Name: ______________________________ Date: ____________________ Period: ________

AP Physics C
Momentum HO16

1.) An 80.0 kg hockey player standing on ice throws a 0.160 kg hockey puck horizontally at the net with a speed of 30.0 m/s. With what speed and in what direction will the hockey player begin to move if there is no friction between his feet and the ice? (8-16)

2.) A baseball has a mass of 0.145 kg. (8-8)

a.) If the velocity of a pitched ball has a magnitude of 30.0 m/s and after the ball is batted the velocity is 45.0 m/s in the opposite direction, find the magnitude of the change in momentum of the ball and of the impulse applied to it by the bat.

b.) If the ball remains in contact with the bat for 2.00 ms, find the magnitude of the average force applied by the bat.

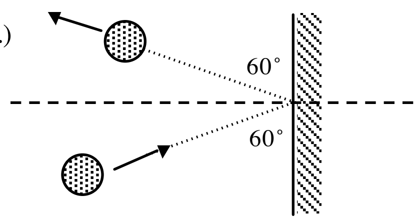
3.) A net force of $F(t) = A + Bt^2$ and directed to the right is applied to a girl on roller skates. The girl has a mass m. The force starts at $t_1 = 0$ and continues until $t = t_2$. (8-11)

a.) What is the impulse J of the force? b.) If the girl is initially at rest, what is her speed at time t_2?

4.) A golf ball (m = 46 g) is struck a blow that makes an angle of 45° with the horizontal. The drive lands 200 m away on a flat fairway. If the golf club and the ball are in contact for 7.0 ms, what is the average force of impact?

5.) An 1800 kg car stopped at a traffic light is struck from behind by a 900 kg car and the two become entangled. If the smaller car was moving at 20 m/s before the collision, what is the speed of the entangled mass after the collision?

6.)



A 3.0 kg steel ball strikes a wall with a speed of 10 m/s at an angle of 60° with the surface. It bounces off with the same speed and angle. If the ball is in contact with the wall for 0.20 s, what is the average force exerted on the ball by the wall?

7.) A block of mass m_1 = 1.60 kg initially moving to the right with a speed of 4.00 m/s on a frictionless surface collides with a spring attached to a second block of mass m_2 = 2.10 kg moving to the left with a speed of 2.50 m/s. The spring has a spring constant of 600 N/m.

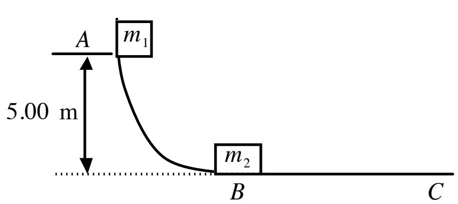
a.) At the instant when m_1 is moving to the right with a speed of 3.00 m/s, determine the speed of m_2.

b.) Determine the distance the spring is compressed at that instant.

c.) Find the velocity of m_1 and the compression in the spring at the instant that m_2 is at rest.

8.) A 1500 kg car traveling east with a speed of 25.0 m/s collides at an intersection with a 2500 kg van traveling north at a speed of 20 m/s. Find the direction and magnitude of the velocity of the wreckage after the collision, assuming a perfectly inelastic collision.

9.)



A block of mass m_1 = 5.00 kg is released from A. It makes a head-on elastic collision with a block of mass m_2 = 10.0 kg at B, initially at rest. Calculate the maximum height to which m_1 rises after the collision. Assume all surfaces are frictionless.

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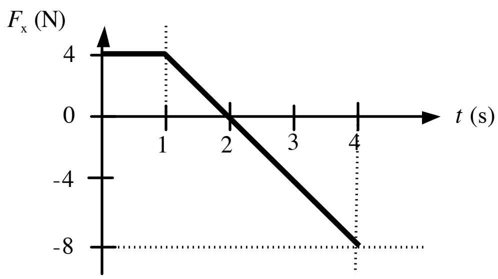
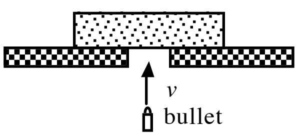
AP Physics C
Momentum HO17

1.) A 1.2 kg object moving with a speed of 8.0 m/s collides perpendicularly with a wall and bounces off with a speed of 6.0 m/s. If the object is in contact with the wall for 2.0 ms, what is the magnitude of the average force on the object by the wall?

2.) 

The only force acting on a 2.0 kg object moving along the x-axis is shown. If the velocity v_x is –2.0 m/s at t = 0, what is the velocity at t = 4.0 s?

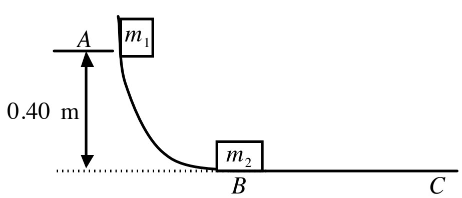
3.) The only force acting on a 2.0 kg mass moving along the x-axis is given by $F_x = (4.0t)$ N, where t is in seconds. If the velocity v_x of the mass is 3.0 m/s at t = 0, at what time will v_x be equal to 8.0 m/s?

4.) 

A 10 g bullet moving 1000 m/s strikes and passes through a 2.0 kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. To what maximum height will the block rise above its initial position?

