Your Name: ______________________

PHY203

Exam #2
Chapters 5-8
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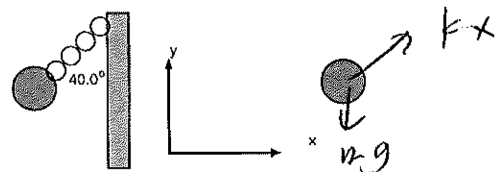
Fri, Oct, 24, 2025

Solutions

Exam2825Makeup F25



1. A ball of mass, m, is attached to a spring and is spun around a vertical pole as shown above.

a. Above and to the right draw a free body diagram of the ball. **5**

b. Write out Newton's 2nd Law for the ball in both directions. **15**

x: $kx \sin 40^\circ = ma = \frac{mv^2}{r}$

y: $kx \cos 40^\circ - mg = 0$

Assume m=4.00 kg, k = 500 N/m, and the unstretched length of the spring is 0.85 m

c. Find the magnitude of the force exerted by the spring and the (total) length of the spring when stretched. **10**

y: $kx = \frac{mg}{\cos 40^\circ} = \frac{4\,g}{\cos 40^\circ} = 51.2\ N$

$x = \frac{51.2}{500} = 0.102\ m$

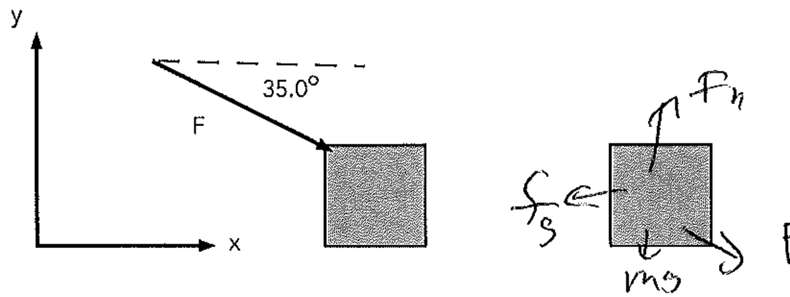
$L = .102 + .85 = 0.952\ m$

d. Find the speed of the ball. **10**

x: $51.2 \sin 40^\circ = \frac{mv^2}{r}$ $\quad r = L \sin 40^\circ = .952 \sin 40^\circ = 0.612\ m$

$v^2 = \frac{(51.2)(\sin 40^\circ)(0.612)}{4.00} = 5.04$

$v = 2.24\ m/s$



2. A block of mass m is <u>at rest</u> on a rough surface with a pushing force applied, as shown. Force, F, is applied at a downward angle of 35.0°.

a. Above and to the right draw a free body diagram of the block. **5**

b. Write out Newton's 2nd Law for the block in both directions. **20**

x: $F\cos 35^0 - f_s = ma = 0$

y: $F_n - mg - F\sin 40^0 = 0$

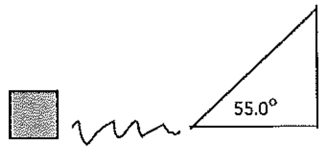
Assume m=6.50 kg and the coefficients of kinetic and static friction are μ_k= 0.300 and μ_s= 0.550.
c. Find the minimum force, F, that will get the block to start sliding. **10**

y: $F_n = 6.5g + F\sin 40^0$

x: $F\cos 35^0 - \mu_s(6.5g + F\sin 35^0) = 0$

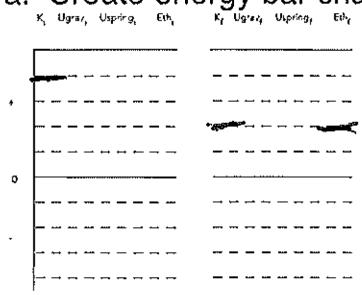
$F(\cos 35^0 - \mu_s \sin 35^0) = \mu_s 6.5g$

$F = \dfrac{(.550)(6.5)g}{\cos 35^0 - .55\sin 35^0} = 69.6\ \text{N}$



3. A block of mass 6.50 kg is sliding on a horizontal surface and has an initial speed of 17.5 m/s. It encounters a rough patch of length, L, which has a coefficient of kinetic friction of 0.250. At the end of that rough patch the speed of the block is 9.50 m/s.

a. Create energy bar charts: **5**



b. Use Conservation of Energy to find the length of the rough patch. **10**

$$K_i = K_f + E_{th}$$

$$\frac{1}{2} m v_i^2 = \frac{1}{2} m v_f^2 + \mu_k m g \Delta s$$

$$\Delta s = \frac{17.5^2 - 9.5^2}{2 \cdot (.250)\, g}$$

$$= 44.0\ m$$

The block then slides up a smooth ramp that makes an angle of 55.0° with respect to the horizontal.

