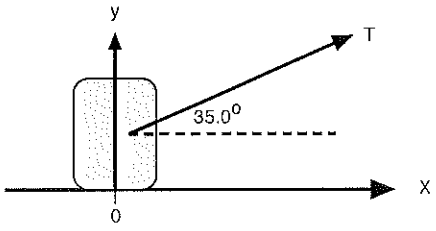
Your Name: _____

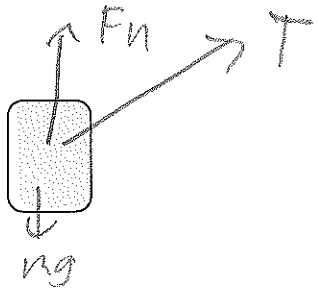
PHY203

Exam #2
Chapters 4-7
Fri., 3/23/18

Solutions

Exam2S18





1. A block of mass m is at rest on a frictionless surface. A string is attached to the block and the string is pulled at an angle of 35.0°. The block slides across the surface.

a. Above and to the right draw a free body diagram of the block while it is sliding. 5

b. Write out Newton's 2nd Law for the block in both directions while it is sliding.

x: $T\cos 35^\circ = ma$ 5

y: $F_n + T\sin 35^\circ - mg = 0$ 5

Assume m=4.50 kg and T=30.0 N.

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

$F_n = mg - T\sin 35^\circ$

$= (4.50)g - (30.0)\sin 35^\circ = 26.9\ N$ 5

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

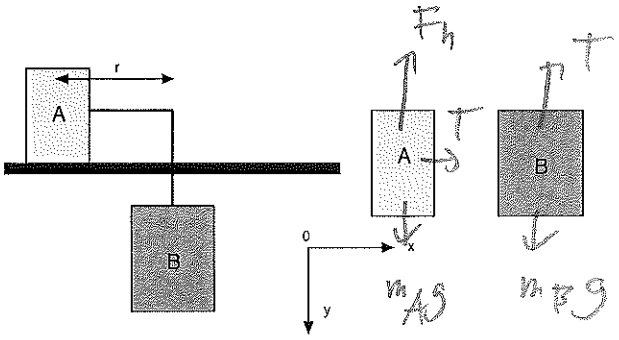
$a = \frac{1}{m}(T\cos 35^\circ)$

$= \frac{1}{4.50}(30.0\cos 35^\circ) = 5.46\ \frac{m}{s^2}$ 5

e. Find the distance the block travels in 15.0 s.

$x = \frac{1}{2}at^2 = \frac{1}{2}(5.46)(15.0)^2$

$= 614\ m$ 5



2. A block of mass, M_A, is connected by a light string to a block of mass M_B, which is suspended beneath the table through a hole in the center. Block B is not moving in the vertical direction. Block A is sliding around in a circle of radius, r, on a frictionless surface.

a. Draw free body diagrams on the blocks above and to the right. 5

b. Write out Newton's 2nd Law for both blocks in both directions.

A: x: $T = m_A a = \frac{m_A v^2}{r}$ 5

y: $m_A g - F_n = 0$ 5

B: y: $m_B g - T = 0$ 5

Given M_A=6.50 kg, M_B=9.00 kg, and r=0.750 m.

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

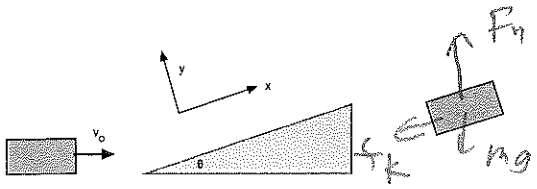
$T = m_B g = (9.00) g = 88.3\ N$ 5

d. Find the speed of block A.

$T = \frac{m_A v^2}{r}$

$v^2 = \frac{rT}{m_A} = \frac{(.750)(88.3)}{6.50}$ 5

$v = 3.19\ \frac{m}{s}$



3. A block of mass m is traveling on a horizontal, frictionless surface at a speed v. It encounters a rough ramp which makes an angle θ with respect to the horizontal. The coefficient of kinetic friction between block and ramp is μ_k. The block slides up the ramp a length L before coming (momentarily) to rest.

a. Above and to the right draw a free body diagram of the block while it is sliding up the ramp. 5

b. Write out Newton's 2nd Law for the block in both directions while it is sliding up the ramp.

x: $-f_k - mg\sin\theta = ma$ 5

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

Assume m=4.00 kg, L=27.5 m, θ = 37.5°, and v=20.5 m/s.

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

$F_n = (4.00)g\cos(37.5^\circ) = 31.1\,N$ 5

d. Using energy conservation, find the coefficient of friction, μ_k.

