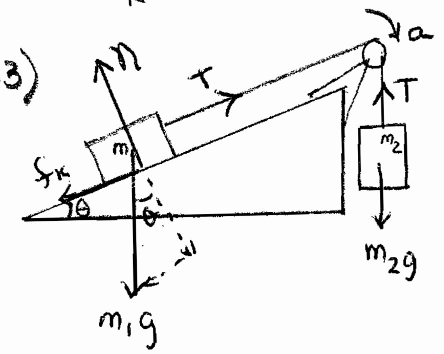
For m_2: ③ $m_2 g - T = m_2 a$ Add ① + ③ $\Rightarrow$

$m_2 g - \mu_k(m_1 g) = m_2 a + m_1 a = (m_1 + m_2)a$

$$\mu_k = \frac{m_2 g - (m_1 + m_2)a}{m_1 g} = \frac{(5.00kg)(9.8 m/s^2) - (15.0kg)(1.39 m/s^2)}{(10.0kg)(9.80 m/s^2)}$$

$\mu_k = 0.287$

53)



$\theta = 37.0°$ $m_1 = 7.00kg$ $m_2 = 12.0kg$

$\mu_k = 0.250$

For M_2: $\Sigma F_y = M_2 a$

$M_2 g - T = M_2 a$ ①

For M_1: $\Sigma F_x = M_1 a$

$T - f_k - M_1 g \sin 37.0° = M_2 a$ ②

Add equations ① and ②:

$M_2 g - f_k - M_1 g \sin 37.0° = (M_1 + M_2)a$ ③

$\Sigma F_y = 0 \therefore \eta = M_1 g \cos 37.0°$

$\eta = (7.00kg)(9.80 m/s^2)(.799)$

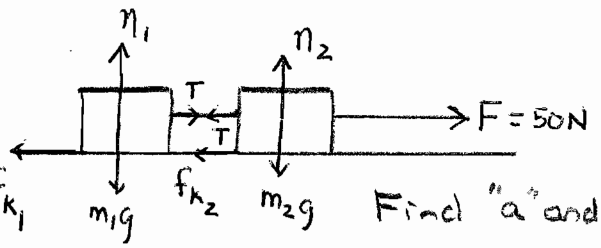
$\eta = 54.8N$ substitute into ③

$(12kg)(9.80 m/s^2) - (.250)(54.8N) - (7.00kg)(9.80 m/s^2)(.602) = (19.0kg)a$

$\therefore$

$a = 3.32 m/s^2$

69)



$m_1 = 10$ Kg

$m_2 = 20$ kg

$\mu_k = 0.10$

Find "a" and "T"

a) $f_{k_1} = f_{k_2} = 0$

For m_1:

$\Sigma F = m_1 a$

$T = m_1 a$ ①

For m_2: $F - T = M_2 a$ ② Add ① and ②:

$F = (M_1 + M_2) \cdot a \quad \therefore \quad a = 50N / 30kg = 1.7 \, m/s^2$

$T = (10 \, Kg)(1.7 \, m/s^2) = 17 N$

b) Repeat with friction: $\Sigma F_y = 0 \therefore n_1 = m_1 g$ and $n_2 = m_2 g$

For $m_1 \Rightarrow \quad T - f_{k_1} = M_1 a \quad \therefore \quad T - \mu_k m_1 g = m_1 a$ ①

For $m_2 \Rightarrow \quad F - T - f_{k_2} = M_2 a \quad \therefore \quad F - T - \mu_k m_2 g = m_2 a$ ②

Add ① and ② $\Rightarrow \quad F - \mu_k g(m_1 + m_2) = (m_1 + m_2) a$

$50N - (.10)(9.8 \, m/s^2)(30 \, kg) = (30 Kg) a \quad \therefore \quad a = 0.69 \, m/s^2$

Substitute into ①:

$T - (.10)(10 \, Kg)(9.8 \, m/s^2) = (10 \, kg)(0.69 \, m/s^2)$

$T = 6.9N + 9.8N = 16.7N$

$T \cong 17N$