**Chapter 7**

1. When a 4.00-kg object is hung vertically on a certain light spring that obeys Hooke’s law, the spring stretches 2.50 cm. If the 4.00-kg object is removed, (a) how far will the spring stretch if a 1.50-kg block is hung on it? (b) How much work must an external agent do to stretch the same spring 4.00 cm from its unstretched position?

Solution:

**A diagram of a square with lines and arrows

Description automatically generated**2. A 4.00-kg particle moves from the origin to position Ⓒ, having coordinates x = 5.00 m and y = 5.00 m (Fig.  P7.31). One force on the particle is the gravitational force acting in the negative y direction. Using Equation 7.3, calculate the work done by the gravitational force on the particle as it goes from O to Ⓒ along (a) the purple path, (b) the red path, and (c) the blue path. (d) Your results should all be identical. Why?

Solution:

3. The potential energy of a system of two particles separated by a distance r is given by U(r) = A/r, where A is a constant. Find the radial force that each particle exerts on the other.

Solution:

**Chapter 8**

1. Can a force of static friction do work? If not, why not? If so, give an example.

Answer:

2. A ball of mass *m* falls from a height *h* to the floor. (a) Write the appropriate version of Equation 8.2 for the system of the ball and the Earth and use it to calculate the speed of the ball just before it strikes the Earth. (b) Write the appropriate version of Equation 8.2 for the system of the ball and use it to calculate the speed of the ball just before it strikes the Earth.

Solution:

3. An 820-N Marine in basic training climbs a 12.0-m vertical rope at a constant speed in 8.00 s. What is his power output?

Solution:

**Solutions for Chapter 7**

1. When a 4.00-kg object is hung vertically on a certain light spring that obeys Hooke’s law, the spring stretches 2.50 cm. If the 4.00-kg object is removed, (a) how far will the spring stretch if a 1.50-kg block is hung on it? (b) How much work must an external agent do to stretch the same spring 4.00 cm from its unstretched position?

Solution:

When the load of mass *M* = 4.00 kg is hanging on the spring in equilibrium, the upward force exerted by the spring on the load is equal in magnitude to the downward force that the Earth exerts on the load, given by *w* = *Mg*. Then we can write Hooke’s law as *Mg* = +*kx*. The spring constant, force constant, stiffness constant, or Hooke’s-law constant of the spring is given by



(a) For the 1.50-kg mass,



(b) Work

**A diagram of a square with lines and arrows

Description automatically generated**2. A 4.00-kg particle moves from the origin to position Ⓒ, having coordinates x = 5.00 m and y = 5.00 m (Fig.  P7.31). One force on the particle is the gravitational force acting in the negative y direction. Using Equation 7.3, calculate the work done by the gravitational force on the particle as it goes from O to Ⓒ along (a) the purple path, (b) the red path, and (c) the blue path. (d) Your results should all be identical. Why?

Solution:

The gravitational force is downward:

A diagram of a square with lines and points

Description automatically generated*Fg* = *mg* = (4.00 kg)(9.80 m/s2) = 39.2 N

(a) Work along OAC = work along OA + work along AC



(b) W along OBC = W along OB + W along BC



(c) Work along OC = *F*g(OC) cos 135°



(d) 

3. The potential energy of a system of two particles separated by a distance r is given by U(r) = A/r, where A is a constant. Find the radial force that each particle exerts on the other.

Solution:

We use the relation of force to potential energy as the force is the negative derivative of the potential energy with respect to distance:





If A is positive, the positive value of radial force indicates a force of repulsion.

**Solutions for Chapter 8**

1. Can a force of static friction do work? If not, why not? If so, give an example.

Answer:

Yes, if it is exerted by an object that is moving in our frame of reference. The flat bed of a truck exerts a static friction force to start a pumpkin moving forward as it slowly starts up.

2. A ball of mass *m* falls from a height *h* to the floor. (a) Write the appropriate version of Equation 8.2 for the system of the ball and the Earth and use it to calculate the speed of the ball just before it strikes the Earth. (b) Write the appropriate version of Equation 8.2 for the system of the ball and use it to calculate the speed of the ball just before it strikes the Earth.

Solution:

(a) The system of the ball and the Earth is isolated. The gravitational energy of the system decreases as the kinetic energy increases.







(b) The gravity force does positive work on the ball as the ball moves downward. The Earth is assumed to remain stationary, so no work is done on it.

∆*K* = *W*





3. An 820-N Marine in basic training climbs a 12.0-m vertical rope at a constant speed in 8.00 s. What is his power output?

Solution:

The Marine must exert an 820-N upward force, opposite the gravitational force, to lift his body at constant speed. The Marine’s power output is the work he does divided by the time interval:

