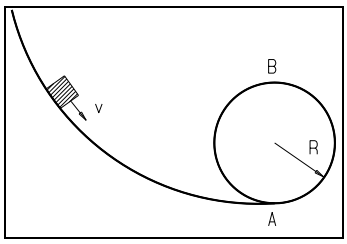
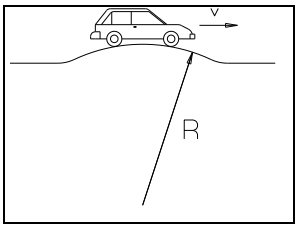
DYNAMICS OF UNIFORM CIRCULAR MOTION

A 3.2 kg block is sliding on the inside of a frictionless vertical loop so that at the lowest point A it has speed v_A=9.0 m/s. The loop's radius is 2.0 m.



5.1 Find the magnitude of the force exerted by the loop on the block at point A. [1.6×10^2 N]

A car of mass 1200 kg moving at 60.0 km/hr goes over a bump of circular cross section.



5.2 Find the radius of curvature of the bump if the car just barely stays on the road surface. [28.3 m]

5.3 Find the force exerted by the road surface on the car if the radius of curvature is R=40.0 m. [3.42×10^3 N]

A 5.0 kg ball is attached to the end of a rope 0.80 m long. A man swings the ball and rope in complete circles at constant 1 revolution per second. The plane of the motion contains the vertical (g is in the plane of the circle) and the rope remains taut at all times.

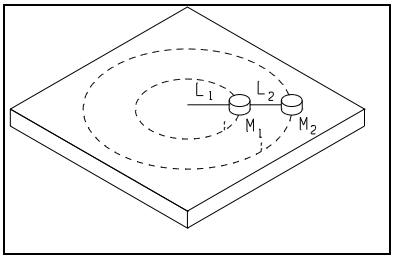
5.4 Find the tension in the rope when the ball is at the lowest point of its motion. [2.1×10^2 N]

5.5 Find the tension in the rope when it is along the horizontal. [1.6×10^2 N]

A 50.0 gram coin is placed on a flat horizontal turntable at 10.0 cm from the spindle. The turntable is observed to make four revolutions in 6.28 seconds. The coin rides on the turntable without slipping.

5.6 Find the net force on the coin. [8.00×10^{-2} N]

A block of mass M_1=8.0 kg is attached to a cord of length L_1=0.40 m which is fixed at one end and moves in a circle. A second block of mass M_2=4.0 kg is attached to M_1 by a cord of length L_2=0.30 m and also moves in a circle. There is no friction between the masses and the table and the period of the motion is 2.4 s.



5.7 Find the tension in L_1. [41 N]

5.8 Find the tension in L_2. [19 N]

A carnival Ferris wheel has a 15 m radius and completes five turns about its horizontal axis every minute.

5.9 Find the magnitude of the acceleration of a passenger when the passenger's velocity points straight down. [4.1 m/s^2]

WORK & ENERGY CONSERVATION

A rope raises a 5.00 kg bucket at constant acceleration 3.00 m/s^2.

6.1 Find the work done by the rope on the bucket as the bucket is displaced by 3.00 meters. [192 J]

6.2 Find the bucket's change in kinetic energy as the bucket is displaced by 3.00 meters. [45.0 J]

A 2.2 kg block is sliding on the inside of a frictionless vertical loop so that at the lowest point of its motion it has speed v_A=18 m/s. The loop's radius is 2.0 meters.

6.3 Find the block's speed at the highest point of the motion. [16 m/s]

6.4 Find the force exerted by the track on the block at the highest point of the motion. [2.5x10^2 N]

A 2.0 kg projectile reaches maximum height with kinetic energy 64 J in 2.0 seconds after it is fired.

6.5 Find the total distance it travels in the horizontal direction. [32 m]

A block at the top of an inclined plane is released from rest. At the bottom of the incline the block has covered a distance of 4.0 m and has speed 6.0 m/s. There is no friction anywhere.

6.6 Find the angle of the incline. [27^o]

A running man doubles his kinetic energy by increasing his speed by 2.0 m/s.

6.7 Find his original speed. [4.8 m/s]

A 50.0 g bullet, initially traveling 5.00x10^2 m/s, penetrates 25.0 cm into a wall.

6.8 Calculate the force exerted by the wall on the bullet assuming that it is constant. [2.50x10^4 N]

A 5.00 kg projectile is shot straight up with initial speed 30.0 m/s and reaches maximum height 40.0 meters.

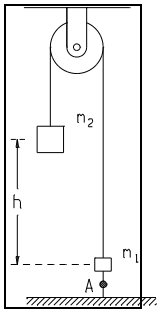
6.9 Find the work done by air friction on the projectile during this motion. [-290 J]

A 2.00 kg ball is allowed to fall from rest.

6.10 Find its kinetic energy after it has dropped 10.0 meters. Neglect air friction. [196 J]

Mass m_2 = 4.0 kg is at height h = 2.0 m above mass m_1=3.0 kg. The system is at rest when the string is cut at A.

6.11 Find the speed of the masses when they are at the same height. [1.7 m/s]



MOMENTUM CONSERVATION & COLLISIONS

Two skaters, a 65 kg man and a 50 kg woman, are holding hands while skating across the ice at 6 m/s. They push each other and separate so that the man is moving in the same direction at 8 m/s.

7.1 Find the velocity of the woman. [3.4 m/s in the same direction as before]

A vessel at rest explodes into three pieces of equal mass. Two pieces fly off at right angles to each other with speeds 2.0 m/s and 4.0 m/s.

7.2 Find the speed of the third piece. [4.5 m/s]

A 200 g ball moving at 15 m/s collides with a 400 g ball initially at rest. The collision is perfectly inelastic.

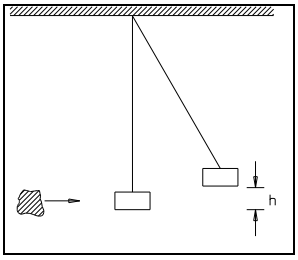
7.3 Find the amount of energy lost during the collision. [15 J]

Mass m_A=3.0 kg moving with initial speed v_A = 6.0 m/s slides down a frictionless incline. At the bottom it collides with mass m_B = 6.0 kg which is initially at rest. After the collision, the masses stick together and move as one.

7.4 Find the velocity of the composite mass after the collision if the height of the incline is 1.2 meters. [2.6 m/s]

7.5 Find the height of the incline if the velocity of the composite mass is 2.6 m/s. [1.2 m]

A 1.5 kg ball of putty traveling horizontally strikes a 3.0 kg block suspended from a fixed point with a 3.0 m massless cord. The collision is perfectly inelastic.



7.6 Find the speed of the putty just prior to striking the block if the combined mass rises to height h = 0.3 m. [7.3 m/s]

7.7 Find the height to which the combined mass rises if the speed of the putty prior to striking the block is 7.3 m/s. [0.3 m]

A ball moving with speed 12 m/s collides with another ball of twice the mass that is initially at rest.

7.8 Find the final speed of the larger ball if the collision is perfectly elastic. [8 m/s]

7.9 Find the final speed of the composite mass if the collision is perfectly inelastic. [4 m/s]

A 5.0 kg object with speed 6.0 m/s collides head on with an 8.0 kg object moving toward it with speed 6.0 m/s.

7.10 If, after the collision, the 8.0 kg object is moving in the same direction with half its initial speed, find the final speed of the 5.0 kg object. [1.2 m/s]