

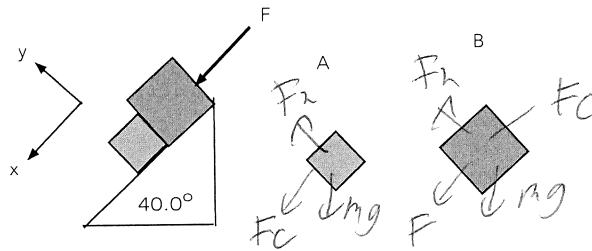
Your Name: _____

PHY203

Exam #2
Chapters 5-8
10/28/22

Solutions

Exam2F22



1. Blocks A and B are in contact and block B is being pushed down a smooth ramp which makes an angle of 40.0° with respect to the horizontal by a force, F , which is parallel to the ramp.

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

b. Write out Newton's 2nd Law for both blocks in the x- and y-directions. 15

$$A: \quad x: \quad F_c + m_A g \sin 40^\circ = m_A a$$

$$y: \quad F_n - m_A g \cos 40^\circ = 0$$

$$B: \quad x: \quad F - F_c + m_B g \sin 40^\circ = m_B a$$

$$y: \quad F_n - m_B g \cos 40^\circ = 0$$

c. Assuming that $m_A = 5.50 \text{ kg}$, $m_B = 8.50 \text{ kg}$, and $F = 125 \text{ N}$, find the magnitude of the acceleration of the blocks and the magnitude of the contact force between the blocks.

10

Combine x equations!

$$F + (m_A + m_B) g \sin 40^\circ = (m_A + m_B) a$$

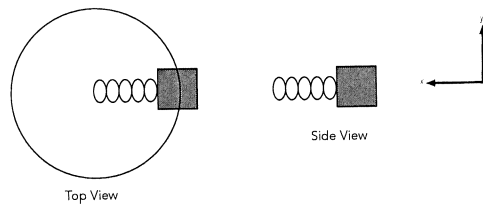
$$a = \frac{F}{(m_A + m_B)} + g \sin 40^\circ$$

$$= \frac{125}{14.0} + 9.8 \sin 40^\circ = 15.2 \text{ m/s}^2$$

Insert into A's x!

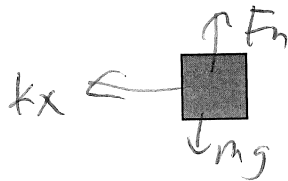
$$F_c = m_A (a - g \sin 40^\circ)$$

$$= 5.50 (15.2 - 9.8 \sin 40^\circ) = 48.9 \text{ N}$$



2. A block of mass $m=0.750$ kg is attached to a spring and is rotating 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 side view position depicted above. **5**



b. Write out Newton's 2nd Law for the block in the x- and y-directions. **15** 10

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

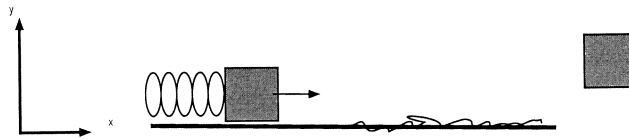
$$y: \quad F_n - mg = 0$$

c. Find the spring constant of the spring. **5** 10

$$k = \frac{mv^2}{xr} = \frac{(0.750)(6.50)^2}{(0.900)(1.25)} = 28.214 \text{ /m}$$

d. Find the period of the block's motion. **5**

$$T = \frac{2\pi r}{v} = \frac{2\pi \cdot (1.25)}{6.50} = 1.21 \text{ s}$$



3. A block of mass 2.50 kg is resting on a horizontal, frictionless floor. It is attached to a spring with spring constant 500 N/m. The block is pushed with a force F , compressing the spring by 0.250 m.

a. Find the magnitude of the pushing force, F . **5**

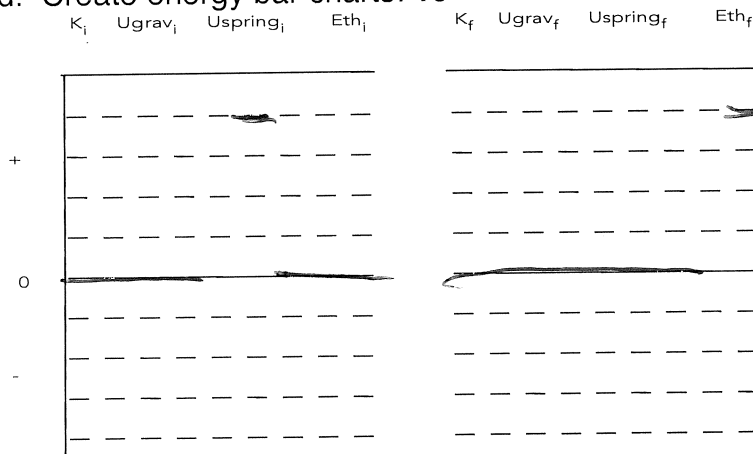
$$F = kx = (0.250)(500) = 125 \text{ N}$$

The block is released and slides along the frictionless floor until it encounters a rough surface. The block slides a distance of 5.00 m on the rough surface before coming to rest.

b. List the forms of energy that are non-zero at the beginning of the problem. **5**

c. List the forms of energy that are non-zero at the end of the problem. **5**

d. Create energy bar charts: **10**



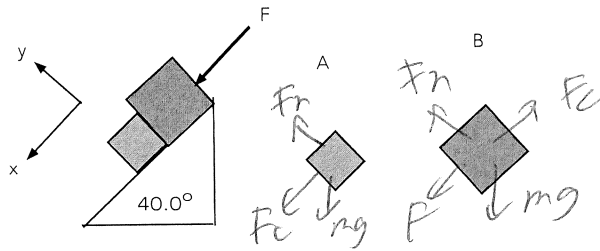
e. Use Conservation of Energy to find the coefficient of kinetic friction of the rough surface. **15**

$$\frac{1}{2} kx^2 = E_{\text{th}} = f_k \Delta s = \mu_k mg \Delta s$$

$$\mu_k = \frac{kx^2}{2mg \Delta s} = \frac{(500)(0.250)^2}{2 \cdot 2.50 \text{ g} (5.00)}$$

$$= 0.127$$

Exam2F22alt



1. Blocks A and B are in contact and block B is being pushed down a smooth ramp which makes an angle of 40.0° with respect to the horizontal by a force, F, which is parallel to the ramp.

