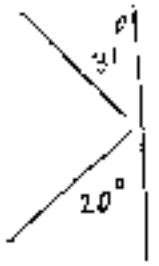
(1)




$$\Delta p_x = -0.12 \times 2.2 \times \sin 31^0 - 0.12 \times 3.5 \times \sin 20^0$$
$$= -.136 - .144 = -.280 \text{ kg-m/s}$$

$$\Delta p_y = +.12 \times 2.2 \times \cos 30^0 - .12 \times 3.5 \times \cos 20^0$$
$$= .229 - .395 = -.166 \text{ kg-m/s}$$

$$\Delta F_x = -\frac{.280}{.04} = -7 \text{ N}$$

$$\Delta F_y = -\frac{.166}{.04} = -4.15 \text{ N}$$

(2)

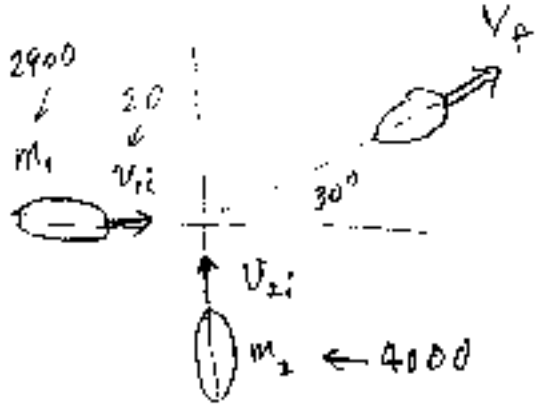
$$\frac{1}{2} k x^2 = \frac{1}{2} m_1 v_1^2 \qquad k = 1960 \text{ N/m}$$

$$\frac{1}{(.05)^2} \quad \frac{1}{.1} \quad 7^2$$

$$W = \frac{1}{2} \times .1 \times 6^2 - \frac{1}{2} \times .1 \times 7^2 = -0.65 \text{ J}$$

$$F_{fric} = -\frac{.65}{4} = -.163 \text{ N}$$

(3)




$$m_1 v_{1i} = M V_f \cos 30$$

2900 20 6900 .866

$$V_f = 9.706 \text{ m/sec}$$ ✓

$$m_2 v_{2i} = M V_f \sin 30^0$$

4000 6900 $\frac{1}{2}$

$$v_{2i} = 8.366 \text{ m/s}$$

$$KE_i^{tot} = \frac{1}{2} \times 2900 \times 20^2 + \frac{1}{2} \times 4000 \times 8.366^2$$

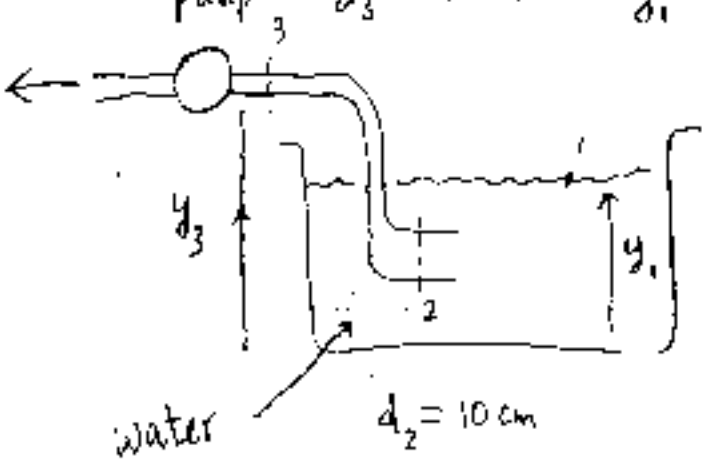
$$= 5.8 \times 10^5 + 1.40 \times 10^5 = 7.20 \times 10^5 \text{ J}$$

$$KE_f^{tot} = \frac{1}{2} \times 6900 \times 9.706^2 = 3.25 \times 10^5 \text{ J}$$ ✓

④

$v_3 = 12$ m/s  $y_3 = 3.6$ m

$d_3 = 4$ cm  $y_1 = 2.4$ m




$$A_3 = \frac{\pi}{4}(0.04)^2 \simeq 12.57 \times 10^{-4} \text{ m}^2$$

$$Q_{\text{per hour}} = 3600 \times 12.57 \times 10^{-4} \times 12$$

$$\simeq 54.3 \text{ m}^3$$

$$v_2 = v_3\left(\frac{4}{10}\right)^2 = 12 \times \left(\frac{4}{10}\right)^2$$

$$= 1.92 \text{ m/s} \quad \checkmark$$

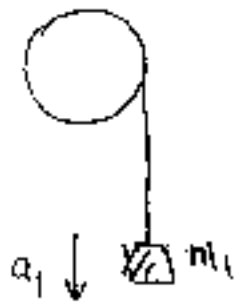
$$p_3 + \frac{1}{2}\rho v_3^2 + \rho g y_3 = p_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1$$

($v_1 \simeq 0$)

$$p_3 = \underbrace{1000 \times 9.8 \times (2.4 - 3.6)}_{-1.18 \times 10^4} + 1.013 \times 10^5 - \underbrace{\frac{1}{2} \times 1000 \times 12^2}_{7.7 \times 10^4}$$

$$= 1.75 \times 10^4 \text{ Pa}$$

(5)




$$\alpha = \frac{a}{R} = \frac{5}{.1} = 50 \text{ rad/sec}$$

$$\theta = 0 + \frac{1}{2}(50)\times(2.5)^2 = 156.3 \text{ rad}$$

$$\begin{cases} mg - T = ma \\ TR = I\dfrac{a}{R} \end{cases} \qquad a = \frac{mg}{m + \frac{I}{R^2}}$$

$$m + \frac{I}{R^2} = \frac{mg}{a} = \frac{.4\times 9.8}{5}$$

$.4$ | $.784$

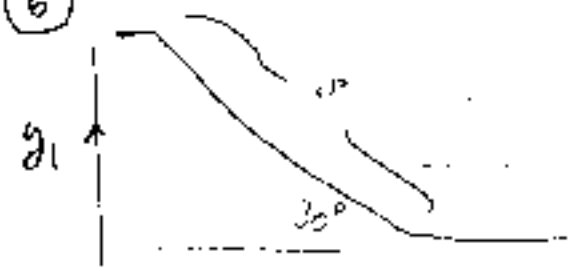
$$\frac{I}{R^2} = .384$$

$$I = .384 \times 10^{-2} \text{ kg-m}^2$$

$$= \frac{1}{2} M R^2$$

$$\therefore M = .768 \text{ kg}$$

(6)




$$Mgy_1 = \frac{1}{2} I \omega_f^2 + \frac{1}{2} M v_f^2$$

$y_1 = 2.5$, $I = \frac{1}{2} MR^2$

$$= \left(\frac{1}{4} + \frac{1}{2}\right) M v_f^2$$

$$\therefore v_f = \left[\frac{4}{3} \times 9.8 \times 2.5\right]^{1/2} = 5.71 \text{ m/s}$$

$$t = \frac{s}{v_{av}} = \frac{2.5/\sin 30^\circ}{(0+5.71)/2} = 1.75 \text{ sec}$$

$$\begin{cases} v_f^2 = v_i^2 + 2as \\ s = v_i t + \frac{1}{2} a t^2 \\ v_i = 0 \end{cases}$$

$$\Rightarrow t = \frac{s}{v_f/2}$$