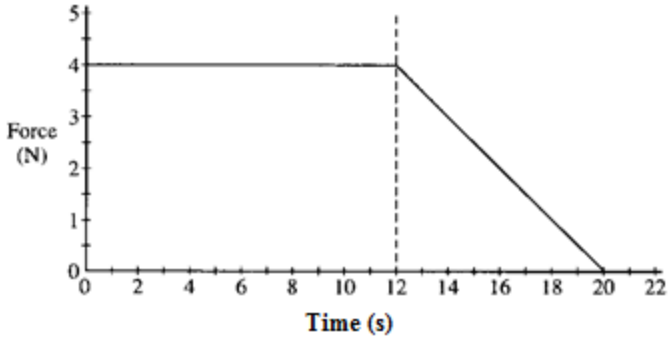
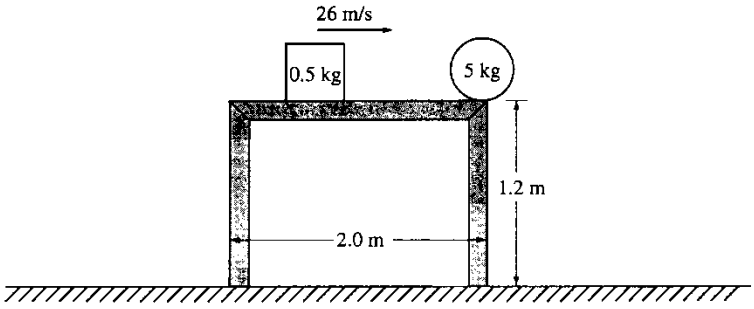


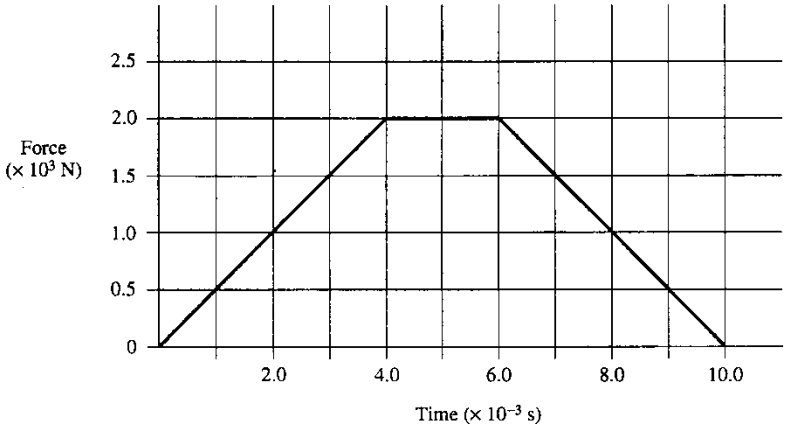
1. A 0.20 kg object moves along a straight line. The net force acting on the object varies with time as shown in the graph above. The object starts from rest x = 0 and time t = 0 and is pushed for a time of 20 s. Determine each of the following.

a. The acceleration of the particle when its time is 6s.
b. The impulse imparted during the first 12 seconds.
c. The time it takes the object to reach 120m/s.
d. The speed of the object at 8s.
e. The change in the momentum of the object from t = 12 s to t = 20 s
f. Which of the above answers would change if the cart had a greater mass?

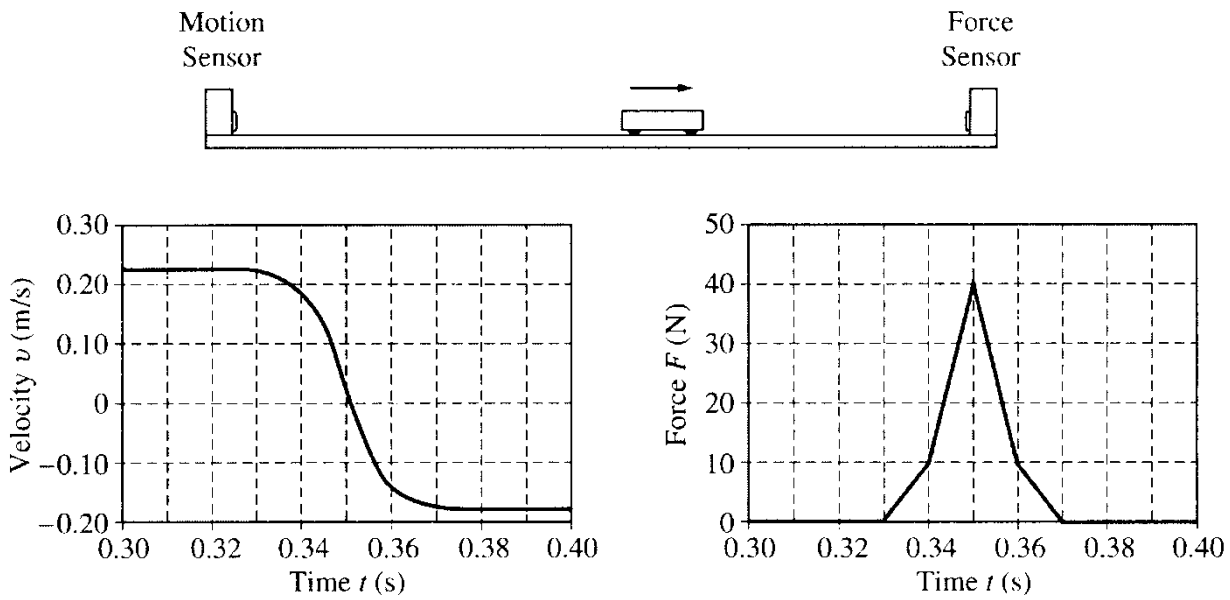


Note: Figure not drawn to scale.