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

b. Write out Newton's 2nd Law for both blocks in the x- and y-directions. 15

$$A: \quad x: \quad F_c + m_A g \sin 40^\circ = m_A a$$

$$y: \quad F_{nA} - m_A g \cos 40^\circ = 0$$

$$B: \quad x: \quad F - F_c + m_B g \sin 40^\circ = m_B a$$

$$y: \quad F_{nB} - m_B g \cos 40^\circ = 0$$

c. Assuming that $M_A = 4.50 \text{ kg}$, $M_B = 7.00 \text{ kg}$, and $F = 115 \text{ N}$, find the magnitude of the acceleration of the blocks and the magnitude of the contact force between the blocks.

10

combine A, B + equations:

$$F + (m_A + m_B) g \sin 40^\circ = (m_A + m_B) a$$

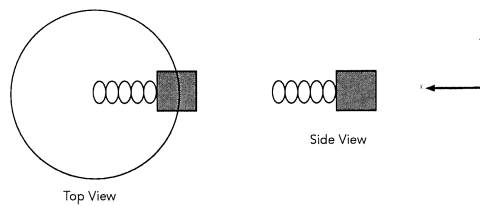
$$a = \frac{F}{m_A + m_B} + g \sin 40^\circ$$

$$= \frac{115}{11.5} + g \sin 40^\circ = 16.3 \text{ m/s}^2$$

Insert into A x equation:

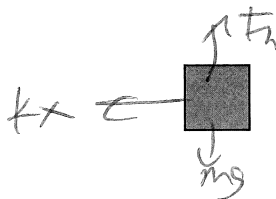
$$F_c = m_A (a - g \sin 40^\circ)$$

$$= 4.50 (16.3 - g \sin 40^\circ) = 450 \text{ N}$$



2. A block of mass $m=0.650$ kg is attached to a spring and is rotating on a horizontal, frictionless table at a constant speed of 7.50 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 side view position depicted above. **5**



b. Write out Newton's 2nd Law for the block in the x- and y-directions. **15**

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

$$y: \quad F_r - mg = 0$$

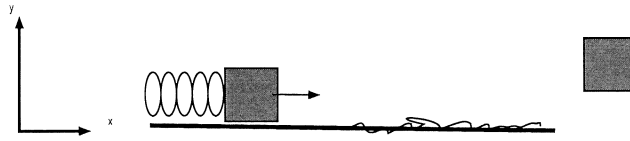
c. Find the spring constant of the spring. **5**

$$k = \frac{mv^2}{x + r} = \frac{(0.650)(7.50)^2}{(0.350)(1.25)}$$

$$= 32.5 \text{ N/m}$$

d. Find the period of the block's motion. **5**

$$T = \frac{2\pi r}{v} = \frac{2\pi(1.25)}{7.50} = 1.05 \text{ s}$$



3. A block of mass 3.50 kg is resting on a horizontal, frictionless floor. It is attached to a spring with spring constant 400 N/m. The block is pushed with a force F , compressing the spring by 0.250 m.

a. Find the magnitude of the pushing force, F . 5

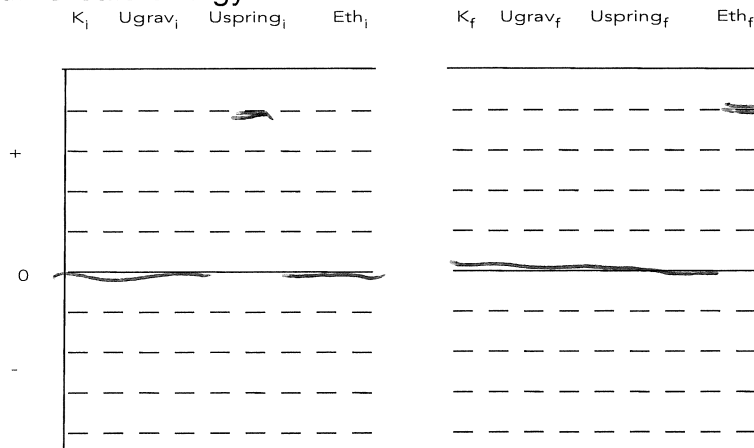
$$F = kx = (0.250)(400) = 100 \text{ N}$$

The block is released and slides along the frictionless floor until it encounters a rough surface. The block slides a distance of 4.00 m on the rough surface before coming to rest.

b. List the forms of energy that are non-zero at the beginning of the problem. 5

c. List the forms of energy that are non-zero at the end of the problem. 5

d. Create energy bar charts: 10



e. Use Conservation of Energy to find the coefficient of kinetic friction of the rough surface. 15

$$\frac{1}{2} kx^2 = E_{\text{th}} = \int_k \Delta s = \mu_k mg \Delta s$$

$$\mu_k = \frac{kx^2}{2 \cdot mg \Delta s} = \frac{(400)(0.250)^2}{2 \cdot (3.50)g(4.00)}$$

$$= 0.0910$$