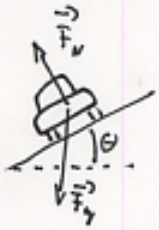
Homework 5

total 18.5 = 17.5 + 1

Ch. 7 :

24.



(1)

(a) x-comp: $-m\frac{v^2}{r} = -F_N \cdot \sin\theta$

y-comp: $0 = F_N \cos\theta - mg$

$\rightarrow \quad F_N = \frac{mg}{\cos\theta}$

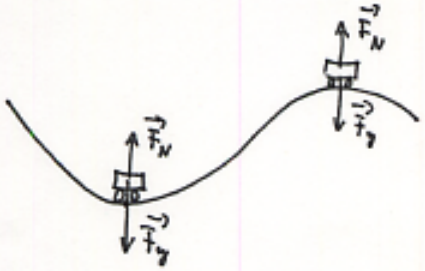
$\rightarrow \quad m\frac{v^2}{r} = \frac{mg}{\cos\theta}\sin\theta = mg\tan\theta$

$\rightarrow \quad \tan\theta = \frac{v^2}{rg}$

(b) $\tan\theta = \frac{(13.4\,\frac{m}{s})^2}{50.0\,m \cdot 9.80\,\frac{m}{s^2}}$

$\rightarrow \theta = 20.1°$

25.



(1)

(a) $m\frac{v^2}{r} = F_N - F_g$

$\rightarrow F_N = m\left(\frac{v^2}{r} + g\right) = 2.5 \cdot 10^4\ N$

(b) At max speed $F_N = 0$

$-m\frac{v^2}{r} = -mg$

$v^2 = rg = 15\,m \cdot 9.8\,\frac{m}{s^2} \rightarrow v = 12\,\frac{m}{s}$

27. (a) $a_c = \frac{v^2}{r} = \omega^2 r = 9.00\,m \cdot \left(4\,\frac{2\pi\,rad}{60\,s}\right)^2 = 1.58\,\frac{m}{s^2}$ (1)

(b)

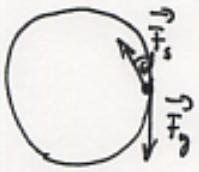
$ma_c = F_s - mg$

$F_s = m(a_c + g) = 455\,N$

(c) $-ma_c = F_s - mg$

$\rightarrow F_s = m(g - a_c) = 329\,N$

(d)



x-comp: $-ma_c = F_{s/x}$

y-comp: $0 = F_{s/y} - mg$

$\rightarrow F_{s/x} = -63.2\,N$

$F_{s/y} = 392\,N$

$\rightarrow F_s = \sqrt{F_{s/x}^2 + F_{s/y}^2} = 397\,N$

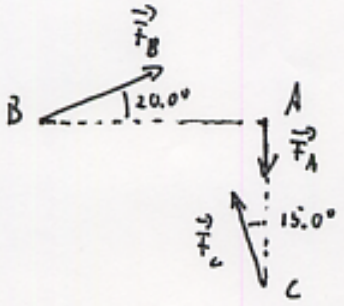
$\tan\theta = \frac{-F_{s/x}}{F_{s/y}} = 9.15°$

Ch 8:

1. $40.0\ Nm = F \cdot 0.300\ m$ (0.5)

$F = 133\ N$

3. (1.5)



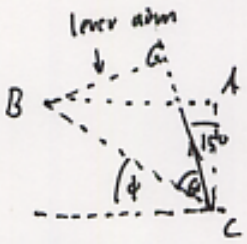
Axis at point A:

$T_B = -F_B \cdot 0.600\ m \cdot \sin 20.0° = -20.5\ Nm$

$T_C = -F_C \cdot 0.800\ m \cdot \sin 15.0° = -186\ Nm$

$\rightarrow T = T_B + T_C = -207\ Nm$

Axis at point B:



$T_A = -0.600\ m \cdot 800\ N$

$T_C = \sqrt{(0.600\ m)^2 + (0.800\ m)^2} \cdot \sin\theta \cdot 900\ N$

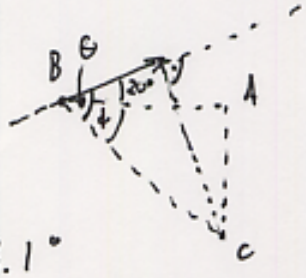
$\theta = 90° - \tan^{-1}\frac{80}{60} - 15.0° = 21.9°$

ϕ

$T_C = 335\ Nm$

$T = -145\ Nm$

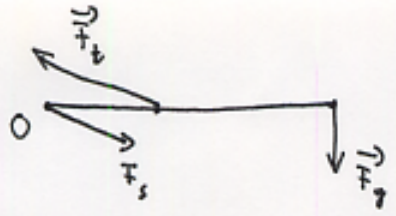
Axis at point C:



$\theta = 20° + \tan^{-1}\frac{80.0\ cm}{60.0\ cm} = 73.1°$

$T = T_B = -\sqrt{(0.600\ m)^2 + (0.800\ m)^2} \cdot \sin\theta \cdot 100\ N = -95.7\ Nm$

7.



(1)

$$-F_g \cdot 0.290\,m + F_t \cdot 0.080\,m \cdot \sin 12^\circ = 0$$

$$F_t = \frac{F_g \cdot 0.240\,m}{0.080\,m \cdot \sin 12^\circ} = \underline{724\,N}$$

$$F_{s|x} - F_t \cos 12^\circ = 0 \quad \rightarrow \quad F_{s|x} = 708\,N$$

$$F_{s|y} + F_t \sin 12^\circ - F_g = 0 \quad \rightarrow \quad F_{s|y} = 109\,N$$

$$\rightarrow F_s = \sqrt{F_{sx}^2 + F_{sy}^2} = \underline{716\,N}$$

8. x-comp: $$x_{cg} = \frac{16 m_H \cdot 0 + 2 \cdot m_H \cdot 0.100\,nm \cdot \cos 53^\circ}{16 m_H + 2 m_H} = \underline{6.7 \cdot 10^{-3}\,nm}.$$ (1)

y-comp: $y_{cg} = \underline{0}$

10. Axis of rot. A:

(1)

$$F_1 \cdot 3.10\,m - 2.50\,m \cdot w_s - 0.800\,m \cdot w_p \cdot \sin 28.0^\circ = 0$$

$$F_1 = \frac{2.50\,m \cdot 750\,N + 0.800\,m \cdot 1250\,N \cdot \sin 28.0^\circ}{3.10\,m} = \underline{756\,N}$$

26.

$$\frac{3}{4}\ell \cdot F_T - \frac{1}{2}\ell \cdot F_{g/B} \cdot \cos 65^\circ - \ell F_{g/W} \cdot \cos 65^\circ = 0$$

$$F_T = \frac{4}{3}\left(\frac{1}{2} F_{g/B} \cdot \cos 65^\circ + F_{g/W} \cdot \cos 65^\circ\right) = \underline{1.4 \cdot 10^3\ N}$$

From $\Sigma F_x = 0$:

$$-F_T \cos 25^\circ + F_{H/x} = 0 \quad \rightarrow \quad \underline{F_{H/x} = 1.3 \cdot 10^3\ N}$$

$\Sigma F_y = 0$:

$$F_T \sin 25^\circ + F_{H/y} - F_{g/B} - F_{g/W} = 0$$

$$\underline{F_{H/y} = 2.6 \cdot 10^3\ N}$$

58.

