Your Name: _____

PHY203

Exam #2
Chapters 4-7
Fri., 10/27/17

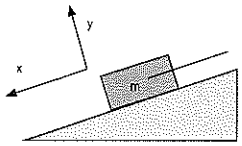
1 _____ (out of 40)

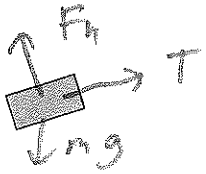
2 _____ (out of 30)

3 _____ (out of 30)

Solutions

Exam2F17





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1. A 5.50 kg block is placed at rest on a frictionless ramp which makes an angle of 50.0° with respect to the horizontal. A string is attached to the block as shown. As the block slides down the ramp, the tension in the string is maintained at a constant value of 35.0 N.

a. Draw a free body diagram for the block on the block above and to the right.

mg mT

10

b. Write out Newton's 2nd Law for the block in the x- and y-directions using the coordinate system above.

$x: \quad mg\sin\theta - T = ma$ 10

$y: \quad F_n - mg\cos\theta = 0$ 10

c. Find the magnitude of the normal force on the block.

$F_n = (5.50)g\cos(50.0)$ 5

$= 34.7\,N$

d. Find the magnitude of the acceleration of the block.

$a = g\sin\theta - \frac{T}{m}$

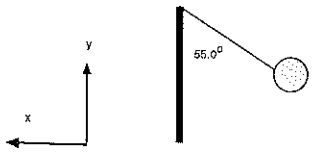
$= g\sin(50.0) - \frac{35.0}{5.50}$ 5

$= 1.15\,m/s^2$

e. Find the distance the block travels along the ramp in 1.50 s.

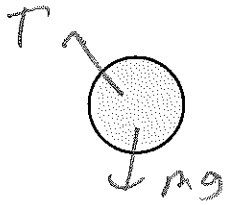
$x = 0 + 0 + \frac{1}{2}(1.15)(1.50)^2$ 5

$= 1.30\,m$



2. A ball of mass m is attached to a vertical pole with a length of string L and spun with a constant speed v. in a horizontal circle,

a. Draw a free body diagram of the ball below:



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b. Write expressions for Newton's 2nd Law in the x- and y-directions.

x: $T\sin\theta = ma = \frac{mv^2}{r}$ 5

y: $T\cos\theta - mg = 0$ 5

Assume that m = 2.50 kg, and L = 1.55 m.

c. Find the magnitude of the tension in the string.

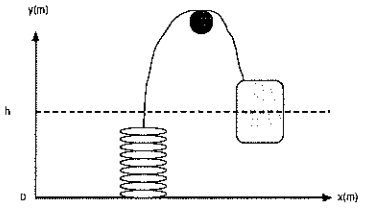
$T = \frac{mg}{\cos\theta} = \frac{(2.50)g}{\cos(55.0)} = 42.8\,N$ 5

d. Find the speed of the ball.

$v^2 = \frac{rT\sin\theta}{m} = \frac{LT\sin^2\theta}{m}$ 10

$= \frac{(1.55)(42.8)\sin^2(55.0)}{2.50}$

$v = 4.22\ m/s$



3. A block of mass m is attached to a string which goes over a pulley and then attaches to a spring with spring constant k. Initially the block is held a distance h above ground level as shown such that the spring is neither compressed nor extended.

a. Assuming that m = 8.50 kg, h = 2.50 m, and k = 50.0 N/m, find the initial energy of the system.

$E = U = mgh$

$= (8.50)g(2.50)$ 10

$= 208\ J$

b. The block is released. Find the speed of the block just before it hits the ground.

$E_i = 208\ J$

$E_f = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

$= \left(\frac{8.50}{2}\right)v^2 + \frac{1}{2}(50.0)(2.50)^2$ 20

$= 208$

$v^2 = \left(\frac{2}{8.50}\right)\left[208 - \left(\frac{50}{2}\right)(2.50)^2\right]$

$v = 3.99\ m/s$

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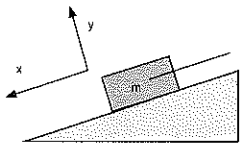
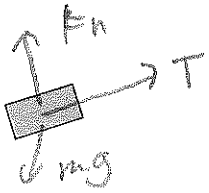
Alt Solutions

Exam2F17





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1. A 7.50 kg block is placed at rest on a frictionless ramp which makes an angle of 50.0° with respect to the horizontal. A string is attached to the block as shown. As the block slides down the ramp, the tension in the string is maintained at a constant value of 40.0 N.

a. Draw a free body diagram for the block on the block above and to the right.

b. Write out Newton's 2nd Law for the block in the x- and y-directions using the coordinate system above.

x: $mg\sin\theta - T = ma$ 10

y: $F_n - mg\cos\theta = 0$ 10

c. Find the magnitude of the normal force on the block.

$F_n = (7.50)\,g\cos(50.0)$

$= 47.3\ N$ 5

d. Find the magnitude of the acceleration of the block.

$a = g\sin\theta - \frac{T}{m}$

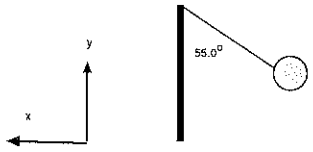
$= g\sin(50.0) - \frac{40.0}{7.50}$ 5

$= 2.18\ m/s^2$

e. Find the distance the block travels along the ramp in 1.75 s.

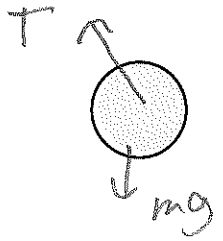
$x = 0 + 0 + \frac{1}{2}(2.18)(1.75)^2$

$= 3.34\ m$ 5



2. A ball of mass m is attached to a vertical pole with a length of string L and spun with a constant speed v. m a horizontal circle

a. Draw a free body diagram of the ball below:



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b. Write expressions for Newton's 2nd Law in the x- and y-directions.

$x: \quad T\sin\theta = ma = \frac{mv^2}{r}$ 5

$y: \quad T\cos\theta - mg = 0$ 5

Assume that m = 3.50 kg, and L = 1.25 m.

c. Find the magnitude of the tension in the string.

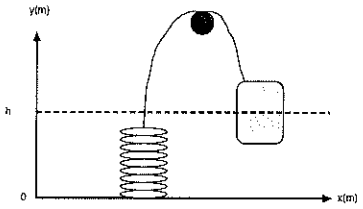
$T = \frac{mg}{\cos\theta} = \frac{(3.50)g}{\cos(55.0)} = 60.0\ N$ 5

d. Find the speed of the ball.

$v^2 = \frac{rT\sin\theta}{m}$ 10

$= \frac{LT\sin^2\theta}{m} = \frac{(1.25)(60.0)\sin^2(55.0)}{3.50}$

$v = 3.79\ m/s$



3. A block of mass m is attached to a string which goes over a pulley and then attaches to a spring with spring constant k. Initially the block is held a distance h above ground level as shown such that the spring is neither compressed nor extended.

a. Assuming that m = 7.50 kg, h = 1.50 m, and k = 50.0 N/m, find the initial energy of the system.

$E = U = mgh$ 10

$= (7.50)g(1.50)$

$= 110\ J$

b. The block is released. Find the speed of the block just before it hits the ground.

$E_i = 110\ J$

$E_f = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$

$= \left(\frac{7.50}{2}\right)v^2 + \frac{1}{2}(50.0)(1.50)^2$ 20

$= 110\ J$

$v^2 = \left(\frac{2}{7.50}\right)\left[110 - \left(\frac{50.0}{2}\right)(1.50)^2\right]$

$v = 3.79\ m/s$