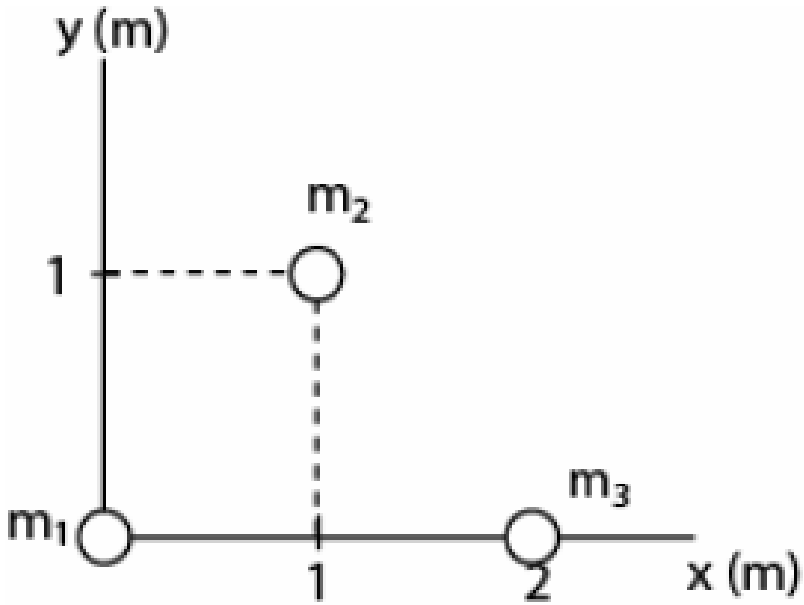
Questions

Chapter 9
Center of Mass and Linear Momentum

9-1 The Center of Mass
M2-062

If the masses of m_1 and m_3 in Fig. 5 are 1.0 kg each and m_2 is 2.0 kg, what are the coordinates of the center of mass?

A) (1.25, 0.50) *m*
B) (0.50, 1.00) *m*
C) (1.00, 0.50) *m*
D) (0.75, 1.00) *m*
E) (0.50, 0.75) *m*



Answer C

9-1 The Center of Mass
M2-061

A 3.0 kg mass is positioned at (0, 8.0) m, and a 1.0 kg mass is positioned at (12, 0) m. What are the coordinates of a 4.0 kg mass which will result in the center of mass of the system of three masses being located at the origin (0, 0)?

A) (-12, -8.0) m
B) (-3.0, -6.0) m
C) (3.0, 6.0) m
D) (-6.0, -3.0) m
E) (-12, 0) m

Answer B

9-1 The Center of Mass
M2-042

Four masses, m1 = 1.0 kg, m2 = 2.0 kg, m3 = 3.0 kg and m4 = 4.0 kg are placed at the corners of a square of side a = 1.0 m, as shown in Fig 3. The x and y coordinates of their center of mass are:

A) (0.5 m, 0.0 m)
B) (1.0 m, 1.0 m)
C) (0.5 m, 0.5 m)
D) (0.5 m, 0.7 m)
E) (0.0 m, 0.0 m)

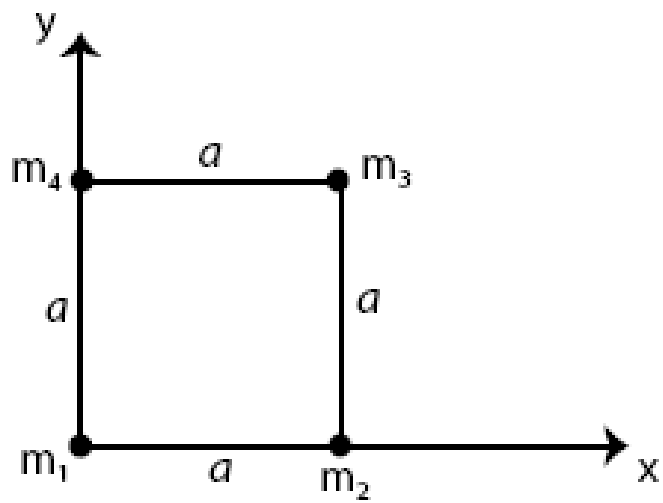


Figure 3

Answer D

9-1 The Center of Mass
M2-041

A 1.0 kg particle is moving with a velocity of 16 m/s along the positive x direction while a 3.0 kg particle is moving with a velocity of 4.0 m/s along the positive y direction. Find the magnitude of their center of mass velocity.

