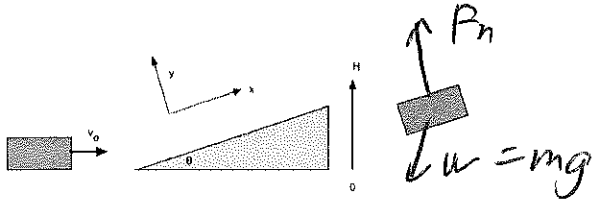
Your Name: _____

PHY203

Exam #2
Chapters 4-7
Fri., 10/26/18

Solutions



1. A block of mass 15.5 kg is sliding along a frictionless floor with a speed of 25.5 m/s. It slides up a frictionless ramp (which makes an angle of 35.0° with the horizontal) until it stops (momentarily).

a. While the block is sliding up the ramp, what are the forces acting on the block?

weight, normal force 5

b. On the figure above and to the right draw a free body diagram while the block is sliding up the ramp. 5

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

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

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

d. Find the magnitude of the acceleration of the block while it is on the ramp.

$a = -g\sin\theta$, $g\sin\theta = g\sin(35^\circ)$ 5

$= 5.63\ m/s^2$

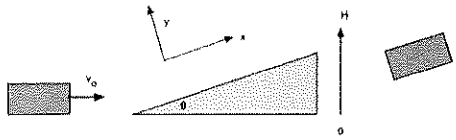
e. Using forces and kinematics, find the maximum <u>height</u> the block reaches before it starts to slide down again.

$0 = (25.5)^2 + 2a\Delta x$

$= (25.5)^2 - 2(5.63)\Delta x$ 10

$\Delta x = 57.7\ m$

$H = \Delta x \sin 35^\circ = 33.1\ m$



2. A block of mass 15.5 kg is sliding along a frictionless floor with a speed of 25.5 m/s. It slides up a frictionless ramp (which makes an angle of 35.0° with the horizontal) until it stops (momentarily).

a. While the block is sliding on the floor, what non-zero form(s) of energy are involved?

kinetic energy 4

b. While the block is sliding on the ramp, what non-zero form(s) of energy are involved?

KE, potential energy due to gravity 6

c. Using Conservation of Energy, find the maximum height the block reaches before it starts to slide down again.

$$\frac{1}{2} m v^2 = mgH$$

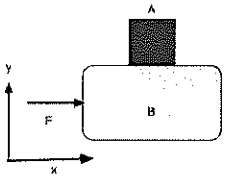
$$H = \frac{(25.5)^2}{2g}$$

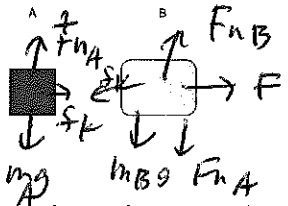
$$= 33.1 \text{ m}$$

10

D . Briefly compare and discuss your final answers from Problems 1 and 2.

Answers to problems 1 & 2 should be the same. Same problem - different methods 5





3. Block A (mass M_A) is sliding across the rough surface on the top of block B (mass M_B) (with the coefficient of kinetic friction between block A and top of block B μ_k). Block B is sliding on a frictionless surface. Block B is being pushed with a force F.

a. Draw free body diagrams of the blocks on the figure up and to the right. 4

b. Write out Newton's 2nd Law for both blocks in both directions. Be sure to label the parameters as A or B when they are different. (Hint: the accelerations of the two blocks are not the same.)

A: x: $f_k = m_A a_A$

y: $F_{nA} - m_A g = 0$ 16

B: x: $F - f_k = m_B a_B$

y: $F_{nB} - m_B g - F_{nA} = 0$

Given M_A=5.50 kg, M_B=7.50 kg, F=55.0 N, and μ_k =0.350

c. Find the magnitudes of the normal forces on blocks A and B.

$F_{nA} = (5.50)g = 54.0\ N$ 6

$F_{nB} = (5.50+7.50)g = 128\ N$

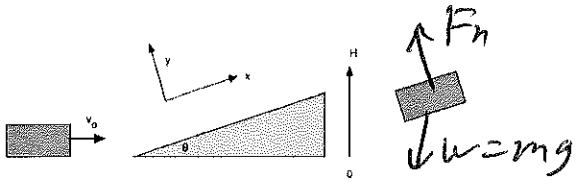
d. Find the magnitude of the frictional force between blocks A and B.

