Solutions PHYS-205A (Final Exam) Spring 2018

**Prob. 1**

$$[h^2] = [(r_2 - r_1)^2] \quad \text{(because they are added together)}$$

$$\Rightarrow [h] = [r_2] = [r_1]$$

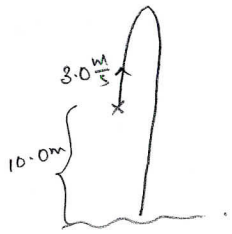
Thus, $[K] = [h]^3 = \text{Length}^3$

So, it could represent a volume.

**Prob. 2**

$\Delta x = -10.0\,m$ $\quad v_i = +3.0\,\frac{m}{s}$ $\quad a = -9.8\,\frac{m}{s^2}$.

$\Delta t =$ $\quad v_f =$




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

$$-10.0 = 3.0\,\Delta t - \frac{1}{2} 9.8\,\Delta t^2$$

$$4.9\,\Delta t^2 - 3.0\,\Delta t - 10.0 = 0$$

$$\Delta t = \frac{3.0 \pm \sqrt{3.0^2 - 4(4.9)(-10.0)}}{2(4.9)}$$

$= +1.77\,s$ (OR) $-1.15\,s$.

↳ time when fish reaches water.

$$\Delta x_{pelican} = v_p \Delta t = (3.0)(1.77) = 5.31\,m$$

Height above water $= 5.31\,m + 10.0\,m$

$= 15.3\,m$

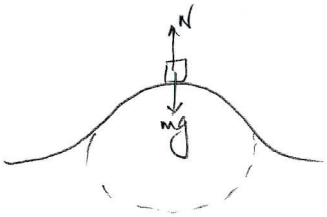
## Prob. 3

$$\vec{A} - \vec{B} = 2\vec{C}$$
$$\vec{A} + \vec{B} = 4\vec{C}$$

Adding: $\vec{A} = 3\vec{C} = 3(3\hat{i} + 4\hat{j}) = 9\hat{i} + 12\hat{j}$

Subtracting: $-2\vec{B} = -2\vec{C} \Rightarrow \vec{B} = \vec{C} = 3\hat{i} + 4\hat{j}$.

## Prob. 4

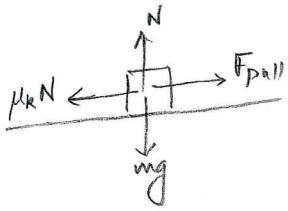



$$N - mg = -\frac{mv^2}{R}$$

$N = 0$:

$$v = \sqrt{gR} = \sqrt{(9.8)(150)} = 38\ \frac{m}{s}$$

## Prob. 5




$$W = \vec{F}_{fric} \cdot \vec{d}$$
$$= \mu_k mg\, d \cos 180$$
$$= -(0.30)(25)(9.8)(10.0)$$
$$= -735\ J$$

## Prob. 6

$$F = -\frac{\partial U}{\partial x} = -\left[2ax - 4bx^3\right] = -2ax + 4bx^3$$

$F = 0 \Rightarrow$

$$4bx^3 - 2ax = 0$$
$$4bx\left(x^2 - \frac{a}{2b}\right) = 0$$

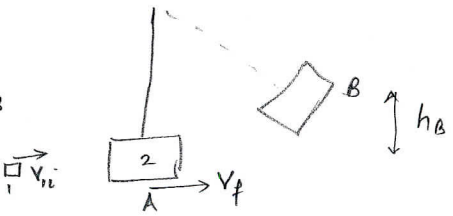
$\Rightarrow x = 0$, $x = \pm\sqrt{\frac{a}{2b}}$.

## Prob. 7

$$K_A + U_A = K_B + U_B$$

$$\frac{1}{2}(m_1+m_2)V_A^2 + mg\,h_A = \frac{1}{2}(m_1+m_2)V_B^2 + mg\,h_B$$

($h_A = 0$, $V_B = 0$)




$$V_A = \sqrt{2gh_B} = \sqrt{2(9.8)(0.30\,m)} = 2.43\ \frac{m}{s}$$

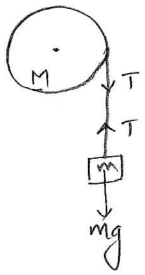
$V_f = V_A$

$$m_1 V_{1i} + m_2 V_{2i} = (m_1+m_2)V_f$$

($V_{2i} = 0$)

$$V_{1i} = \frac{m_1+m_2}{m_1} V_f = \left(\frac{0.0030+1.00}{0.0030}\right) 2.43 = 812\ \frac{m}{s}$$

## Prob. 8




m:

$$mg - T = ma$$

M:

$$TR = I\alpha$$

$$TR = \frac{1}{2}MR^2\alpha$$

$$T = \frac{1}{2}Ma$$

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$$mg = \left(m + \frac{1}{2}M\right)a$$

$$a = \frac{m}{m+\frac{1}{2}M}\,g = \left(\frac{0.50}{0.50+\frac{1.00}{2}}\right) 9.8 = 4.9\ \frac{m}{s^2}$$

## Prob. 9

$$L_i^{disc} + L_i^{kid} = L_f^{disc} + L_f^{kid}$$

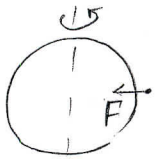
$$\frac{1}{2}MR^2\omega_i + mR^2\omega_i = \frac{1}{2}MR^2\omega_f + 0$$

$$\omega_f = \omega_i\left(1 + \frac{mR^2}{\frac{1}{2}MR^2}\right) = \omega_i\left(1 + \frac{2m}{M}\right) = (0.40)\left(1 + \frac{2(40.0)}{100.0}\right)$$

$$= 0.72\ \frac{rad}{s}$$

Prob. 10

$$\frac{GMm}{R^2} = m\omega^2 R \qquad M = \frac{2.0\times10^{30}}{2.0}\ kg$$




$$\omega = \sqrt{\frac{GM}{R^3}}$$

$$= \sqrt{\frac{(6.67\times10^{-11})(1.0\times10^{30})}{(10.0\times10^{3}\ m)^3}}$$

$$= \sqrt{6.67\times10^{13}} = 8.2\times10^{6}\ \frac{rad}{s}$$