Solutions

# PHYS- 203 A (Midterm Exam 03) Fall 2021

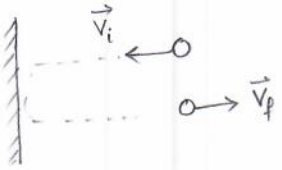
## Problem 1

No, $W_N \neq 0$ because the displacement of the object is in the direction of the normal force.

## Problem 2

$W_g = 0$, because it is a round trip.

## Problem 3




$$\vec{V}_f = +\hat{i}\ 5.0\ \frac{m}{s}$$

$$\vec{V}_i = -\hat{i}\ 5.0\ \frac{m}{s}$$

$$\vec{J} = m\vec{V}_f - m\vec{V}_i$$

$$= (0.050)\ \hat{i}\ 5.0 - (-\hat{i})\ (0.050)\ 5.0$$

$$= \hat{i}\ 0.50\ kg\ \frac{m}{s}$$

## Problem 4

$v = \omega R$ (perfect rolling)

$v > \omega R$ (sliding)

$v < \omega R$ (slipping)

## Problem 5

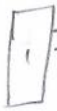
$$\Delta K = W_g + W_N \qquad W_N = 0$$

$$W_g = \Delta K = \frac{1}{2} m V_E^2 - \frac{1}{2} m V_e^2$$

$$= \frac{1}{2} (500.0) (12)^2 - \frac{1}{2} (500.0) (8.0)^2$$

$$= 2.0 \times 10^4 \text{ J}$$

## Problem 6




1- shooter
2- bullet

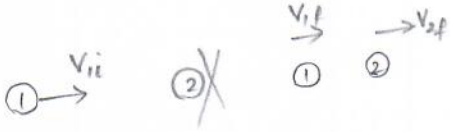
$$m_1 V_{1i} + m_2 V_{2i} = m_1 V_{1f} + m_2 V_{2f}$$

$$0 + 0 = m_1 V_{1f} + m_2 V_{2f}$$

$$V_{1f} = -\frac{m_2}{m_1} V_{2f}$$

$$= -\frac{(0.0050)}{75} (600.0) = -0.040 \frac{m}{s} = -4.0 \frac{cm}{s}$$

## Problem 7




$$V_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) V_{1i} + \left(\frac{2 m_2}{m_1 + m_2}\right) V_{2i}$$

$$= \left(\frac{25 - 75}{25 + 75}\right) (+4.0) + \frac{2(75)}{(25+75)} (0)$$

$$= -2.0 \frac{m}{s}$$

$$V_{2f} = \left(\frac{2 m_1}{m_1 + m_2}\right) V_{1i} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right) V_{2i}$$

$$= \frac{2(25)}{(25+75)} (+4.0) + \left(\frac{75 - 25}{25 + 75}\right) (0)$$

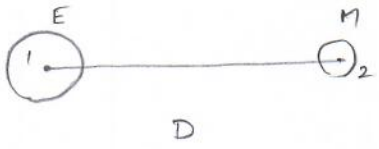
$$= +2.0 \frac{m}{s}$$

## Problem 8

$$x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2} \quad (x_1 = 0)$$

$$= \frac{0 + (7.4 \times 10^{22})\ 60.\ R_E}{(600 \times 10^{22} + 7.4 \times 10^{22})}$$

$$= 0.73\ R_E = 4.7 \times 10^6\ \text{m}$$ → from center of Earth.




$$D = 3.84 \times 10^8\ \text{m}$$

$$= \frac{3.84 \times 10^8}{6.4 \times 10^6} R_E = 60.\ R_E$$

## Problem 9

$\Delta\theta =$

$\Delta t = 8.00\ \text{s}$

$\omega_i = 0$

$\omega_f = 75.0\ \frac{\text{rad}}{\text{s}}$

$\alpha = ?$

$$\alpha = \frac{\omega_f - \omega_i}{\Delta t} = \frac{75.0 - 0}{8.00} = 9.4\ \frac{\text{rad}}{\text{s}^2}$$