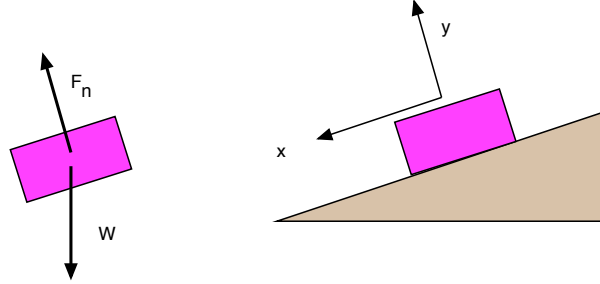


Your Name: \_\_\_\_\_

**PHY203**  
**Exam #2**  
**Chapters 4,5,11**  
**Mon., 3/8/13**

# Solutions

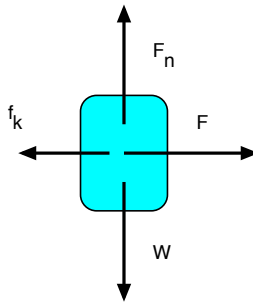


1. A block of mass,  $m=5.00$  kg, is sliding down a frictionless ramp.
- a. On the figure to the right above, draw a free-body diagram (sketch and label all the forces on the block). **5**
- b. On the figure to the left above, sketch and label an x-y coordinate system in which all the acceleration is along one axis. **5**
- c. Assuming that the ramp makes an angle of  $40^\circ$  with respect to the horizontal direction, find the magnitude of the normal force.

y-direction:  $F_n - mg \cos \theta = 0$  **10**  
 $F_n = mg \cos \theta = (5.00)(9.81) \cos(40^\circ) = 37.6 \text{ N}$

- d. Find the magnitude of the acceleration of the block. **10**

$mg \sin \theta = ma$   
 x-direction:  $a = \frac{mg \sin \theta}{m} = g \sin \theta = (9.81) \sin(40^\circ) = 6.31 \frac{\text{m}}{\text{s}^2}$



2. A force,  $F$ , pushes on a block of mass,  $m=2.00$  kg. The block is traveling at a constant speed of  $2.00$  m/s before the pushing force is applied. The force is applied at  $x=0$ . After the block has traveled a distance of  $10.0$  m, it is traveling with a speed of  $4.00$  m/s. The coefficient of kinetic friction between the block and the table is  $0.250$ .

a. On the figure to the right above, draw a free-body diagram (sketch and label all the forces on the block). **5**

b. To find the acceleration of the block, which kinematic equation will work best? Explain briefly. **5**

eq. C: we know the initial and final velocities and the distance traveled. Need a.

c. Find the acceleration of the block.

$$v^2 = v_o^2 + 2a\Delta x$$

$$a = \frac{v^2 - v_o^2}{2\Delta x} = \frac{(4.00)^2 - (2.00)^2}{2(10.0)} = 0.600 \frac{m}{s^2} \quad \mathbf{5}$$

d. Find the magnitude of the frictional force.

$$f_k = \mu_k F_n = \mu_k mg = (0.250)(2.00)(9.81) = 4.90 N \quad \mathbf{5}$$

e. Find the magnitude of the pushing force,  $F$ .

$$F - f_k = ma \quad \mathbf{10}$$

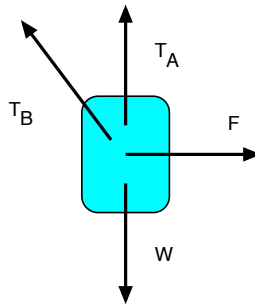
$$F = ma + f_k = (2.00)(0.600) + 4.90 = 6.10 N$$

3. a. Write out an expression for the acceleration due to gravity (also known as the gravitational field) on the surface of the Earth,  $g$ , in terms of  $G$ ,  $M_E$ , and  $R_E$ .

$$g = \frac{GM_e}{R_e^2} \qquad \mathbf{5}$$

b. If the Earth expanded to three times its radius while losing half of its mass, find the acceleration of gravity on the surface of this modified Earth.

$$g' = \frac{G(0.5)M_e}{(3R_e)^2} = \frac{g}{18} = \frac{9.81}{18} = 0.545 \frac{m}{s^2} \qquad \mathbf{10}$$



4. A block of  $m = 7.50 \text{ kg}$  is hanging from a couple of light strings as shown above. A Horizontal force,  $F=20 \text{ N}$ , is applied as shown.
- a. On the figure to the right above, draw a free-body diagram (sketch and label all the forces on the block). **5**

- b. Find the magnitude of the x-component of the tension in string B.

x-direction:  $F - T_{Bx} = 0$  **5**  
 $T_{Bx} = 20 \text{ N}$

- c. If the tension in string A is  $55.0 \text{ N}$ , find the magnitude of the y-component of the tension in string B.

y-direction:  $T_{By} + T_A - W = 0$  **10**  
 $T_{By} = -T_A + W = -55.0 + 73.6 = 18.6 \text{ N}$

- d. Find the magnitude of the tension in string B.

$$T_B = (T_{Bx}^2 + T_{By}^2)^{1/2} \quad \mathbf{5}$$

$$= (20^2 + 18.6^2)^{1/2} = 27.3 \text{ N}$$