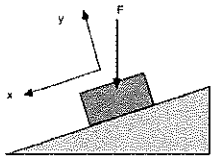
Your Name: _____

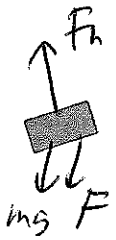
PHY203

Exam #2
Chapters 4-7
Fri., 3/22/19

Solutions

Exam2S19





1. A block of mass m is placed on a rough ramp (which makes an angle of θ with respect to the horizontal). The kinetic coefficient between block and ramp is μ_k. A vertical force F is applied to the block.

a. Draw a free body diagram of the block on the figure above and to the right. 5

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

x: $mg\sin\theta + F\sin\theta - \mu_k F_n = ma$ 10

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

Assume m = 6.50 kg, F = 85.0 N, μ_k = 0.350, and $\theta = 35.0^o$.

c. Find the magnitude of the normal force.

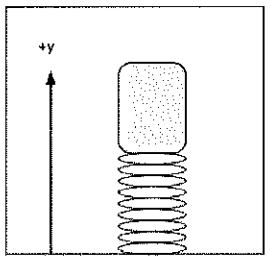
$F_n = 6.50g\cos 35.0^\circ + 85.0\cos 35.0^\circ$ 5

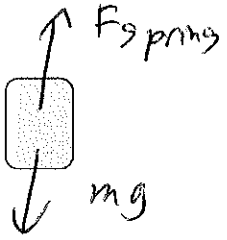
$= 122\ N$

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

$a = \frac{1}{6.50}\left[(6.50g + 85.0)\sin 35^\circ - (0.350)(122)\right]$ 10

$= 6.56\ m/s^2$





2. An 8.50 kg block is lowered onto a spring until it stops moving. The spring has a spring constant of 500 N/m.

a. Draw a free body diagram on the block above and to the right. 5

b. Write out Newton's 2nd Law for the block in the y-direction and find the compression of the spring.

$$y: \quad kx - mg = ma = 0$$

$$x = \frac{8.50g}{500} = 0.167\,m$$

10

c. The spring/block combination is placed in an elevator which begins to accelerate upwards with magnitude 4.50 m/s^2. Write out Newton's 2nd Law for the block and find the compression of the spring.

$$y: \quad kx - mg = ma$$

$$x = \frac{m}{500}(g + 4.50)$$

$$= 0.243\,m$$

10

d. The elevator then reaches a constant speed upwards of 6.50 m/s. Find the compression of the spring. Write out Newton's 2nd Law for the block and find the compression of the spring.

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

$$x = 0.167\,m$$

5

3. A block of mass 5.50 kg is traveling with a velocity

$\vec{v} = (9.50\hat{i} - 4.50\hat{j})m/s$

a. Find the initial kinetic energy of the block.

$K = \frac{1}{2}mv^2 = \frac{1}{2}(5.50)(9.50^2 + 4.50^2)$

$= 304\ J$

/10

It is subjected to a force which causes the block to undergo a displacement:

$\vec{F} = (-60.0\hat{i} + 95.0\hat{j})N$

$\vec{r} = (7.50\hat{i} + 8.00\hat{j})m$

b. Find the work done on the block by the force.

$W = \vec{F} \cdot \vec{r} = (-60.0\hat{i} + 95.0\hat{j}) \cdot (7.50\hat{i} + 8.00\hat{j})$

$= -(60)(7.50) + (95)(8)$

$= 310\ J$

10

c. Using work and energy find the magnitude of the final velocity of the block.

$304 + 310 = 614\ J = \frac{1}{2}mv_f^2$

$v_f^2 = \frac{2(614)}{5.5}$

$v_f = 14.9\ m/s$

10

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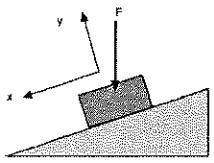
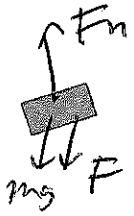




1. A block of mass m is placed on a rough ramp (which makes an angle of θ with respect to the horizontal). The kinetic coefficient between block and ramp is μ_k. A vertical force F is applied to the block.

a. Draw a free body diagram of the block on the figure above and to the right. 5

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

x: $mg\sin\theta + F\sin\theta - \mu_k F_n = ma$ /10

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

Assume m = 7.50 kg, F = 90.0 N, μ_k = 0.250, and θ = 35.0°.

c. Find the magnitude of the normal force.

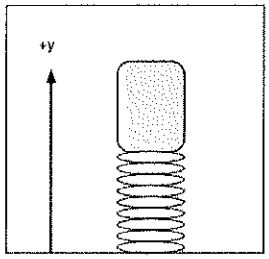
$F_n = (7.50g + 90.0)\cos 35.0$ 5

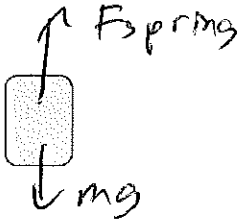
$= 134\ N$

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

$a = \frac{1}{7.50}\left[(7.50g + 90.0)\sin 35.0^\circ - 0.250(134)\right]$ /10

$= 8.07\ m/s^2$





2. A 9.50 kg block is lowered onto a spring until it stops moving. The spring has a spring constant of 500 N/m.

a. Draw a free body diagram on the block above and to the right. 5

b. Write out Newton's 2nd Law for the block in the y-direction and find the compression of the spring.

$y: \quad kx - mg = ma \quad = 0$

$x = \frac{9.50g}{500} = 0.186\ m$ 10

c. The spring/block combination is placed in an elevator which begins to accelerate upwards with magnitude 5.00 m/s^2. Write out Newton's 2nd Law for the block and find the compression of the spring.

$y: \quad kx - mg = ma$

$x = \frac{1}{500}(9.50)(g + 5.00)$ 10

$= 0.281\ m$

d. The elevator then reaches a constant speed upwards of 8.50 m/s. Find the compression of the spring. Write out Newton's 2nd Law for the block and find the compression of the spring.

$y: \quad kx - mg = 0$

$x = 0.186\ m$ 5

3. A block of mass 6.50 kg is traveling with a velocity
$\vec{v} = (8.50\hat{\imath} - 5.00\hat{\jmath})m/s$
a. Find the initial kinetic energy of the block.

$K = \frac{1}{2}mv^2 = \frac{1}{2}(6.50)(8.50^2 + 5.00^2)$ 10

$= 310\ J$

It is subjected to a force which causes the block to undergo a displacement:
$\vec{F} = (-55.0\hat{\imath} + 90.0\hat{\jmath})N$
$\vec{r} = (7.50\hat{\imath} + 8.00\hat{\jmath})m$
b. Find the work done on the block by the force.

$W = \vec{F} \cdot \vec{r} = (-55.0\hat{\imath} + 90.0\hat{\jmath}) \cdot (7.50\hat{\imath} + 8.00\hat{\jmath})$

$= -(55)(7.5) + (90)(8)$ 10

$= 308\ J$

c. Using work and energy find the magnitude of the final velocity of the block.

$K_f = 310 + 308 = 618\ J$

$618 = \frac{1}{2}mv_f^2$ 10

$v_f^2 = \frac{2(618)}{6.50}$

$v_f = 13.9\ m/s$