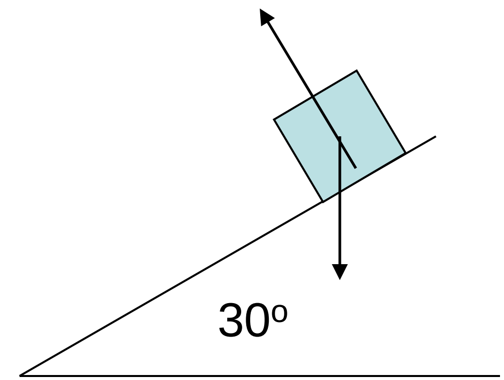
Review

Chapters

7-9

1. A 0.50 kg block slides down a frictionless 30° incline, starting from rest. The work done by the net force on this block after sliding for 4.0 s is:
   A) 37 J
   B) 20 J
   C) 0 J
   D) 49 J
   E) 96 J



$$a = g\sin 30 = 4.9 m/s^2$$

$$v = at = 4.9 \times 4 = 19.6 m/s$$

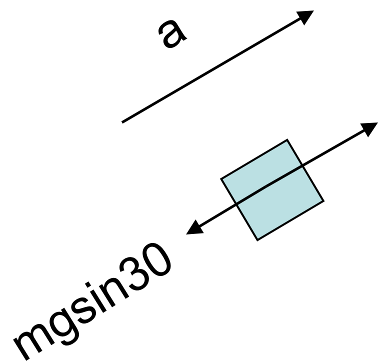
$$W_{net} = \Delta K = K_f - K_i = \frac{1}{2}mv^2 = \frac{1}{2}0.50 \times 19.6^2 = 96\,J$$

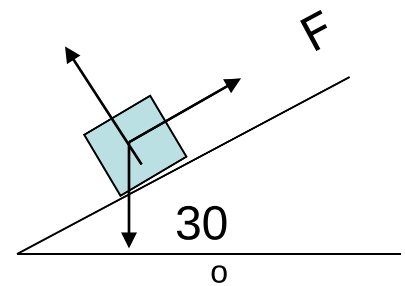
2. A person lifts a 0.40 kg cup of water 0.64 m vertically up at constant velocity of 1.2 m/s. The work done on the cup of water by him is:
   A) 2.5 J
   B) 5.0 J
   C) 3.0 J
   D) 0 J
   E) -2.5 J

$$W_{app} = mgd = 0.40 \times 9.8 \times 0.64 = 2.5\ J$$

3. A man pushes a 50 kg crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. His force is parallel to the slope. The acceleration of the crate is 1.5 m/s^2 and is directed up the slope. The work done by the man is:

A) 2800 J
B) 1600 J
C) 2000 J
D) 3000 J
E) 2300 J





$$F - mg\sin 30 = ma$$

$$F = m(g\sin 30 + a) = 50(4.9 + 1.5) = 320\ N$$

$$W_F = Fd = 320 \times 5.0 = 1600\ J$$

4. A 20 N force acts horizontally on a 2.0 kg box initially (t = 0) resting on a frictionless floor. The rate at which this force is doing work at t = 2.0 s is:
A) 600 W
B) 80 W
C) 400 W
D) 100 W
E) 200 W

$$a = \frac{F}{m} = \frac{20}{2} = 10 m/s^2$$

$$v = at = 10 \times 2.0 = 20 m/s$$

$$P = Fv = 20 \times 20 = 400 W$$

5. A ball dropped from rest reaches a speed of 3 m/s just before it hits the ground. If the same ball is thrown downward from the same height with a speed of 4 m/s, its speed just before hitting the ground is

A) 5 m/s
B) 6 m/s
C) 7 m/s
D) 10 m/s
E) 4 m/s

$$W_{g1} = \Delta K = K_f - K_i = \frac{1}{2}mv^2 - 0 = \frac{1}{2}m \times 3^2 = 4.5m$$

$$W_{g2} = \Delta K = K_f - K_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = \frac{1}{2}m \times v^2 - \frac{1}{2}m \times 4^2 = 0.5mv^2 - 8m$$

$$W_{g1} = W_{g2}$$

$$4.5m = 0.5mv^2 - 8m$$

$$12.5 = 0.5v^2$$

$$v = 5\, m/s$$

6. A varying force F_x acts on a particle of mass m = 2.0 kg as shown in Figure 1. Find the speed of the particle at x = 8.0 m, if the kinetic energy at x = 0 is 9.0 J.

