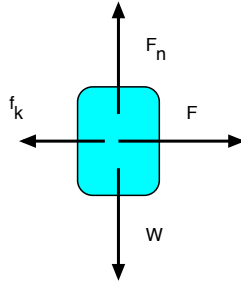


Your Name: _____

**PHY203
Exam #2
Chapters 6-8
Fri., 4/3/15**

Solutions



1. A 6.50 kg block is being pulled horizontally with a force of 55.0 N and is traveling to the right (positive x-direction) on a rough horizontal table with a *constant speed* of 0.750 m/s. The block travels a distance of 4.50 m in 6.00 s. Take up as the positive y-direction.

a. On the figure above, draw a free body diagram of the block as it is being pulled.

5

b. Calculate how much work is done by the pulling force. (magnitude and sign).

$$W = Fd = (55.0)(4.50) = 248 \text{ J}$$

5

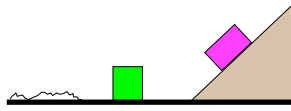
c. Calculate the work done by friction (magnitude and sign).

frictional force same so work is same but negative: -248 J **5**

d. Find the power exerted by the pulling force.

$$P = W/t = (248)/(6.00) = 41.2 \text{ W}$$

5



2. A block with mass of 3.50 kg slides down a frictionless ramp from a height of 1.50 m. The angle the ramp makes with the horizontal is 45° .
- a. Use Conservation of Energy to find the speed of the block at the bottom of the ramp assuming it started from rest.

$$E = mgy_o = \frac{1}{2}mv^2$$

$$v^2 = \frac{2mgy_o}{m} = \frac{2(1.50)(9.81)(1.50)}{1.50}$$

15

$$v = 5.42 \text{ m/s}$$

- b. While sliding on a frictionless floor, the block collides with and sticks to a block of mass 2.50 kg. Find the speed of the 2-block combination.

$$\vec{p}_i = \vec{p}_f = 0$$

$$m_1v_1 = (m_1 + m_2)v_2$$

10

$$v_2 = \frac{(3.50 \text{ kg})(5.42 \text{ m/s})}{6.00 \text{ kg}} = 3.16 \text{ m/s}$$

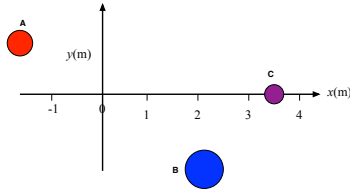
- c. The 2-block combination slides onto a rough patch with a coefficient of kinetic friction of 0.300. Use Conservation of Energy to find how far the blocks slide before coming to rest.

$$E = \frac{1}{2}mv^2 = f_k \Delta s = \mu_k mg \Delta s$$

$$\Delta s = \frac{v^2}{2\mu_k g} = \frac{(3.16)^2}{2(0.300)g}$$

15

$$= 1.70 \text{ m}$$



3. Balls are arranged as shown above: Ball A is 3.50 kg at $x = -1.50$ m, $y = 1.00$ m; Ball B is 5.50 kg at $x = 2.00$ m, $y = -1.00$ m; and Ball C is 2.00 kg at $x = 3.50$ m, $y = 0$.

a. Find the center of mass of the system and write it in *vector notation*.

$$x_{CM} = \frac{(3.50)(-1.50) + (5.50)(2.00) + (2.00)(3.50)}{11.0\text{kg}}$$

$$= 1.16\text{m}$$

20

$$y_{CM} = \frac{(3.50)(1.00) + (5.50)(-1.00) + 0}{11.0\text{kg}}$$

$$= -0.182\text{m}$$

$$\vec{r}_{CM} = 1.16m\hat{i} - 0.182m\hat{j}$$

b. The balls are connected by massless rods and the system is pushed from rest with a force of 55.0 N in the +y-direction for 0.300 s. Find the impulse and write it in vector notation.

$$\vec{I} = \vec{F}\Delta t$$

10

$$= (55.0N\hat{j})(0.300s) = 16.5Ns\hat{j}$$

c. Find the velocity of the center of mass after the impulse and write it in vector notation.