A) 7.0 m/s
B) 4.0 m/s
C) 16 m/s
D) 5.0 m/s
E) 0

Answer D

9-1 The Center of Mass
M2-041

A circular hole of radius 5.0 cm is cut from a uniform square of metal sheet having sides 20 cm as shown in Fig 2. Which point could be the center of mass of this sheet?

A) Point A
B) Point B
C) Point C
D) Point D
E) Point E

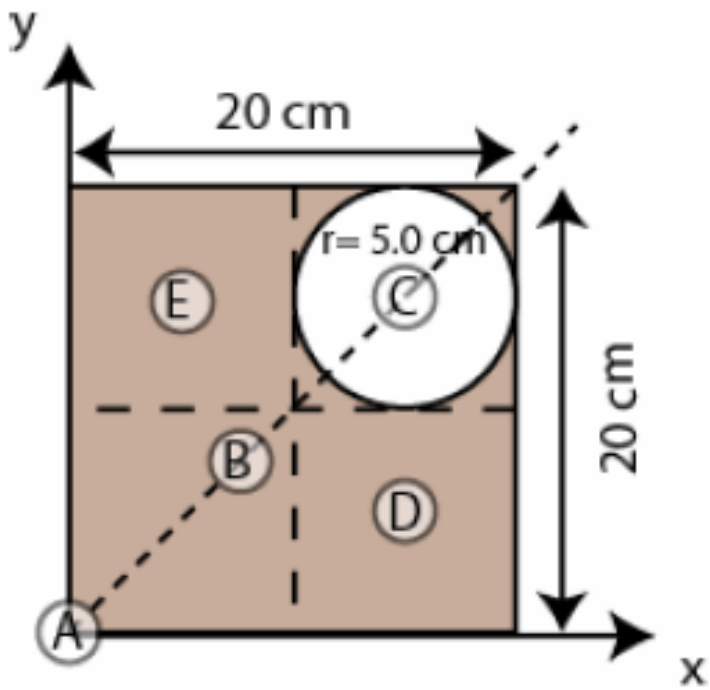


Figure 2

Answer B

9-3 Linear Momentum
M2-062

Each object in Fig. 4 has a mass of 2.0 *kg*. The mass m_1 is at rest, m_2 has a speed of 3.0 *m*/*s* in the direction of +ve *x*-axis and m_3 has a speed of 6.0 *m*/*s* in the direction of +ve *y*-axis. The momentum of the center of mass of the system is:

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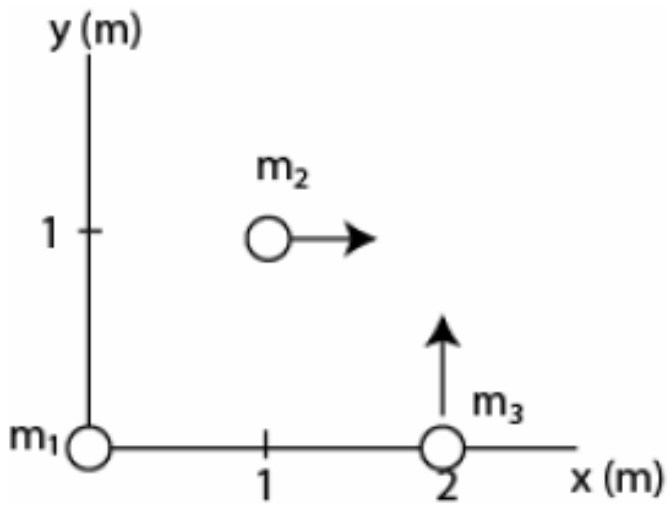
A) $(6.0\hat{i} + 12\hat{j})$ kg m/s

B) $(1.0\hat{i} + 2.0\hat{j})$ kg m/s

C) $(3.0\hat{i} + 6.0\hat{j})$ kg m/s

D) 3.0 kg m/s

E) $(-3.0\hat{i} + 6.0\hat{j})$ kg m/s



Answer A

9-3 Linear Momentum
M2-061

Two identical 1500 kg cars are moving perpendicular to each other. One moves with a speed of 25 m/s due north and the other moves at 15 m/s due east. What is the total momentum of the system?