A) 5.0 m/s
B) 7.0 m/s
C) 6.0 m/s
D) 4.0 m/s
E) 3.0 m/s

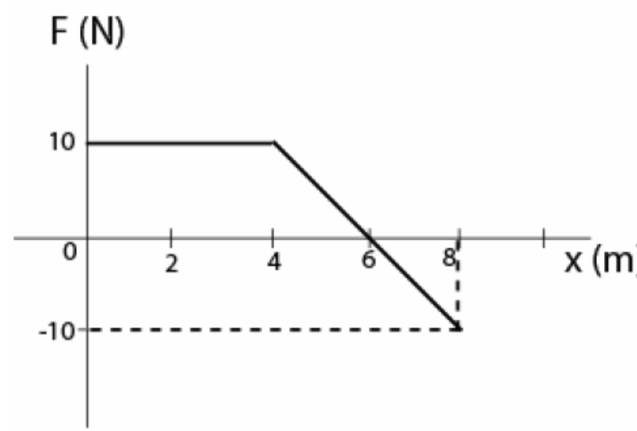


Figure 1

$$W = 10\times 4 + \tfrac{1}{2}10\times 2 - \tfrac{1}{2}10\times 2 = 40\ J$$

$$W = \Delta K = K_f - K_i \Rightarrow 40 = \tfrac{1}{2}mv^2 - 9.0$$

$$\tfrac{1}{2}2.0\times v^2 = 49 \Rightarrow v = 7.0\ m/s$$

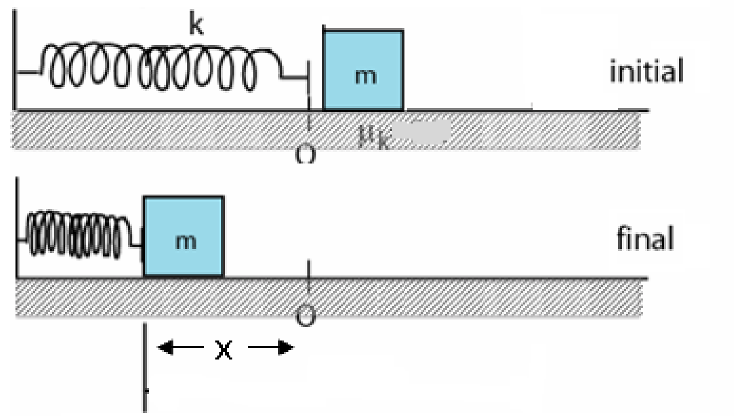
7. A 0.50 kg block is attached to an ideal spring with a spring constant of 80 N/m rests on a horizontal frictionless surface. The spring is stretched 4.0 cm longer than its equilibrium length and then released. The speed of the block when it passes through the equilibrium point is:

A) 0.71 m/s
B) 1.0 m/s
C) 1.5 m/s
D) 0.33 m/s
E) 0.51 m/s

$$\tfrac{1}{2}kx^2 = \tfrac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{kx^2}{m}} = \sqrt{\frac{80 \times 0.040^2}{0.50}} = 0.51\, m/s$$

8. A 0.75-kg block slides on a rough horizontal table top. Just before it hits a horizontal ideal spring its speed is 3.5 m/s. It compresses the spring 5.7 cm before coming to rest. If the spring constant is 2600 N/m, the coefficient of kinetic friction between the block and the table is:

A) 0.52
B) 0.65
C) 1.0
D) 0.88
E) 0.41



$$\Delta E = -\Delta E_{th} = -f_k x$$

$$E_f - E_i = \tfrac{1}{2}kx^2 - \tfrac{1}{2}mv^2 = -\mu_k mgx$$

$$\mu_k = \frac{\tfrac{1}{2}mv^2 - \tfrac{1}{2}kx^2}{mgx} = 0.88$$

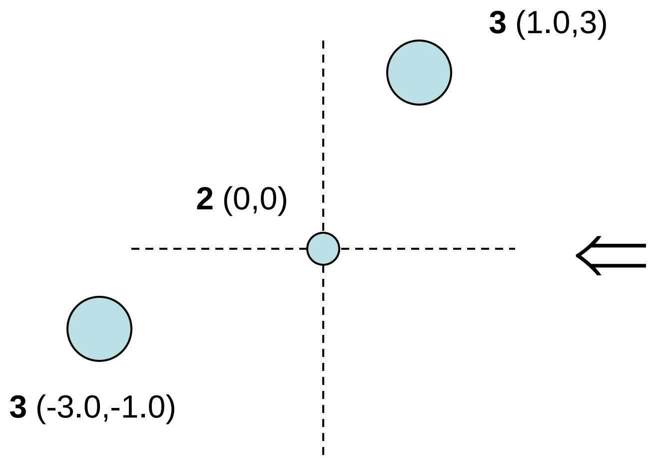
9. Sphere A has a mass M and is moving with speed 10 m/s. It makes a head-on elastic collision with a stationary sphere B of mass 3M. After the collision the speed of B is:
   A) 2.0 m/s
   B) 5.0 m/s
   C) 1.0 m/s
   D) 4.0 m/s
   E) 6.0 m/s

$$v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i}$$

$$v = \frac{2 \times M}{M + 3M} \times 10 = \frac{2}{4} \times 10 = 5.0\ m/s$$

10. The two pieces of uniform sheets made of the same metal are placed in the x-y plane as shown in Figure 2. The center of mass (x_{com}, y_{com}) of this arrangement is:

A) (1.0, -1.0) cm
B) (-2.0, 2.0) cm
C) (-0.75, 0.75) cm
D) (0.50, -0.50) cm
E) (-0.50, 0.50) cm



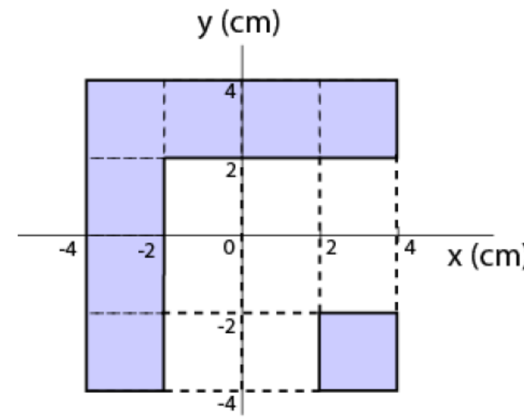


Figure 2

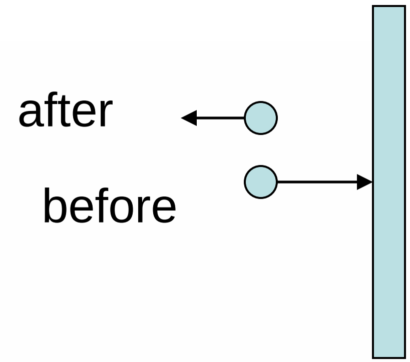
$$x_{com} = \frac{\sum m_i x_i}{M} = \frac{3\times1.0+2\times0+3\times(-3.0)}{3+2+3} = \frac{-6.0}{8} = -0.75\,cm$$

$$y_{com} = \frac{\sum m_i y_i}{M} = \frac{3\times3.0+2\times0+3\times(-1.0)}{3+2+3} = \frac{6.0}{8} = 0.75\,cm$$

$$COM\ \ is\ at\ (-0.75, 0.75)\,cm$$

11. A 0.50 kg ball moving at 2.0 m/s perpendicular to a wall rebounds from the wall at 1.4 m/s. The impulse on the ball is:

A) 1.7 N · s away from wall
B) 0.30 N · s away from wall
C) 0.30 N · s toward wall
D) zero
E) 1.7 N · s towards the wall



$$taking\ +ve\ x-axis\ to\ be\ toward\ the\ wall:$$

$$p_i = m\vec{v}_i = 0.50 \times 2.0i = 1.0i\ N.s$$

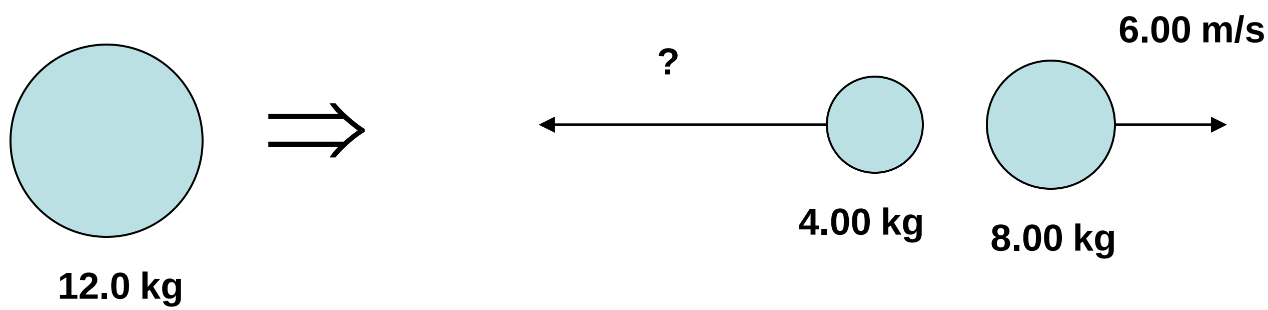
$$p_f = m\vec{v}_f = 0.50 \times (-1.4i) = -0.7i\ N.s$$

$$\Delta p = p_f - p_i = -0.7i - 1.0i = -1.7i\ N.s$$

$$here\ the\ -ve\ sign\ means\ away\ from\ the\ wall.$$

12. An object of 12.0 kg at rest explodes into two pieces of masses 4.00 kg and 8.00 kg. The velocity of the 8.00 kg mass is 6.00 m/s in the positive x-direction. The change in the kinetic energy is:

A) 48.0 J
B) 54.0 J
C) 290 J
D) 432 J
E) 154 J



$$8 \times 6 = 4 \times v \Rightarrow v = 12\ m/s\ in\ -ve\ x-direction$$

$$K_i = 0$$

$$K_f = \tfrac{1}{2} \times 4 \times 12^2 + \tfrac{1}{2} \times 8 \times 6^2 = 288 + 144 = 432\ J$$

$$\Delta K = K_f - K_i = 432\ J$$