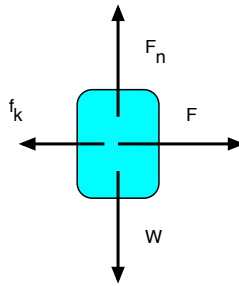
$$\vec{I} = \Delta\vec{p} = m\vec{v}$$

10

$$= 16.5Ns\hat{j} = (11.0\text{kg})\vec{v}$$

$$\vec{v} = 1.50\text{m} / s\hat{j}$$

Alt Solutions



1. A 6.50 kg block is being pulled horizontally with a force of 65.0 N and is traveling to the right (positive x-direction) on a rough horizontal table with a *constant speed* of 0.900 m/s. The block travels a distance of 4.50 m in 5.00 s. Take up as the positive y-direction.

a. On the figure above, draw a free body diagram of the block as it is being pulled.

5

b. Calculate how much work is done by the pulling force. (magnitude and sign).

$$W = Fd = (65.0)(4.50) = 292 \text{ J}$$

5

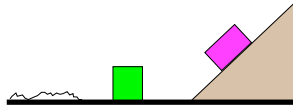
c. Calculate the work done by friction (magnitude and sign).

frictional force same so work is same but negative: -292 J **5**

d. Find the power exerted by the pulling force.

$$P = W/t = (292)/(5.00) = 58.4 \text{ W}$$

5



2. A block with mass of 3.50 kg slides down a frictionless ramp from a height of 2.50 m. The angle the ramp makes with the horizontal is 45° .
- a. Use Conservation of Energy to find the speed of the block at the bottom of the ramp assuming it started from rest.

$$E = mgy_o = \frac{1}{2}mv^2$$

$$v^2 = \frac{2mgy_o}{m} = \frac{2(3.50)(9.81)(2.50)}{3.50} \quad \mathbf{15}$$

$$v = 7.00m/s$$

- b. While sliding on a frictionless floor, the block collides with and sticks to a block of mass 2.50 kg. Find the speed of the 2-block combination.

$$\vec{p}_i = \vec{p}_f = 0$$

$$m_1v_1 = (m_1 + m_2)v_2 \quad \mathbf{10}$$

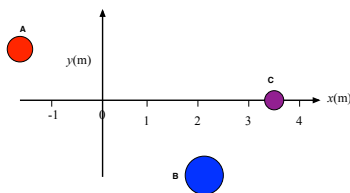
$$v_2 = \frac{(3.50kg)(7.00m/s)}{6.00kg} = 4.09m/s$$

- c. The 2-block combination slides onto a rough patch with a coefficient of kinetic friction of 0.250. Use Conservation of Energy to find how far the blocks slide before coming to rest.

$$E = \frac{1}{2}mv^2 = f_k\Delta s = \mu_k mg\Delta s$$

$$\Delta s = \frac{v^2}{2\mu_k g} = \frac{(4.09)^2}{2(0.250)g} \quad \mathbf{15}$$

$$= 3.40m$$



3. Balls are arranged as shown above: Ball A is 4.50 kg at $x = -1.50$ m, $y = 1.00$ m; Ball B is 6.50 kg at $x = 2.00$ m, $y = -1.00$ m; and Ball C is 3.00 kg at $x = 3.50$ m, $y = 0$.

a. Find the center of mass of the system and write it in *vector notation*.

$$x_{CM} = \frac{(4.50)(-1.50) + (6.50)(2.00) + (3.00)(3.50)}{14.0\text{kg}}$$

$$= 1.20\text{m}$$

20

$$y_{CM} = \frac{(4.50)(1.00) + (6.50)(-1.00) + 0}{14.0\text{kg}}$$

$$= -0.143\text{m}$$

$$\vec{r}_{CM} = 1.20\text{m}\hat{i} - 0.143\text{m}\hat{j}$$

b. The balls are connected by massless rods and the system is pushed from rest with a force of 65.0 N in the +y-direction for 0.300 s. Find the impulse and write it in vector notation.

$$\vec{I} = \vec{F}\Delta t$$

10

$$= (65.0\text{N}\hat{j})(0.300\text{s}) = 19.5\text{Ns}\hat{j}$$

c. Find the velocity of the center of mass after the impulse and write it in vector notation.

$$\vec{I} = \Delta\vec{p} = m\vec{v}$$

10

$$= 19.5\text{Ns}\hat{j} = (14.0\text{kg})\vec{v}$$

$$\vec{v} = 1.39\text{m/s}\hat{j}$$