c. Use Conservation of Energy to find the speed of the block when it is at a height of 3.00 m. **10**

$$K_f = mgh + K_f'$$

$$\frac{1}{2} m (9.5)^2 = mg(3) + \frac{1}{2} m v_{f'}^2$$

$$v_{f'}^2 = 9.5^2 - 6g$$

$$v_f' = 5.60\ m/s$$

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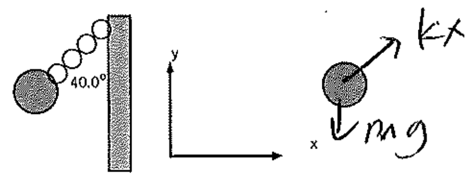


1. A ball of mass, m, is attached to a spring and is spun around a vertical pole as shown above.

a. Above and to the right draw a free body diagram of the ball. **5**

b. Write out Newton's 2nd Law for the ball in both directions. **15**

$$x: \quad kx \sin 40^\circ = ma = \frac{mv^2}{r}$$

$$y: \quad kx \cos 40^\circ - mg = 0$$

Assume m=6.50 kg, k = 600 N/m, and the unstretched length of the spring is 0.750 m

c. Find the magnitude of the force exerted by the spring and the (total) length of the spring when stretched. **10**

$$kx = \frac{mg}{\cos 40^\circ} = \frac{6.5g}{\cos 40^\circ} = 83.2\text{ N} = F_{spring}$$

$$x = \frac{83.2}{600} = 0.139\text{ m}$$

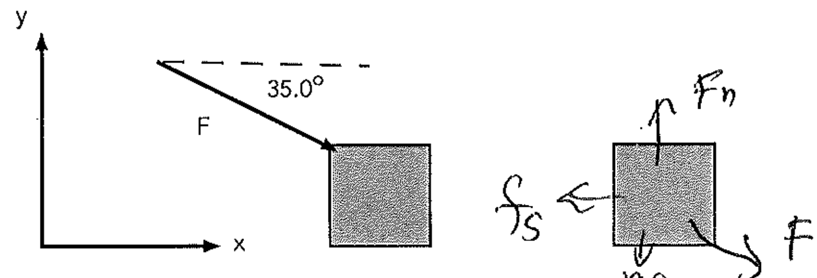
$$L = .750 + .139 = 0.889\text{ m}$$

d. Find the speed of the ball. **10**

$$x: \quad v^2 = \frac{(kx \sin 40^\circ)\, r}{m} \qquad r = .889 \sin 40^\circ = 0.571$$

$$= \frac{(83.2) \sin 40^\circ (0.571)}{6.50} = 4.70$$

$$v = 2.17\text{ m/s}$$



2. A block of mass m is <u>at rest</u> on a rough surface with a pushing force applied, as shown. Force, F, is applied at a downward angle of 35.0°.

a. Above and to the right draw a free body diagram of the block. **5**

b. Write out Newton's 2nd Law for the block in both directions. **20**

x: $F\cos 35^\circ - \mu_s F_n = ma = 0$
or f_s

y: $F_n - mg - F\sin 35^\circ = 0$

Assume m=7.50 kg and the coefficients of kinetic and static friction are μ_k= 0.350 and μ_s= 0.600.

c. Find the minimum force, F, that will get the block to start sliding. **10**

$F_n = mg + F\sin 35^\circ$

$F\cos 35^\circ - \mu_s(mg + F\sin 35^\circ) = 0$

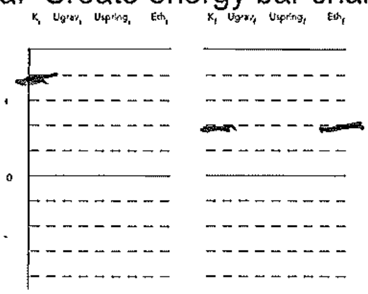
$F(\cos 35^\circ - \mu_s \sin 35^\circ) = \mu_s mg$

$$F = \frac{(.6)(7.50)g}{\cos 35^\circ - .6\sin 35^\circ} = \frac{44.1}{.475}$$

$= 92.8\ N$

3. A block of mass 5.50 kg is sliding on a horizontal surface and has an initial speed of 19.5 m/s. It encounters a rough patch of length, L, which has a coefficient of kinetic friction of 0.350. At the end of that rough patch the speed of the block is 12.0 m/s.

a. Create energy bar charts: **5**



b. Use Conservation of Energy to find the length of the rough patch. **10**

$$\frac{1}{2} m (19.5)^2 = \frac{1}{2} m (12.0)^2 + \mu_k m g \Delta s$$

$$19.5^2 - 12.0^2 = 2 \mu_k g \Delta s$$

$$\Delta s = \frac{19.5^2 - 12.0^2}{2(.350) g}$$

$$= 34.4 \text{ m}$$

The block then slides up a smooth ramp that makes an angle of 55.0° with respect to the horizontal.

c. Use Conservation of Energy to find the speed of the block when it is at a height of 4.00 m. **10**

$$\frac{1}{2} m (12.0)^2 = \frac{1}{2} m v^2 + m g h$$

$$v^2 = 12^2 - 2gh$$

$$= 12^2 - 2g(4)$$

$$v = 8.04 \text{ m/s}$$