Solution

Final Exam (PHYS-203A-002) FALL 2017

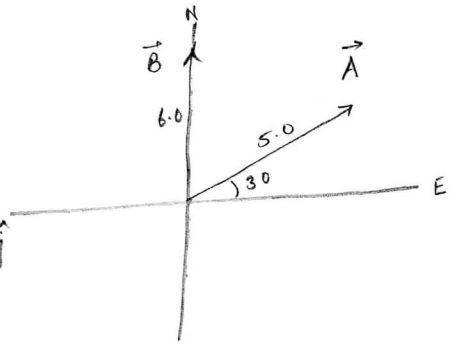
Prob. 1

$$\vec{A} = 5.0\cos 30\,\hat{i} + 5.0\sin 30\,\hat{j}$$

$$-\vec{B} = 0\,\hat{i} + 6.0\,\hat{j}$$

$$\vec{C} = \vec{A} - \vec{B} = 5.0\cos 30\,\hat{i} + (5.0\sin 30 - 6.0)\,\hat{j}$$

$$= 4.3\,\hat{i} - 3.5\,\hat{j}$$

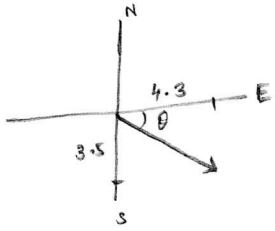


$$|\vec{C}| = \sqrt{(4.3)^2 + (-3.5)^2}$$

$$= 5.5 \text{ units}$$

$$\theta = \tan^{-1}\left(\frac{4.3}{3.5}\right)$$

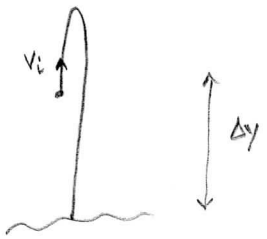
$= 51^\circ$ South of East.



Prob. 2

$\Delta y = -15.0\text{ m}$ $\quad v_i = +4.0\ \frac{m}{s}$ $\quad a = -9.8\ \frac{m}{s^2}$

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



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

$$-15.0 = 4.0\,\Delta t + \frac{1}{2}(-9.8)\,\Delta t^2$$

$$4.9\,\Delta t^2 - 4.0\,\Delta t - 15.0 = 0$$

$$\Delta t = \frac{4.0 \pm \sqrt{(4.0)^2 - 4(4.9)(-15.0)}}{2(4.9)}$$

$$= \frac{4.0 \pm 17.6}{9.8} = \boxed{2.2\text{ s}} \quad (\text{OR}) \quad -1.4\text{ s}$$

↓ correct solution

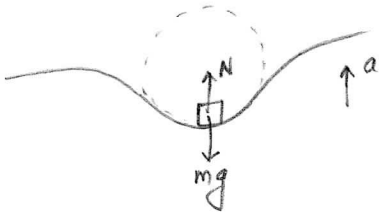
Prob. 3

$$F = m\,a$$

$$65 = 66\,a$$

$$a = \frac{65}{66} = 0.99\ \frac{m}{s^2}$$

Prob. 4



$$\vec{N} + m\vec{g} = m\vec{a}$$

$$+N - mg = +m\frac{v^2}{R}$$

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

$$= (75)(9.8) + (75)\frac{(25)^2}{150} = 1048 \text{ Newtons} \rightarrow 1100 \text{ Newtons.}$$

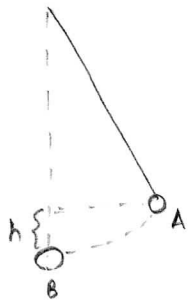
Prob. 5

$$\frac{1}{2}mv_A^2 + mgh_A = \frac{1}{2}mv_B^2 + mgh_B$$

($v_A = 0$)

$$v_B = \sqrt{2g(h_A - h_B)}$$

$$= \sqrt{2(9.8)(0.50)} = 3.1\ \frac{m}{s}$$



Prob. 6

$$x_{cm} = \frac{m_B x_B + m_J x_J}{(m_B + m_J)}$$

$$= \frac{(45)(0.0) + (90)(10.0)}{(45+90)} = 6.67\ m$$

Prob. 7

$\Delta x =$ $\quad V_i = 25 \frac{m}{s} \quad a = 2.0 \frac{m}{s^2}$

$\Delta t = 7.0\,s \quad V_f =$

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

$$= (25)(7.0) + \frac{1}{2}(2.0)(7.0)^2 = 224\,m$$

$$\Delta\theta = \frac{\Delta x}{R} = \frac{224\,m}{0.30\,m} = 747\ rad$$

Prob. 8

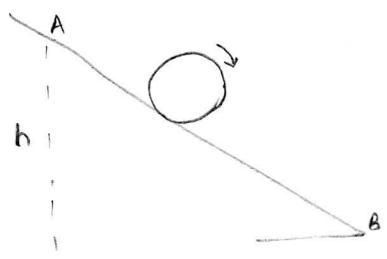
$V = \omega R$

$$K_L = \frac{1}{2} M v^2$$

$$K_R = \frac{1}{2} I \omega^2 = \frac{1}{2}\left(\frac{2}{5} M R^2\right) \omega^2 = \frac{1}{5} M v^2$$

$$\frac{K_R}{K_L + K_R} = \frac{\frac{1}{5} M v^2}{\frac{1}{2} M v^2 + \frac{1}{5} M v^2} = \frac{\frac{1}{5}}{\frac{1}{2} + \frac{1}{5}} = \frac{2}{7} = 0.29$$

Prob. 9



$$\frac{1}{2} m v_A^2 + \frac{1}{2} I \omega_A^2 + mgh_A = \frac{1}{2} m v_B^2 + \frac{1}{2} I \omega_B^2 + mgh_B$$

($\frac{1}{2} m v_A^2 = 0$, $\frac{1}{2} I \omega_A^2 = 0$, $mgh_B = 0$)

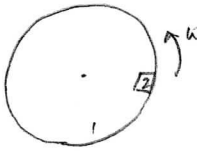
$$mgh_A = \frac{1}{2} m v_B^2 + \frac{1}{2}\cdot\frac{1}{2} m R^2 \omega_B^2$$

$$gh_A = \frac{1}{2} v_B^2 + \frac{1}{4} v_B^2$$

$$gh_A = \frac{3}{4} v_B^2$$

$$v_B = \sqrt{\frac{4}{3} g h_A} = \sqrt{\frac{4}{3}(9.8)(1.20)} = 4.0 \frac{m}{s}$$

Prob. 10



$$L_{1i} + L_{2i} = L_{1f} + L_{2f}$$

$$I_1 \omega_i + m_2 R_{2i}^2 \omega_i = I_1 \omega_f + m_2 R_{2f}^2 \omega_f$$

$$(125)(0.6) + m_2 (1.5)^2 (0.6) = (125)(0.9) + m_2 (0.75)^2 (0.9)$$

$$75 + 1.35\, m_2 = 112.5 + 0.506\, m_2$$

$$0.844\, m_2 = 37.5$$

$$m_2 = 44.4 \text{ kg}$$