(a) $F_{Nail} \cdot 5.00\ cm \cdot \cos 30^\circ - F \cdot 30.0\ cm = 0$

$$\rightarrow \quad F_{Nail} = \frac{150N \cdot 30.0\ cm}{5.00\ cm \cdot \cos 30^\circ} = \underline{1.04 \cdot 10^3\ N}$$

(b) x-comp:

$$F_{P/x} - F_{Nail} \cdot \sin 30.0^\circ + F = 0$$

$$F_{P/x} = 370\ N$$

y-comp:

$$F_{P/y} - F_{Nail} \cdot \cos 30.0^\circ = 0$$

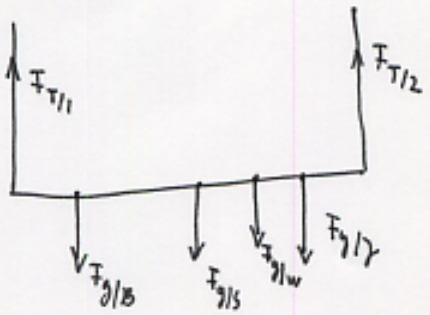
$$F_{P/y} = 900\ N$$

$$\rightarrow \quad F_P = \sqrt{F_{P/x}^2 + F_{P/y}^2} = 973\ N$$

$$\theta = \tan^{-1}\frac{900\ N}{370\ N} = 67.7^\circ \quad \text{above the horizontal to the right.}$$

70.

(1)



$$-1.00\,m \cdot 750\,N - 1.50\,m \cdot 345\,N - 2.00\,m \cdot 500\,N - 2.50\,m \cdot 1000\,N + 3.00\,m \cdot F_{T/2} = 0$$

$$\rightarrow F_{T/2} = 1.59 \cdot 10^3\,N$$

$$F_{T/1} = 750\,N + 345\,N + 500\,N + 1000\,N - 1.59 \cdot 10^3\,N = 1.01 \cdot 10^3\,N$$

Ch 9:

2. (a) $A = \frac{\pi}{4} d^2 = 7.85 \cdot 10^{-5}\ m^2$ (1) extra

$F = 4.00 \cdot 10^8 \frac{N}{m^2} \cdot 7.85 \cdot 10^{-5}\ m^2 = \underline{\underline{3.14 \cdot 10^4\ N}}$

(b) $A = \pi d \cdot h = 1.57 \cdot 10^{-1}\ m^2$

$F = 4.00 \cdot 10^8 \frac{N}{m^2} \cdot 1.57 \cdot 10^{-4}\ m^2 = \underline{\underline{6.28 \cdot 10^4 N}}$

5. $Y = \frac{\frac{F}{A}}{\frac{\Delta L}{L}} = \frac{90\,kg \cdot 9.8 \frac{m}{s^2} \cdot 50\,m}{\frac{\pi}{4} \cdot (0.01\,m)^2 \cdot 1.6\,m} = \underline{\underline{3.5 \cdot 10^8\ Pa}}$ (0.5)

10. (a) $Y = \frac{\frac{F}{A}}{\frac{\Delta L}{L}}$ (1)

$\rightarrow \Delta L = \frac{F \cdot L}{A \cdot Y} = \frac{mg \cdot L}{A \cdot Y} = \frac{800\,kg \cdot 9.80 \frac{m}{s^2} \cdot 25.0\,m}{4.00 \cdot 10^{-4}\ m^2 \cdot 20 \cdot 10^{10}\ Pa} = \underline{\underline{2.5 \cdot 10^{-3}\ m}}$

(b) $F_{cable} = F_g + ma = m(g+a)$

$\Delta L = \frac{m(g+a) \cdot L}{A \cdot Y}$

$\Delta L_{extra} = \frac{ma \cdot L}{A \cdot Y} = \underline{\underline{7.5 \cdot 10^{-4}\ m}}$

(c) $F_{cable} = F_g + ma = m(g+a)$

$F_{cable} = 2.2 \cdot 10^8\ Pa \cdot 4.00 \cdot 10^{-4}\ m^2 = 8.8 \cdot 10^4\ N$

~~$8.8 \cdot 10^4\ N = 800\,kg \cdot 9.8 \frac{m}{s^2}$~~

$\rightarrow m = \frac{8.8 \cdot 10^4\ N}{9.8 \frac{m}{s^2} + 3.0 \frac{m}{s^2}} = \underline{\underline{6.9 \cdot 10^3\ kg}}$

19. $p_A + \rho \cdot g \cdot h = p_V$ (0.5)

$$h = \frac{p_V - p_A}{\rho \cdot g} = \frac{p_{gauge}}{\rho \cdot g} = 1.33\,m$$

24.

