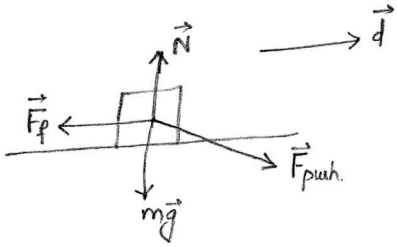
Solutions Midterm Exam 03 (FALL 2017) PHYS - 203A - 002

Prob. 1



(a) $\Delta K = 0$ (constant velocity)

(b) $W_N = 0$ (Normal force is perpendicular to displacement, $\cos 90 = 0$.)

(c) $W_g = 0$ (Gravity is perpendicular to displacement, $\cos 90 = 0$.)

(d) $W_f = \vec{F}_f \cdot \vec{d} = F_f\, d \cos 180$

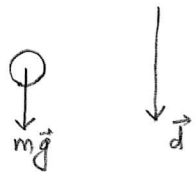
$= (45)(25)(-1) = -1125\ J$

(e) $\Delta K = W_N + W_g + W_f + W_{push}$

$0 = 0 + 0 - 1125\ J + W_{push}$

$W_{push} = +1125\ J$

Prob. 2



(a) Gravity ($m\vec{g}$)

(b) $W_g = m\vec{g} \cdot \vec{d} = mg\, d \cos(0)$

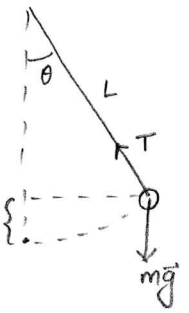
$= (0.60)(9.8)(6.5 - 1.5)$

$= 29.4\ J$

(c) $\Delta U_g = -W_g = -29.4\ J$

(d) $\Delta K = W_g = +29.4\ J$

Prob. 3



(a) Gravity ($m\vec{g}$) and Tension ($\vec{T}$)

(b) $W_T = 0$ (Tension is perpendicular to the instantaneous displacement, $\cos 90 = 0$)

(c) $W_g = -\Delta U_g = -(0 - mgh)$

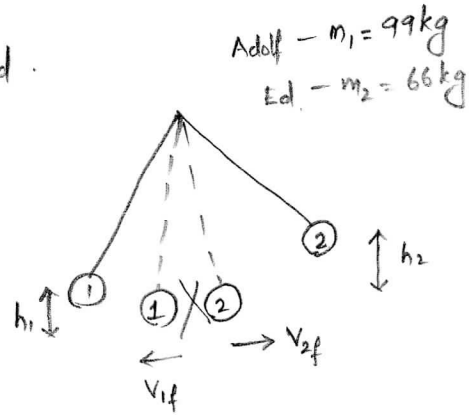
$= mgh = (5.0)(9.8)(0.50) = 24.5\ J$

(d) $\Delta U_g = -W_g = -24.5\ J$

(e) $\Delta K = W_T + W_g = 0 + 24.5 = +24.5\ J$

Prob. 4

During push off momentum is conserved.



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

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

$99\, v_{1f} + 66\, v_{2f} = 0$

$v_{2f} = -1.5\, v_{1f}$

Adolf

$m_1 g h_1 = \frac{1}{2} m_1 v_{1f}^2$

$v_{1f} = \sqrt{2gh_1} = \sqrt{2(9.8)(0.60)} = 3.43\ \frac{m}{s}$

Thus, $v_{2f} = -1.5\, v_{1f} = -1.5(3.43) = -5.14\ \frac{m}{s}$

Ed

$m_2 g h_2 = \frac{1}{2} m_2 v_{2f}^2$

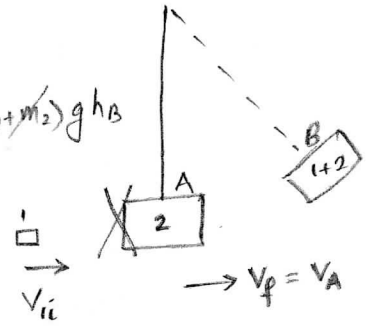
$h_2 = \frac{v_{2f}^2}{2g} = \frac{(5.14)^2}{2(9.8)} = 1.35\ m$

Prob. 5

(A to B)

$$\frac{1}{2}(m_1+m_2)V_A^2 + (m_1+m_2)gh_A = \frac{1}{2}(m_1+m_2)V_B^2 + (m_1+m_2)gh_B$$

$h_A = 0$, $V_B = 0$



$$V_A = \sqrt{2gh_B}$$

$$= \sqrt{2(9.8)(0.300\text{m})} = 2.42\ \frac{\text{m}}{\text{s}}$$

$$= V_f$$

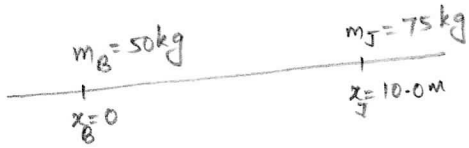
Collision

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

$V_{2i} = 0$

$$V_{1i} = \left(\frac{m_1+m_2}{m_1}\right) V_f = \left(\frac{0.00300+1.00}{0.00300}\right) 2.42 = 809\ \frac{\text{m}}{\text{s}}$$

Prob. 6



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

$$= \frac{(50)(0) + (75)(10)}{(50+75)}$$

$$= \frac{750}{125} = 6.0\text{ m}$$

Prob. 7

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

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

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

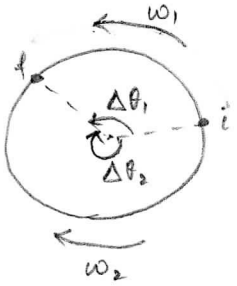
$$= (25)(7.0) + \frac{1}{2}(2.0)(7.0)^2 = 224\,m$$

$$\Delta x = R \Delta\theta \quad \Rightarrow \quad \Delta\theta = \frac{\Delta x}{R} = \frac{224\,m}{0.30\,m} = 747 \text{ radian}$$

Prob. 8

$$\Delta\theta_1 = \omega_1 \Delta t \qquad \Delta\theta_1 + \Delta\theta_2 = 2\pi$$

$$\Delta\theta_2 = \omega_2 \Delta t$$



$$\frac{\Delta\theta_1}{\Delta\theta_2} = \frac{\omega_1}{\omega_2} = \frac{3.0 \times 10^{-3}}{1.0 \times 10^{-3}} = 3.0$$

$$\frac{\Delta\theta_1}{2\pi - \Delta\theta_1} = 3.0$$

$$\Delta\theta_1 = 6.0\pi - 3.0\,\Delta\theta_1$$

$$\Delta\theta_1 = \frac{6.0\pi}{4.0} = 3.0\,\frac{\pi}{2} = 4.7 \text{ radian}$$