Your Name: ________________________

PHY203
Exam #2
Chapters 4-7
Fri., 10/24/14

Solutions

1. Given these vectors:

$\mathbf{F_1}$ = 3.50**i** + 6.00**j**
$\mathbf{F_2}$ = -2.50**i** + 4.00**j**
D = 9.50**i** - 1.75**j**

For parts a. and b., assume the two forces, $\mathbf{F_1}$ and $\mathbf{F_2}$, act on a block of mass 3.50 kg.

a. Find the acceleration of the block in vector notation.

$$\vec{a} = \frac{1}{3.50}[(3.50\hat{i} + 6.00\hat{j}) + (-2.50\hat{i} + 4.00\hat{j})]$$
$$= \frac{1}{3.50}[(1.00\hat{i} + 10.0\hat{j})] = (0.286\hat{i} + 2.86\hat{j})m/s^2$$

10

b. Assuming the block started from rest at x=y=0, find the position of the block in vector notation after the force has been applied for 6.00 s.

$$\vec{r} = 0 + 0 + [(0.286\hat{i} + 2.86\hat{j})m/s^2](6.00)^2$$
$$= (5.15\hat{i} + 51.5\hat{j})m$$

5

For parts c. and d., assume the force, $\mathbf{F_1}$, acts on a block of mass 3.50 kg for 8.50 s with the resulting displacement given by vector, **D**.

c. Find the work done by the force.

$$W = (3.50\hat{i} + 6.00\hat{j}) \bullet (9.50\hat{i} - 1.75\hat{j})]$$
$$= 22.8J$$

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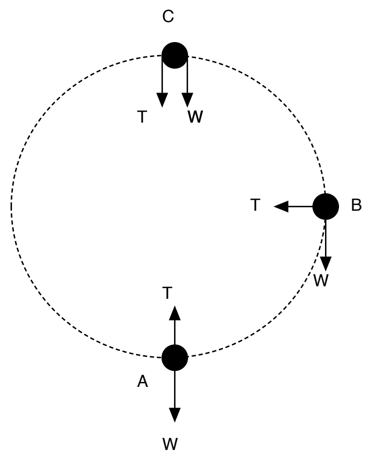
d. Find the power.

P = W/t = 22.8/8.50 = 2.68 W **5**



2. A ball with mass 0.500 kg is attached to a light string and is swung in a vertical circle (+y is the "up" direction) with a radius of 1.50 m and a constant speed of 6.50 m/s.
a. On the sketch above, draw free-body diagrams for the ball at positions A, B, and C.

9

b. Find the magnitude of the tension in the string when the ball is at point A.

$$T - mg = \frac{mv^2}{r}$$

7

$$T = (0.500)[9.81 + \frac{(6.50)^2}{1.50}] = 19.0N$$

c. Find the magnitude of the tension in the string when the ball is at point B.

$$T = \frac{mv^2}{r}$$

7

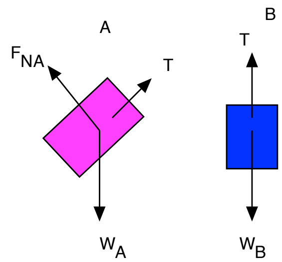
$$T = 0.500\frac{(6.50)^2}{1.50} = 14.1N$$

d. Find the magnitude of the tension in the string when the ball is at point C.

$$T + mg = \frac{mv^2}{r}$$

7

$$T = (0.500)[-9.81 + \frac{(6.50)^2}{1.50}] = 9.18N$$



3. Two blocks with masses m_A and m_B are attached by a light string. The frictionless ramp makes an angle θ with respect to the horizontal direction.
a. On the separate blocks above to the right, draw free-body diagrams for both blocks. Make it clear in what directions forces are pointing.

10

b. Write out Newton's 2nd Law for both blocks in all directions using the coordinate systems in the sketch.

$$A : x : T - m_A g \sin\theta = m_A a$$
$$y : m_A g \cos\theta - F_{NA} = 0$$
$$B : y : m_B g - T = m_B a$$

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c. Assuming m_A =6.00 kg, m_B = 8.00 kg, and the ramp angle is $\theta = 30^o$, use conservation of energy to find the speed of the blocks after the blocks have been released and have traveled a distance of 2.00 m. Assume that the blocks start at the same height = 0.

$$E = m_A g h_{Ao} + m_B g h_{Bo} = 0$$
$$= m_A g h_A + m_B g h_B + \frac{1}{2}(m_A + m_B)v^2$$
$$v^2 = \frac{2g[(8.00)(2.00) - (6.00)(2.00)(\sin 30^o)]}{6.00 + 8.00}$$
$$v = 3.74 m/s$$

