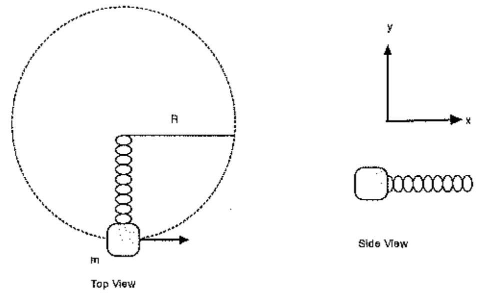
Your Name: ______________________

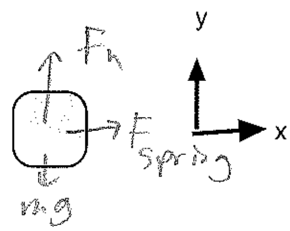
PHY203

Exam #2
Chapters 4-7
Fri., 3/31/17

Solutions



1. A block of mass m=0.750 kg is attached to a spring and rotated on a horizontal, frictionless table at a constant speed of 6.50 m/s. The radius of the circle is R=1.25 m and the uncompressed length of the spring is 0.350 m.
a. Below, draw a free body diagram of the block in the position depicted.



Side View

5

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

x: $F_{spring} = kx = ma = \frac{mv^2}{r}$

10

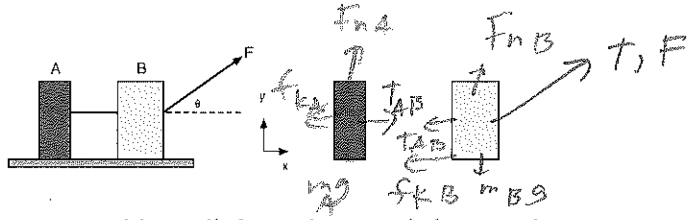
y: $F_n - mg = 0$

c. Find the spring constant of the spring.

$$k = \frac{mv^2}{rx} = \frac{(0.750)(6.50)^2}{(1.25)(1.25-.350)}$$

10

$$= 28.2\ \frac{N}{m}$$



2. Two blocks are connected by a light string and dragged across a rough surface by another light string which is pulled with a force F at an angle θ, as shown. The coefficient of kinetic friction between blocks (masses m_A and m_B) and surface is μ_k.

a. Above and to the right, draw free body diagrams of the two blocks. 10

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

A: x: $T_{AB} - f_{kA} = m_A a$

y: $F_{nA} - m_A g = 0$ 20

B: x: $F\cos\theta - f_{kB} - T_{AB} = m_B a$

y: $F_{nB} + F\sin\theta - m_B g = 0$

Assume F=105 N, θ,= 35.0°, m_A=5.50 kg, m_B =8.50 kg, and μ_k.=0.400.

c. Find the magnitude of the acceleration of the blocks.

$F_{nA} = (5.50)g = 54.0\ N$

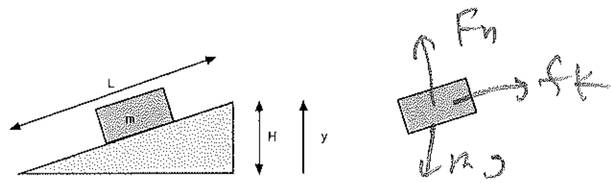
$F_{nB} = (8.50)g - (105)\sin(35.0°) = 23.2\ N$ 10

Ax: $T_{AB} - \mu_k(54.0) = m_A a$

Bx: $105\cos\theta - \mu_k(23.2) - T_{AB} = m_B a$

$105\cos(35.0) - (0.400)(54.0 + 23.2) = (5.50 + 8.50)a$

$a = 3.94\ m/s^2$



3. A block of mass m is at rest at a height H at the top of a rough ramp with a length L. The block is then released and slides down the ramp leaving the ramp with a speed v. The coefficient of kinetic friction between block and ramp is μ_k. Assume m=4.00 kg, H=15.5m, L=27.5 m, and v=12.5 m/s.

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

b. Find the initial energy of the block before it starts sliding. Assume y=0 at the bottom of the ramp.

$E = mgh = (4.00)g(15.5) = 608\ J$ 5

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

$F_n = mg\cos\theta$

$\theta = \sin^{-1}\left(\frac{15.5}{27.5}\right) = 34.3^\circ$ 10

$F_n = (4.00)g\cos(34.3) = 32.4\ N$

d. Using Conservation of Energy, find the coefficient of friction, μ_k.

$608 = \frac{1}{2}mv^2 + f_k\Delta s$ 15

$= \frac{1}{2}(4.00)(12.5)^2 + \mu_k(32.4)(27.5)$

$\mu_k = 0.332$