$f_k = \mu_k F_n = (0.350)(54.0) = 18.9\ N$ 4

e. Find the magnitudes of the accelerations of the blocks.

$a_A = \frac{f_k}{m_A} = \frac{18.9}{5.5} = 3.44\ m/s^2$

$a_B = \frac{F - f_k}{m_B} = \frac{55.0 - 18.9}{7.50} = 4.81\ \frac{m}{s^2}$ 10



1. A block of mass 17.5 kg is sliding along a frictionless floor with a speed of 20.5 m/s. It slides up a frictionless ramp (which makes an angle of 35.0° with the horizontal) until it stops (momentarily).

a. While the block is sliding up the ramp, what are the forces acting on the block?

weight, normal force 5

b. On the figure above and to the right draw a free body diagram while the block is sliding up the ramp. 5

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

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

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

d. Find the magnitude of the acceleration of the block while it is on the ramp.

$|a| = g\sin\theta = g\sin(35.0)$

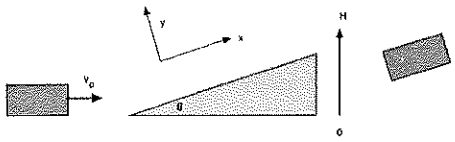
$= 5.63\ m/s^2$ 5

e. Using forces and kinematics, find the maximum <u>height</u> the block reaches before it starts to slide down again.

$0 = 20.5^2 - 2(5.63)(\Delta x)$

$\Delta x = 37.3\ m$

$H = \Delta x \sin\theta = 21.4\ m$ 10



2. A block of mass 17.5 kg is sliding along a frictionless floor with a speed of 20.5 m/s. It slides up a frictionless ramp (which makes an angle of 35.0° with the horizontal) until it stops (momentarily).

a. While the block is sliding on the floor, what non-zero form(s) of energy are involved?

Kinetic Energy 4

b. While the block is sliding on the ramp, what non-zero form(s) of energy are involved?

KE, pot. energy due to gravity 6

c. Using Conservation of Energy, find the maximum height the block reaches before it starts to slide down again.

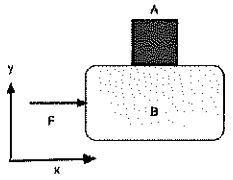
$$\frac{1}{2} m v^2 = mgH$$

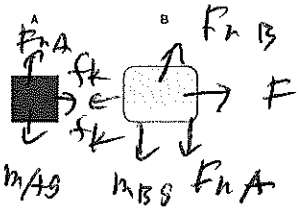
$$H = \frac{v^2}{2g} = \frac{20.5^2}{2g}$$ 10

$$= 21.7 \text{ m}$$

d. Briefly compare and discuss your final answers from Problems 1 and 2.

Should have same answers to #1 and #2. Different methods. 5





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A: x: $f_k = m_A a_A$

y: $F_{n\,A} - m_A g = 0$

B: x: $F - f_k = m_B a_B$

y: $F_{N\,B} - m_B g - F_{n\,A} = 0$ 16

Given M_A=6.50 kg, M_B=8.50 kg, F=65.0 N, and μ_k =0.250

c. Find the magnitudes of the normal forces on blocks A and B.

$F_{N\,a} = (6.50)\,g = 63.8\ N$

$F_{N\,B} = (6.50 + 8.50)\,g = 127\ N$ 6

d. Find the magnitude of the frictional force between blocks A and B.

$f_k = \mu_k F_n = (.250)(63.8) = 16.0\ N$ 4

e. Find the magnitudes of the accelerations of the blocks.

A: $a = \frac{f_k}{m_A} = \frac{16.0}{6.50} = 2.46\ m/s^2$

B: $a = \frac{F - f_k}{m_B} = \frac{65.0 - 16.0}{8.50}$

$= 5.76\ m/s^2$ 10