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Alt Version

1. Given these vectors:

$\mathbf{F_1}$ = 4.50**i** + 7.00**j**
$\mathbf{F_2}$ = -2.50**i** + 4.00**j**
D = 9.50**i** - 1.75**j**

For parts a. and b., assume the two forces, $\mathbf{F_1}$ and $\mathbf{F_2}$, act on a block of mass 3.50 kg.

a. Find the acceleration of the block in vector notation.

$$\vec{a} = \frac{1}{3.50}[(4.50\hat{i} + 7.00\hat{j}) + (-2.50\hat{i} + 4.00\hat{j})]$$
$$= \frac{1}{3.50}[(2.00\hat{i} + 11.0\hat{j})] = (0.572\hat{i} + 3.14\hat{j})m/s^2$$

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b. Assuming the block started from rest at x=y=0, find the position of the block in vector notation after the force has been applied for 6.00 s.

$$\vec{r} = 0 + 0 + [(0.572\hat{i} + 3.14\hat{j})m/s^2](6.00)^2$$
$$= (10.3\hat{i} + 56.6\hat{j})m$$

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For parts c. and d., assume the force, $\mathbf{F_1}$, acts on a block of mass 3.50 kg for 8.50 s with the resulting displacement given by vector, **D**.

c. Find the work done by the force.

$$W = (4.50\hat{i} + 7.00\hat{j}) \bullet (9.50\hat{i} - 1.75\hat{j})]$$
$$= 30.5J$$

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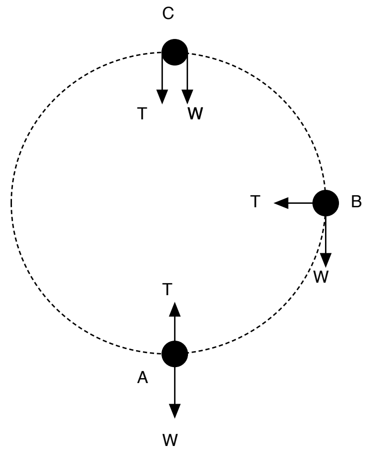
d. Find the power.

P = W/t = 30.5/8.50 = 3.59 W **5**



2. A ball with mass 0.500 kg is attached to a light string and is swung in a vertical circle (+y is the "up" direction) with a radius of 1.50 m and a constant speed of 7.50 m/s.

a. On the sketch above, draw free-body diagrams for the ball at positions A, B, and C.

9

b. Find the magnitude of the tension in the string when the ball is at point A.

$$T - mg = \frac{mv^2}{r}$$

7

$$T = (0.500)[9.81 + \frac{(7.50)^2}{1.50}] = 23.7N$$

c. Find the magnitude of the tension in the string when the ball is at point B.

$$T = \frac{mv^2}{r}$$

7

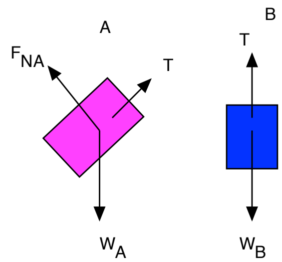
$$T = 0.500\frac{(7.50)^2}{1.50} = 18.8N$$

d. Find the magnitude of the tension in the string when the ball is at point C.

$$T + mg = \frac{mv^2}{r}$$

7

$$T = (0.500)[-9.81 + \frac{(7.50)^2}{1.50}] = 13.8N$$



3. Two blocks with masses m_A and m_B are attached by a light string. The frictionless ramp makes an angle θ with respect to the horizontal direction.
a. On the separate blocks above to the right, draw free-body diagrams for both blocks. Make it clear in what directions forces are pointing.

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b. Write out Newton's 2nd Law for both blocks in all directions using the coordinate systems in the sketch.

$$A : x : T - m_A g \sin\theta = m_A a$$
$$y : m_A g \cos\theta - F_{NA} = 0$$
$$B : y : m_B g - T = m_B a$$

10

c. Assuming m_A =7.00 kg, m_B = 9.00 kg, and the ramp angle is θ = 30°, use conservation of energy to find the speed of the blocks after the blocks have been released and have traveled a distance of 2.50 m. Assume that the blocks start at the same height = 0.

$$E = m_A g h_{Ao} + m_B g h_{Bo} = 0$$
$$= m_A g h_A + m_B g h_B + \frac{1}{2}(m_A + m_B)v^2$$
$$v^2 = \frac{2g[(9.00)(2.50) - (7.00)(2.50)(\sin 30^o)]}{7.00 + 9.00}$$
$$v = 4.11 m/s$$

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