A) 6.0 x10^4 kg·m/s at 59° North of East
B) 4.4 x10^4 kg·m/s at 31° North of East
C) 6.0 x 10^4 kg·m/s at 31° North of East
D) 4.4 x 10^4 kg·m/s at 59° North of East
E) 4.0 x10^4 kg·m/s at 59° North of East

Answer D

9-3 Linear Momentum
M2-042

A 1.0 kg ball strikes a vertical wall at an angle of 30 degrees with a speed of 3.0 m/s and bounces off at the same angle with the same speed, as shown in Fig 4. The change in momentum of the ball is :

A) 6 kg m/s upward
B) 9 kg m/s to the left
C) 3 kg m/s to the right
D) 0 kg m/s
E) 3 kg m/s to the left

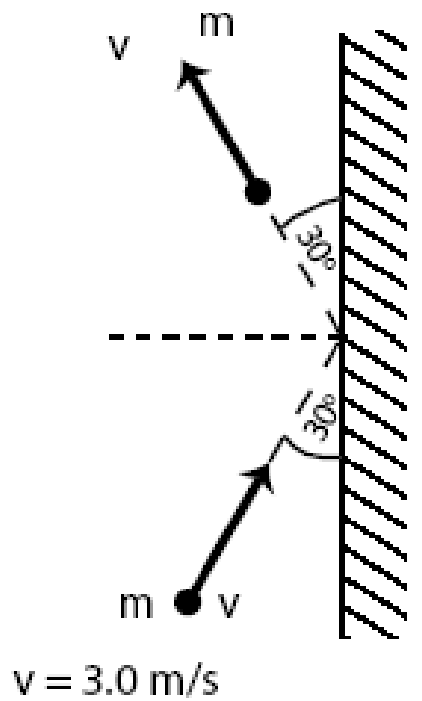


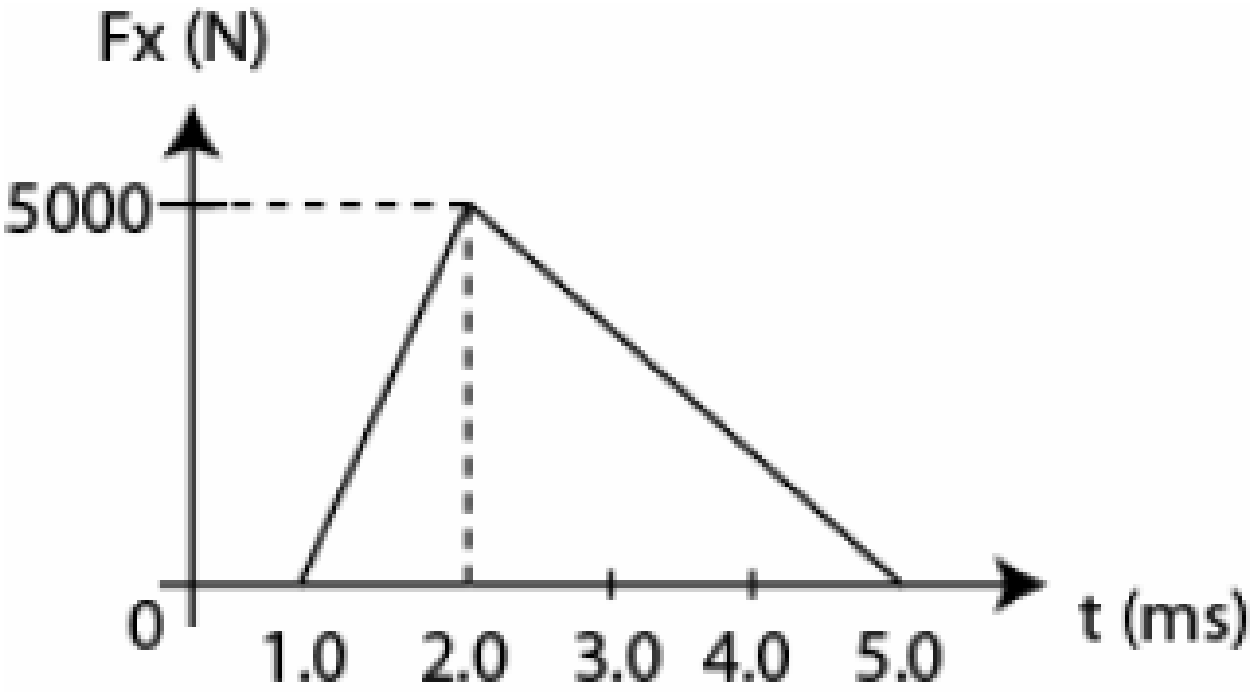
Figure 4

Answer E

9-5 Collision and Impulse
M2-062

An impulsive force F_x as a function of time (in ms) is shown in the Fig. 3 as applied to an object (m = 5.0 kg) at rest. What will be its final speed?

A) 4.2 m/s.
B) - 3.2 m/s.
C) 8.0 m/s.
D) 16 m/s.
E) 2.0 m/s.



Answer E

9-5 Collision and Impulse
M2-042

A 1.0 kg ball falling vertically hits a floor with a velocity of 3.0 m/s and bounces vertically up with a velocity of 2.0 m/s . If the ball is in contact with the floor for 0.10 s, the average force on the floor by the ball is:

A) 50 N down
B) 30 N down
C) 0 N
D) 20 N up
E) 40 N up

Answer A

9-5 Collision and Impulse
M2-041

A 0.5 kg ball having velocity (10 **i** + 10 **j**) m/s collides and bounces off a wall with a velocity of (-5.0 **i** + 10 **j**) m/s. Find the average force on the ball if the collision time is 0.01 s.

A) (-200 **i**) N
B) (-250 **i**) N
C) (-750 **i**) N
D) (150 **i** + 200 **j**) N
E) (25 **i** + 100 **j**) N

Answer C

9-5 Collision and Impulse
M2-041

A 2.0 kg block is given a single impulsive force in the positive x-direction as shown in Fig 3. If the velocity of the block at t=0 was -2.0 m/s, find its velocity at t=5.0 s.

A) 6.0 m/s
B) 5.0 m/s
C) 2.0 m/s
D) 3.0 m/s
E) 1.0 m/s

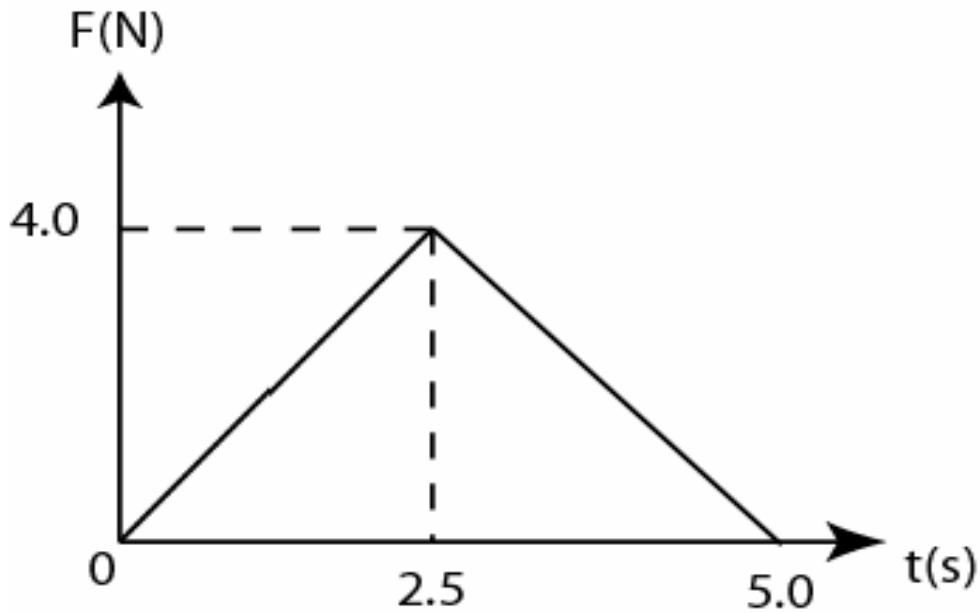


Figure 3

Answer D

9-6 Conservation of Linear Momentum
M2-042

A 6.0 kg body moving with velocity v breaks up (explodes) into two equal masses. One mass travels east at 3.0 m/s and the other mass travels north at 2.0 m/s. The speed v of the 6.0 kg mass is:

A) 3.0 m/s
B) 5.0 m/s
C) 1.0 m/s
D) 2.0 m/s
E) 1.8 m/s

Answer E

9-6 Conservation of Linear Momentum
M2-041

A 10 kg bomb initially at rest explodes, breaking into two pieces of masses 4.0 kg and 6.0 kg. The 4.0 kg piece fly off along the +x axis with a speed 30 m/s. Find the velocity of the 6.0 kg piece.

A) 20 m/s along the -x axis
B) 30 m/s along the -x axis
C) 30 m/s along the +x axis
D) 20 m/s along the +x axis
E) 15 m/s along the -x axis

Answer A

9-7 Momentum and Collision Energy in Collisions
M2-062

A 0.20 kg steel ball, travels along the x-axis at 10 m/s, undergoes an elastic collision with a 0.50 kg steel ball traveling along the y-axis at 4.0 m/s. The total kinetic energy of the two balls after collision is:

A) 18 *J*.
B) 14 *J*.
C) 4.0 *J*.
D) 10 *J*.
E) $(10\hat{i} + 4.0\hat{j})$ J

Answer B

9-7 Momentum and Collision Energy in Collisions
M2-061

A small object with linear momentum 5.0 kg·m/s makes a head-on collision with a large object at rest. The small object bounces straight back with a momentum of magnitude 4.0 kg·m/s. What is the magnitude of the change in momentum of the large object?

A) 9.0 kg·m/s
B) 5.0 kg·m/s
C) 4.0 kg·m/s
D) 1.0 kg·m/s
E) 3.0 kg·m/s

Answer A

9-7 Momentum and Collision Energy in Collisions
M2-042

In an inelastic collision between two objects with no external forces,

A) kinetic energy is conserved but momentum is not conserved
B) momentum is conserved but kinetic energy is not conserved
C) both momentum and kinetic energy are conserved
D) neither momentum nor kinetic energy are conserved
E) kinetic energy is equal to half of momentum

Answer B

9-7 Momentum and Collision Energy in Collisions
M2-042

A 2.0 kg block with a speed of 4.0 m/s undergoes a head on ELASTIC collision with a 4.0 kg block initially at rest. After the collision, the 4.0 kg block has 14.2 J of kinetic energy . The speed of the 2.0 kg block after the collision is:

A) 0 m/s
B) 4.0 m/s
C) 1.3 m/s
D) 2.0 m/s
E) 2.6 m/s

Answer C

9-7 Momentum and Collision Energy in Collisions
M2-041

A ball of mass m1= 0.2 kg and speed= v1 makes an elastic head-on collision with another ball of mass m2 initially at rest. After collision, m1 continues to move in the original direction but with speed = (1/3)v1. What is the value of m2?

A) 0.1 kg
B) 0.3 kg
C) 0.2 kg
D) 0.4 kg
E) 0.5 kg

Answer A

9-8 Inelastic Collisions in One Dimension
M2-041

As shown in Fig 4, a ball of mass M is hanging from a rope to make a pendulum. A 10 g bullet strikes the ball with a speed v=308 m/s. The center of mass of the ball + bullet rises a vertical distance of h=12 cm. Assuming that the bullet remains embedded, calculate the mass M of the ball.

A) 8.0 kg
B) 5.0 kg
C) 3.0 kg
D) 6.0 kg
E) 2.0 kg

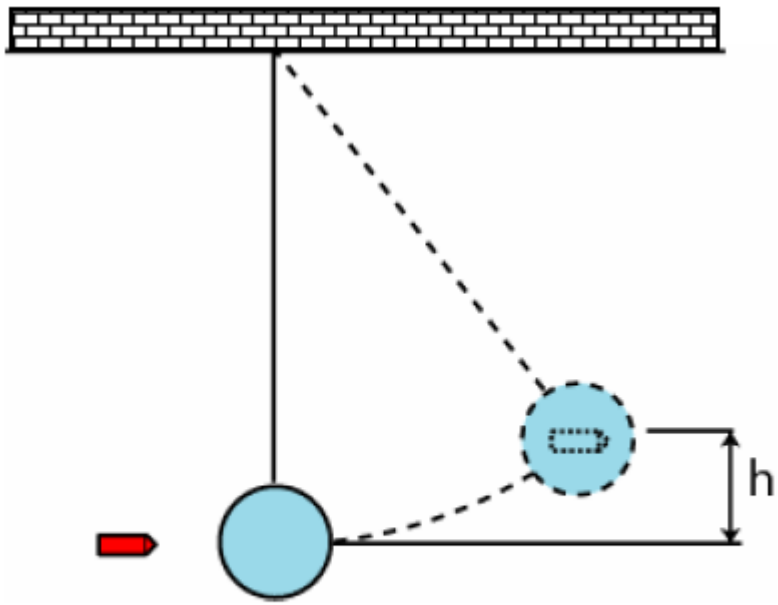


Figure 4

Answer E

9-8 Inelastic Collisions in One Dimension
M2-032

A 10 gram bullet is shot in the +x-direction with a speed of Vo = 500 m/s into a stationary block of wood that has a mass of 5.0 kg (see Fig 3). The bullet embeds itself in the block. What distance (d) will the block slide on a surface having a coefficient of kinetic friction equal to 0.5?

