Final Exam PHYS-203A Spring 2016

Prob. 1

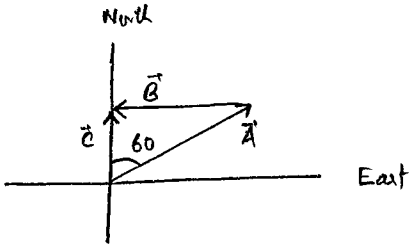
$$\vec{A} = 5.0 \sin 60\, \hat{i} + 5.0 \cos 60\, \hat{j}$$

$$\vec{B} = -4.33\, \hat{i} + 0\, \hat{j}$$

$$\vec{C} = \vec{A} + \vec{B}$$

$$= 0\, \hat{i} + 5.0 \cos 60\, \hat{j}$$

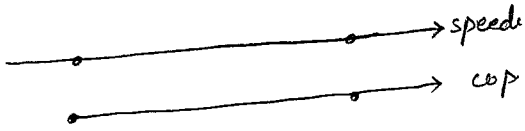
$$= 0\, \hat{i} + 2.5\, \hat{j}$$



$|\vec{C}| = 2.5$ m

direction = North.

Prob. 2



speeder $x_s = v_s t$

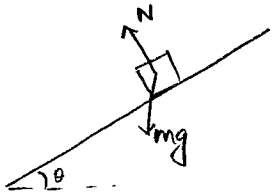
cop $x_c = \frac{1}{2} a t^2$

We are interested in the case $x_s = x_c$

$$x = v_s \sqrt{\frac{2x}{a}}$$

$$\Rightarrow x = \frac{2 v_s^2}{a} = \frac{2 \times 40^2}{2.0} = 1600 \text{ m}.$$

Prob. 3



$$a = -g \sin\theta$$

$$= -9.8 \sin 30 = -4.9 \text{ m/s}^2.$$

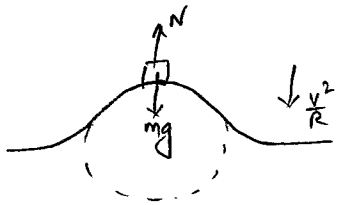
$v_f = 0$

$v_i = 5.0 \frac{m}{s}$

$$v_f = v_i + a \Delta t$$

$$\Delta t = \frac{v_f - v_i}{a} = \frac{0 - 5.0}{-4.9} = 1.02 \text{ seconds}.$$

Prob. 4



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

for $N=0$: $\quad mg = \frac{mv^2}{R} \Rightarrow v = \sqrt{gR}$

$$= \sqrt{9.8 \times 25}$$

$$= 15.7 \ \frac{m}{s}.$$

Prob. 5

$$\frac{1}{2}mv^2 = mgh$$

$$h = L - L\cos\theta$$

$$= L(1-\cos\theta)$$

$$v = \sqrt{2gh}$$

$$= \sqrt{2gL(1-\cos\theta)}$$

$$= \sqrt{2 \times 9.8 \times 3.0\,(1-\cos 30)} = 2.81 \ \frac{m}{s}$$

Prob. 6

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}.$$

($v_{1i} = 0$, $v_{2i} = 0$)

$$v_{2f} = -\frac{m_1}{m_2} v_{1f} = -\frac{3.00 \times 10^{-3}}{90.0} \times 700.0 = 0.023 \ \frac{m}{s}$$

$$= 2.3 \ \frac{cm}{s}$$

Prob. 7

$\omega_i = 0$ $\qquad \alpha = 15 \ \frac{rad}{s^2}$ $\qquad \Delta\theta = ?$

$\omega_f =$ $\qquad \Delta t = 2.00 \ s$

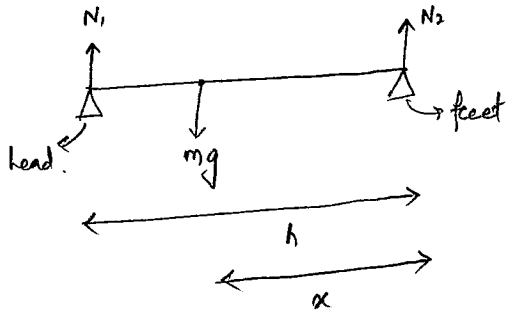
$$\Delta\theta = \omega_i \Delta t + \frac{1}{2}\alpha \Delta t^2$$

$$= 0 + \frac{1}{2} 15 \ (2.00)^2$$

$$= 30 \text{ radians}$$

$$= 30 \text{ rad} \ \frac{1 \text{ rev.}}{2\pi \text{ rad.}} = 4.8 \text{ revolutions}.$$

Prob. 8

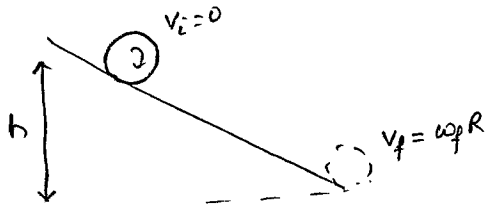


Torque equation: $N_1(h-x) = N_2 x$.

$$x = \frac{N_1}{N_1+N_2} h$$

$$= \frac{500}{500+300} \times 1.8 = 1.13 \text{ m}$$

Prob. 9



$$mgh = \frac{1}{2} m v_f^2 + \frac{1}{2} I \omega_f^2$$

$$mgh = \frac{1}{2} m v_f^2 + \frac{1}{2} \frac{2}{3} m \underbrace{R^2 \omega_f^2}_{v_f^2}$$

$$gh = \left(\frac{1}{2} + \frac{1}{3}\right) v_f^2$$

$$v_f = \sqrt{\frac{6}{5} gh} = \sqrt{\frac{6}{5} \times 9.8 \times 1.20} = 3.76 \frac{m}{s}$$

Prob. 10

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

$$I_i^{disc} \omega_i^{disc} + I_i^{girl} \omega_i^{disc} = I_f^{disc} \omega_f^{disc} + I_f^{girl} \omega_f^{girl}$$

$$\frac{1}{2} M R^2 \omega_i + m R^2 \omega_i = \frac{1}{2} M R^2 \omega_f + m \left(\frac{R}{2}\right)^2 \omega_f$$

$$\left(\frac{M}{2} + m\right) \omega_i = \left(\frac{M}{4} + \frac{m}{4}\right) \omega_f$$

$$\omega_f = \left(\frac{\frac{M}{2} + m}{\frac{M}{4} + \frac{m}{4}}\right) \omega_i = \left(\frac{\frac{100}{2} + 30}{\frac{100}{4} + \frac{30}{4}}\right) 2.10 \frac{rad}{s}$$

$$= 2.92 \frac{rad}{s}.$$