$\frac{1}{2}mv^2 = mgH + f_k\Delta s$

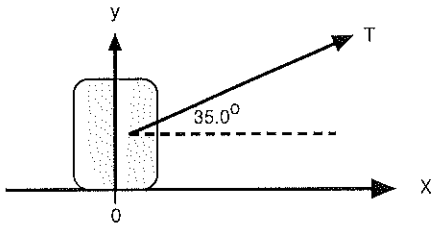
$= mgL\sin\theta + \mu_k mg\cos\theta L$ 20

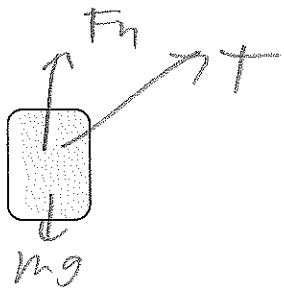
$\frac{v^2}{2} - gL\sin\theta = \mu_k g\cos\theta L$

$\frac{(20.5)^2}{2} - g(27.5)\sin 37.5^\circ = \mu_k g(\cos 37.5^\circ)(27.5)$

$\mu_k = 0.214$

Exam2S18alt





1. A block of mass m is at rest on a frictionless surface. A string is attached to the block and the string is pulled at an angle of 35.0°. The block slides across the surface.

a. Above and to the right draw a free body diagram of the block while it is sliding. 5

b. Write out Newton's 2nd Law for the block in both directions while it is sliding.

x: $T\cos 35^\circ = ma$ 5

y: $F_n + T\sin 35^\circ - mg = 0$ 5

Assume m=5.50 kg and T=40.0 N.

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

$F_n = mg - T\sin 35^\circ$

$= (5.50)g - (40.0)\sin 35^\circ = 31.0\ N$ 5

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

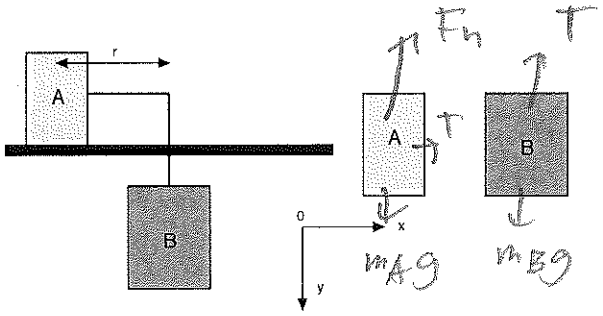
$a = \frac{1}{m} T\cos 35^\circ$

$= \frac{1}{5.50}(40.0\cos 35^\circ) = 5.96\ \frac{m}{s^2}$ 5

e. Find the distance the block travels in 18.0 s.

$x = \frac{1}{2}at^2 = \frac{1}{2}(5.96)(18.0)^2$

$= 965\ m$ 5



2. A block of mass, M_A, is connected by a light string to a block of mass M_B, which is suspended beneath the table through a hole in the center. Block B is not moving in the vertical direction. Block A is sliding around in a circle of radius, r, on a frictionless surface.

a. Draw free body diagrams on the blocks above and to the right. 5

b. Write out Newton's 2nd Law for both blocks in both directions.

A: x: $T = m_A a = \frac{m_A v^2}{r}$ 5

y: $m_A g - F_n = 0$ 5

B: y: $m_B g - T = 0$ 5

Given M_A=7.50 kg, M_B=9.50 kg, and r=1.25 m.

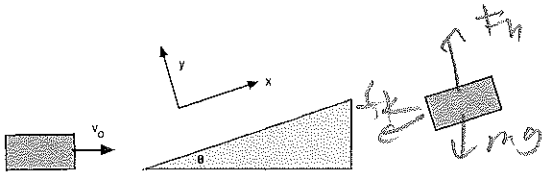
c. Find the magnitude of the tension in the string.

$T = m_B g = (9.50)g = 93.2N$ 5

d. Find the speed of block A.

$v^2 = \frac{Tr}{m_A} = \frac{(93.2)(1.25)}{7.50}$ 5

$v = 3.94 m/s$



3. A block of mass m is traveling on a horizontal, frictionless surface at a speed v. It encounters a rough ramp which makes an angle θ with respect to the horizontal. The coefficient of kinetic friction between block and ramp is μ_k. The block slides up the ramp a length L before coming (momentarily) to rest.

a. Above and to the right draw a free body diagram of the block while it is sliding up the ramp. 5

b. Write out Newton's 2nd Law for the block in both directions while it is sliding up the ramp.

x: $-f_k - mg\sin\theta = ma$ 5

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

Assume m=4.50 kg, L=25.0 m, θ = 37.5°, and v=22.5 m/s.

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

$f_n = (4.50)g\cos(37.5) = 35.0\,N$ 5

d. Using energy conservation, find the coefficient of friction, μ_k.

$\frac{1}{2}mv^2 = mgH + f_k s$

$= mgL\sin\theta + \mu_k mg\cos\theta L$

$\frac{v^2}{2} - gL\sin\theta = \mu_k g\cos\theta L$ 20

$\frac{(22.5)^2}{2} - g(25.0)\sin(37.5) = \mu_k g\cos(37.5)(25.0)$

$\mu_k = 0.534$