A) 2 cm
B) 50 cm
C) 100 cm
D) 5 cm
E) 10 cm

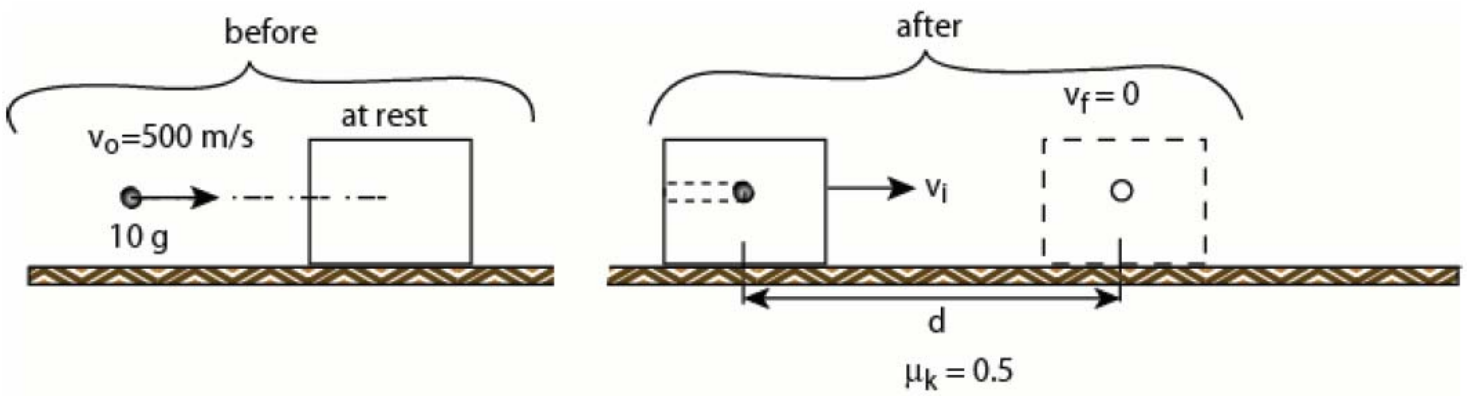


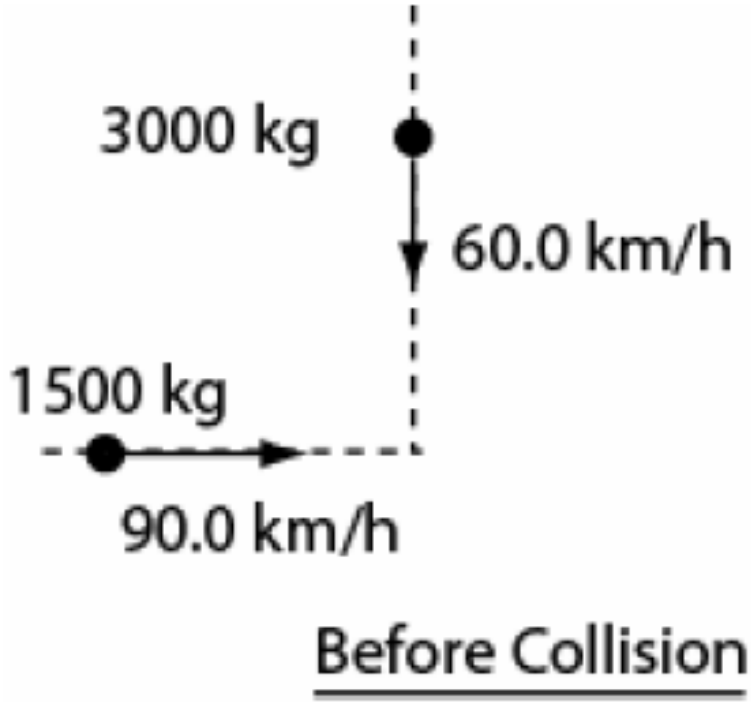
Figure 3

Answer E

9-9 Collisions in Two Dimensions
M2-061

A 1500 kg car traveling at 90.0 km/h east collides with a 3000 kg car traveling at 60.0 km/h south. The two cars stick together after the collision (see Fig 2). What is the speed of the cars after collision?

A) 17.4 m/s
B) 8.33 m/s
C) 13.9 m/s
D) 21.7 m/s
E) 50.0 m/s



Answer C