Solutions

# Midterm Exam 03 (Fall 2017) PHYS-205A-001

## Prob. 1

$$W_{total} = \Delta K$$

$$= \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$= \frac{1}{2}(25)(100) - \frac{1}{2}(25)(25)$$

$$= 1250 - 312.5 = 938\ J$$

$$\vec{v}_i = 4.0\,\hat{i} + 3.0\,\hat{j}$$

$$v_i^2 = (4.0)^2 + (3.0)^2 = 25\ \frac{m^2}{s^2}$$

$$\vec{v}_f = 6.0\,\hat{i} + 8.0\,\hat{j}$$

$$v_f^2 = (6.0)^2 + (8.0)^2 = 100.\ \frac{m^2}{s^2}$$

## Prob. 2

(a) $W_T = 0$. Because force of tension is perpendicular to the instantaneous displacement.

(b) $W_g = -\Delta U_g = mgh = (5.0)(9.8)(0.40) = 19.6\ J$

(c) $\Delta K = W_T + W_g$

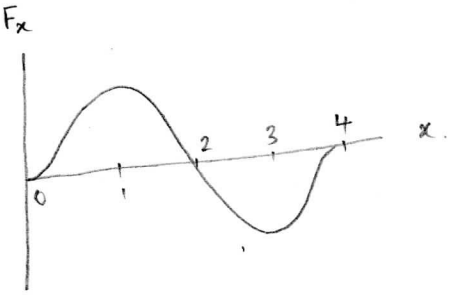
$= 19.6\ J$

## Prob. 3

(a) $F_x = -\frac{\partial U}{\partial x} = -(\text{slope})$

At $x = 3\ m$, the force is negative.

(b)



## Prob. 4

$$\text{Power} = \frac{\text{Energy}}{\text{time}} = \frac{mgh}{\Delta t}$$

$$= \frac{(690\,N)(8.0\,m)}{(6.00\,s)} = 920 \text{ Watt}$$

## Prob. 5

$$(m_b + m_g)\underbrace{v_i}_{=0} = m_b v_{bf} + m_g v_{gf}$$

$$v_{gf} = -\frac{m_b}{m_g} v_{bf} = -\frac{69.0}{36.0}\left(3.00\,\frac{m}{s}\right) = -5.75\,\frac{m}{s}$$

magnitude = $5.75\,\frac{m}{s}$

direction = East.

## Prob. 6

(a) $dm = a\,dx$

$$M = \int dm = \int_0^L a\,dx = aL = \left(3.00\,\frac{kg}{m}\right)(5.00\,m) = 15.0\,kg$$

(b) $$x_{cm} = \frac{\int dm\, x}{\int dm} = \frac{\int_0^L a\,dx\, x}{\int_0^L a\,dx} = \frac{L^2/2}{L} = \frac{L}{2} = 2.50\,m$$

Its center of mass is 2.50 m from $x = 0$.

Prob. 7

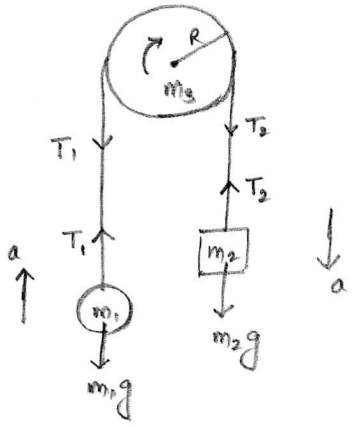
$m_1$ : $T_1 - m_1 g = m_1 a$

$m_2$ : $m_2 g - T_2 = m_2 a$

Torque $m_3$ : $T_2 - T_1 = \frac{1}{2} m_3 a$

$m_2 g - m_1 g = m_1 a + m_2 a + \frac{1}{2} m_3 a$

$$a = \frac{(m_2 - m_1)\, g}{\left(m_1 + m_2 + \frac{1}{2} m_3\right)}$$




Torque

$T_2 R - T_1 R = I \alpha$

$T_2 R - T_1 R = \frac{1}{2} m_3 R^2 \alpha$

$T_2 - T_1 = \frac{1}{2} m_3 a$

$a = \alpha R$