5.) A 6.0 kg object moving 5.0 m/s collides with and sticks to a 2.0 kg object. After the collision the composite object is moving 2.0 m/s in a direction opposite to the initial direction of motion of the 6.0 kg object. Determine the speed of the 2.0 kg object before the collision.

6.) A 2.0 kg object moving 5.0 m/s collides with and sticks to a 8.0 kg object initially at rest. Determine the kinetic energy lost by the system as a result of this collision.

7.) 

A 3.0 kg mass is released from rest at point A of a frictionless track as shown in a figure below. The mass slides down the track and collides with a 1.4 kg mass that is initially at rest on a horizontal frictionless surface. If the masses stick together, what is their speed after the collision?

8.) A 10 g bullet moving horizontally with a speed of 2.0 km/s strikes and passes through a 4.0 kg block moving with a speed of 4.2 m/s in the opposite direction on a horizontal frictionless surface. If the block is brought to rest by the collision, what is the kinetic energy of the bullet as it emerges from the block?

9.) A 3.0 kg mass moving in the positive x direction with a speed of 10 m/s collides with a 6.0 kg mass initially at rest. After the collision, the speed of the 3.0 kg mass is 8.0 m/s, and its velocity vector makes an angle of 35° with the positive x-axis. What is the magnitude and direction of the velocity of the 6.0 kg mass after the collision?

10.) A 3.0 kg mass sliding on a frictionless surface explodes into three 1.0 kg masses. After the explosion the velocities of the three masses are: (1) 9.0 m/s, north; (2) 4.0 m/s, 30° south of west; and (3) 4.0 m/s 30° south of east. What was the magnitude of the original velocity of the 3.0 kg mass?

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AP Physics C
Momentum and Center of Mass HO18

1.) Three objects have the following masses and center of mass coordinates: (1) 2.00 kg, (2.00 m, 3.00 m); (2) 3.00 kg, (2.00 m, -2.00 m); (3) 4.00 kg (-3.00 m, 6.00 m). Find the coordinates of the center of mass of the system.

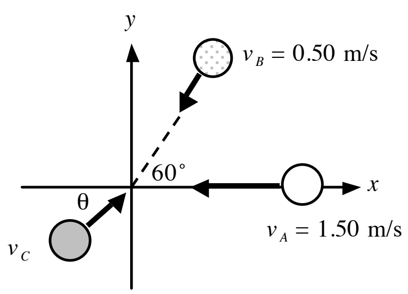
2.) A 0.200 kg steel ball is dropped from a height of 4.00 m onto a horizontal steel slab. The ball rebounds to a height of 3.80 m. (8-58)

a.) Calculate the impulse delivered to the ball during impact.

b.) If the ball is in contact with the slab for 2.00 ms, find the average force on the ball during impact.

3.) A 1500 kg car is traveling south, and a 2000 kg car is traveling west. If the total momentum of the system consisting of the two cars is 8000 kg·m/s directed at 30.0° west of south, what is the speed of each car? (8-62)

4.)



Spheres *A* (mass 0.020 kg), *B* (mass 0.030 kg), *C* (mass 0.050 kg), are each approaching the origin as they slide on a frictionless table. The initial velocities of *A* and *B* are given in the figure below. All three spheres arrive at the origin at the same time and stick together. (8-64)

a.) What must be the *x*- and *y*- components of the initial velocity of *C* if all three objects are to end up at rest after the collision?

b.) Find the direction of sphere *C* before the collision.

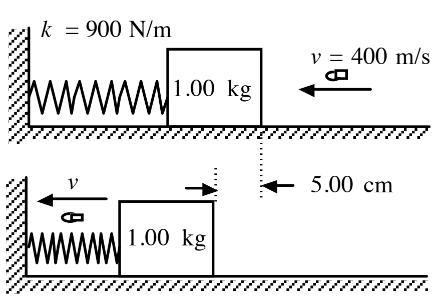
5.) Three particles are placed in the *xy* plane. A 40 g particle is located at (4, 3) m, and a 50 g particle is located at (-2, -2) m. Where must a 20 g particle be placed so that the center of mass of the three-particle system is at the origin?

6.) Three particles are placed in the *xy* plane. A 30 g particle is located at (3, 4) m, and a 40 g particle is located at (-2, -2) m. Where must a 20 g particle be placed so that the center of mass of the three-particle system is at the origin?

7.) At the instant a 2.0 kg particle has a velocity of 4.0 m/s in the positive *x*-direction, a 3.0 kg particle has a velocity of 5.0 m/s in the positive *y*-direction. What is the speed of the center of mass of the two-particle system?

8.) At the instant a 3.0 kg particle has a velocity of 6.0 m/s in the negative *y*-direction, a 4.0 kg particle has a velocity of 7.0 m/s in the positive *x*-direction. What is the speed of the center of mass of the two-particle system?

9.)



A 5.00 g bullet moving with an initial speed of 400 m/s is fired into and passes through a 1.00 kg block as shown below. The block is initially at rest on a frictionless, horizontal surface and is connected to a spring of force constant 900 N/m. The block moves 5.00 cm to the left after impact.

a.) Find the speed at which the bullet emerges from the block.

b.) Find the energy lost in the collision.

10.) Three objects have the following masses and center of mass coordinates: (1) 4.00 kg, (2.00 m, -3.00 m); (2) 2.00 kg, (-2.00 m, 2.00 m); (3) 6.00 kg (3.00 m, -2.00 m). Find the coordinates of the center of mass of the system.