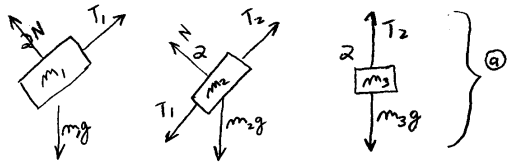
1.



(b) $m_3 g - (m_1+m_2) g \sin\alpha = (m_1+m_2+m_3) a$

$\underbrace{9.2(9.8)}_{90.16} - \underbrace{(8.5)9.8\sin 28}_{39.11} = \underbrace{(9.2+3.5+5.0)a}_{17.70}$ $\quad \boxed{a = 2.88 m/s^2}$ (b) 4

(c) $T_1 - m_1 g \sin\alpha = m_1 a$

$T_1 = m_1 a + m_1 g \sin\alpha = \underbrace{3.5(2.88)}_{10.08} + \underbrace{3.5(9.8)\sin 28}_{16.10} = 26.18\ N = \boxed{26.2\ N}$ (c) 4

(d) $\Sigma F = 0$

$m_3 g - (m_1+m_2) g \sin\alpha - (m_1+m_2) g \mu \cos\alpha = 0$

$m_3(9.8) - \underbrace{8.5(9.8)\sin 28}_{39.11} - \underbrace{8.5(9.8)(.40)\cos 28}_{29.42} = 0$

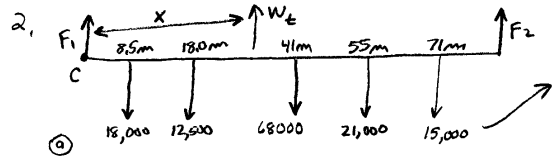
$m_3 = \frac{39.11 + 29.42}{9.8} = 6.993 = \boxed{7.0\ kg}$ (d) 4

(e) $\Sigma F = ma$

$\underbrace{7.0(9.8)}_{68.60} - \underbrace{8.5(9.8)\sin 28}_{39.11} - \underbrace{8.5(9.8)(.28)\cos 28}_{20.59} = \underbrace{8.5+5.0+7.0}_{15.5} a'$ $\quad a' = \boxed{.574 m/s^2}$ (e) 4

(e) $m_3 g - T_2 = m_3 a \quad T_2 = m_3 g - m_3 a = m_3(g-a) = 7.0(9.8-.574) = \boxed{64.6\ N}$ (5) 3

2.



TOTAL WEIGHT $= 1.318 \times 10^6\ N = W_t$

(a) $5.386\times10^6 = 18{,}000(8.5) + 12{,}500(18) + 68{,}000(41) + 21{,}000(55) + 15{,}000(71) = F_2(82)$

$\frac{9.8(1.53\times10^5 + 2.25\times10^5 + 2.788\times10^6 + 1.155\times10^6 + 1.065\times10^6)}{82} = F_2 \Rightarrow \boxed{6.44\times10^5 N}$ (a)

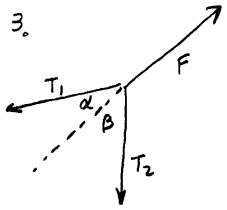
$F_1 = W_t - F_2 = 1.318\times10^6 - 6.57\times10^5 N$

$F_1 \Rightarrow \boxed{6.79\times10^5 N}$ 15

(b) $\Sigma\tau^+ = 5.281\times10^7 Nm = 1.318\times10^6 x$

$x = 40.07 = \boxed{40.1 m \text{ FROM LEFT END}}$ (b) 10

3.



$T_2\cos\beta + T_1\cos\alpha = F$

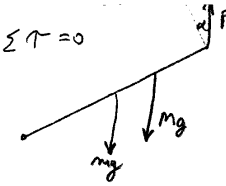
$T_2\sin\beta = T_1\sin\alpha$

(a) $T_2 = mg = 18{,}500(9.8) = \boxed{1.813\times10^5 N}$ (a) 5

(b) $T_1 = T_2\frac{\sin\beta}{\sin\alpha} = 1.813\times10^5\left(\frac{\sin 48}{\sin 25}\right) = \boxed{3.188\times10^5 N}$ (b) 10

(c) $F = \underbrace{1.813\times10^5\cos 48}_{1.213\times10^5} + \underbrace{3.188\times10^5\cos 25}_{2.889\times10^5} = \boxed{4.10\times10^5 N}$ (c) 10

4. $\Sigma\tau = 0$



$mg\frac{L}{2}\cos\alpha + Mgx\cos\alpha = F_2 L\cos\alpha$

(a) $F_2 = \frac{\frac{mgL}{2} + Mgx}{L} = \frac{mg}{2} + \frac{Mgx}{L} = \overbrace{\frac{18.5(9.8)}{2}}^{90.65} + \overbrace{\frac{66(9.8)(2.5)}{3.6}}^{449.2}$

$F_2 = 540N$ (a) 5

(b) SAME AS (a) EXCEPT $\cos\alpha$ DOES NOT CANCEL!

$mg\frac{L}{2}\cos\alpha + Mgx\cos\alpha = F_1 L$

$F_1 = \frac{mg\cos\alpha}{2} + \frac{Mgx\cos\alpha}{L} = \overbrace{\frac{18.5(9.8)}{2}\cos 31}^{77.7} + \overbrace{\frac{66(9.8)(2.5)\cos 31}{3.6}}^{385}$

$F_1 = 463N$ (b) 5

(c) $mg\mu\cos\theta = mg\sin\theta$

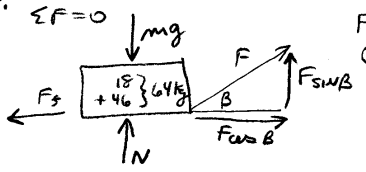
$\tan\alpha = \mu = .53$

$\alpha = 27.9°$ (c) 5

(d) $\Sigma F = ma \Rightarrow mg\sin\alpha - mg\mu\cos\alpha = ma = \overbrace{9.8\sin 27.9}^{4.586} - \overbrace{7.8(.44)\cos 27.9}^{3.811} = .7750 = .78 m/s^2$ (c)

(e) $D = \frac{1}{2}at^2 = 2.5 = \frac{.78}{2}t^2 \quad t = 2.53s \quad v = at + v_0 = .78(2.53) = 1.975 m/s$ (e) 5

5. $\Sigma F = 0$



$F\cos\beta = F_s = N\mu \quad + \quad N + F\sin\beta = mg$

$N = mg - F\sin\beta$

$F\cos\beta = (mg - F\sin\beta)\mu$

$F\cos\beta = mg\mu - F\mu\sin\beta$

$F\cos\beta + F\mu\sin\beta = mg\mu$

$F(\cos\beta + \mu\sin\beta) = mg\mu$

(a) $F = \frac{mg\mu}{(\cos\beta + \mu\sin\beta)} = \frac{64(9.8)(.62)}{(\cos 31 + .62\sin 31)} = 330.5N$ (a) 5

(b) $\Sigma F = 0$

$mg\mu = ma$

$a = g\mu = .34(9.8) = 3.33 m/s^2$ (b) 5

(c) $\Sigma F = ma$

$F\cos\beta - F_s = ma$ ← TOTAL MASS

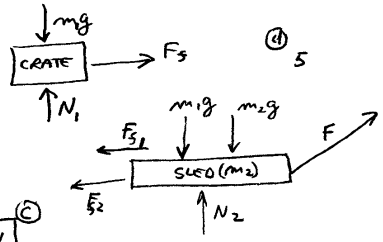
$F\cos\beta - (mg - F\sin\beta)\mu = ma$

$F\cos\beta - mg\mu + F\mu\sin\beta = ma$

$F(\cos\beta + \mu\sin\beta) = ma + mg\mu_2$

$F = \frac{mg\mu_2 + ma}{\cos\beta + \mu\sin\beta} = \frac{64(9.8)(.62) + 64(3.33)}{\cos 31 + .62(\sin 31)} = 512N$ (c) 5

(d)



(d) 5

(e) $\Sigma F = ma$

$F\cos\beta - F_{s_2} - F_{s_1} = m_2 a$

$F_{s_1} = N_1\mu_1 = m_1 g\mu_1$

$F_{s_2} = N_2\mu_2 = [(m_1 + m_2)g - F\sin\beta]\mu$

$F\cos\beta - [(m_1 + m_2)g - F\sin\beta]\mu_2 - m_1 g\mu_1 = m_2 a$

$\underbrace{815\cos 31}_{699N} - \underbrace{[64(9.8) - 815\sin 31].62}_{129N} - \underbrace{46(9.8)(.34)}_{153N} = 18a$

$a = 23.2 m/s^2$ (e) 5