2. A 5-kilogram ball initially rests at the edge of a 2-meter-long, 1.2-meter-high frictionless table, as shown above. A hard plastic cube of mass 0.5 kilogram slides across the table at a speed of 26 meters per second and strikes the ball, causing the ball to leave the table in the direction in which the cube was moving. The figure below shows a graph of the force exerted on the ball by the cube as a function of time.



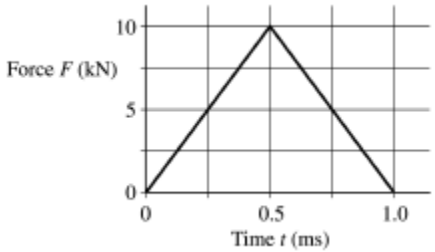
a. Determine the total impulse given to the ball.
b. Determine the horizontal velocity of the ball immediately after the collision.
c. Determine the following for the cube immediately after the collision.
   i. Its speed
   ii. Its direction of travel (right or left), if moving
d. Determine the kinetic energy dissipated in the collision.
e. Determine the distance between the two points of impact of the objects with the floor.



3. A motion sensor and a force sensor record the motion of a cart along a track, as shown above. The cart is given a push so that it moves toward the force sensor and then collides with it. The two sensors record the values shown in the following graphs.

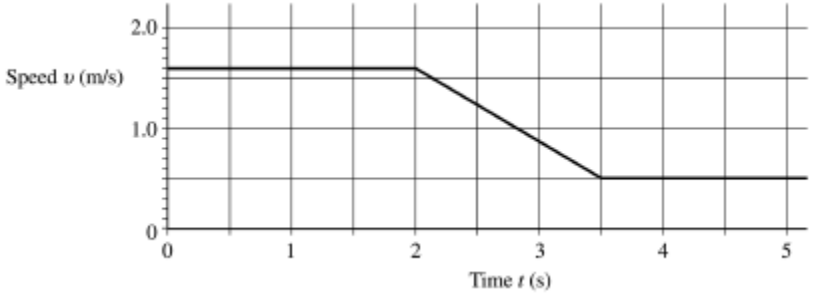
a. Determine the cart's average acceleration between t = 0.33 s and t = 0.37 s.
b. Determine the magnitude of the change in the cart's momentum during the collision.
c. Determine the mass of the cart.
d. Determine the energy lost in the collision between the force sensor and the cart.

4. A 2.0 kg frictionless cart is moving at a constant speed of 3.0 m/s to the right on a horizontal surface, when it collides with a second cart of undetermined mass m that is initially at rest. Force F of the collision as a function of time is showing the graph below, where t=0 is the instant of initial contact. As a result of collision, the second cart acquires a speed of 1.6 m/s to the right. Assume friction is negligible before, during, and after collision.

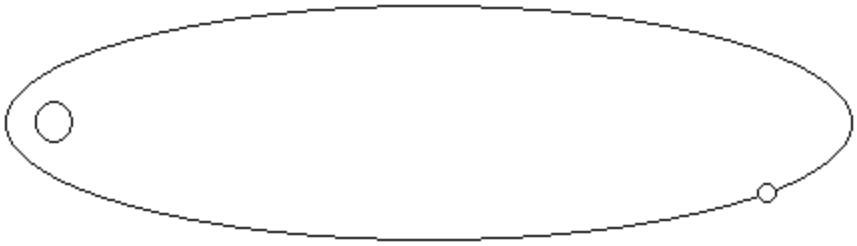


(a) Calculate the magnitude and direction of the velocity of the 2.0kg cart after the collision.
(b) Calculate the mass of the second cart.

After the collision, the second cart eventually experiences a ramp, which it traverses with no frictional losses. The graph below shows the speed *v* of the second cart as a function of time *t* for the next 5.0s, where t=0 is now the instant at which the carts separate.



(c) Calculate the acceleration of the cart at t = 3.0s.
(d) Calculate the distance traveled by the second cart during the 5.0 second interval after the collision.
(e) State whether the ramp goes up or down and calculate the maximum elevation (above or below the initial height) reached by the second cart on the ramp during the 5.0 second interval after the collision.
(f) If the ramp had the same final elevation, but was steeper, how would that change the graph above? Explain.



5. Halley's comet orbits the sun with a high eccentricity so that, when farthest from the sun (aphelion), it has an orbital distance of 35.1 astronomic units and a speed of 0.879km/s. The mass of the comet is estimated at 2.2×10^{14}kg and 1 astronomic unit = 1 AU = 1.496×10^{11}m.

a. What are the kinetic and potential energies when farthest from the sun?

b. What are the kinetic and potential energies when closest to the sun (perihelion), at a distance of 0.586 astronomic units?

c. What is the speed when closest to the sun?

d. What work does the force of the sun's gravity do as the comet moves from the aphelion to the perihelion?