$p_2 = p_1$ (1)

$$\frac{500\,lb}{\frac{\pi}{4}\cdot(1.5\,in)^2} = \frac{F_1}{\frac{\pi}{4}(0.25\,in)^2}$$

$$\rightarrow F_1 = 13.9\,lb$$

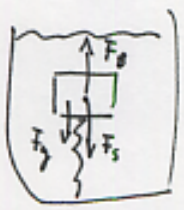
$$F_1 \cdot 2.0\,in - F \cdot 12\,in = 0$$

$$F = F_1 \frac{2.0}{12} = \frac{1}{6.0} F_1 = \underline{2.3\,lb.}$$

26. $\rho_w \cdot V_0 = m_F$

$$m_F = \rho_w \cdot \frac{1}{2} \frac{4\pi}{3} r^3 = 1.35\,g/cm^3 \cdot \frac{2\pi}{3} \cdot (6.00\,cm)^3 = 611\,g.$$ (0.5)

34.



$F_B - F_g - F_s = 0$

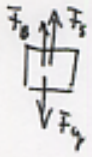
$\rho_w \cdot V \cdot g - \rho_B \cdot V \cdot g - k \cdot \Delta x = 0$ (1)

$\rho_B = \frac{m_B}{V}$

$\rightarrow V = \frac{m_B}{\rho_B}$

$$\Delta x = \frac{1}{k}\left(\frac{\rho_w}{\rho_B} m_B \cdot g - m_B g\right) = \frac{g m_B}{k}\left(\frac{\rho_w}{\rho_B} - 1\right) = \underline{0.165\,m}$$

36.



(1)

$$F_s + F_B - F_g = 0$$

$$F_B = F_g - F_s$$

$$F_B = \rho_L \cdot V g$$

(a) $$V = \frac{F_g - F_{s/w}}{\rho_w \cdot g} = 3.57 \cdot 10^{-3} m^3$$

$$\rightarrow \rho_. = \frac{300N}{9.80 \frac{m}{s^2} \cdot 0.0357 m^3} = 8.57 \cdot 10^3 \frac{kg}{m^3}$$

(b)

$$\rho_0 = \frac{F_B}{V} = \frac{F_g - F_s}{V} = 714 \frac{kg}{m^3}$$

30. (1)

(a) $P_T = P_A + \rho g \cdot h_T = 1.0130 \cdot 10^5 Pa + 1.00 \cdot 10^3 \frac{kg}{m^3} \cdot 9.80 \frac{m}{s^2} \cdot 0.0500 m = 1.0179 \cdot 10^5 Pa$

$P_B = P_A + \rho g h_B = 1.0297 \cdot 10^5 Pa$

$F_t = P_T \cdot A = 1.0179 \cdot 10^5 Pa \cdot (10.0 \cdot 10^{-2} m)^2 = 1.0179 \cdot 10^3 N \approx 1.02 \cdot 10^3 N$

$F_B = P_B \cdot A = 1.0297 \cdot 10^3 N \approx 1.03 \cdot 10^3 N$

(b) $F_s = F_B - F_t - F_g = 86.2 N$

(c) $F_B - F_t = A \cdot (\rho_L g h_b - \rho_L g h_t) = \rho_L g \cdot A \cdot \Delta h = \rho_L g V = F_{Buoyant}$