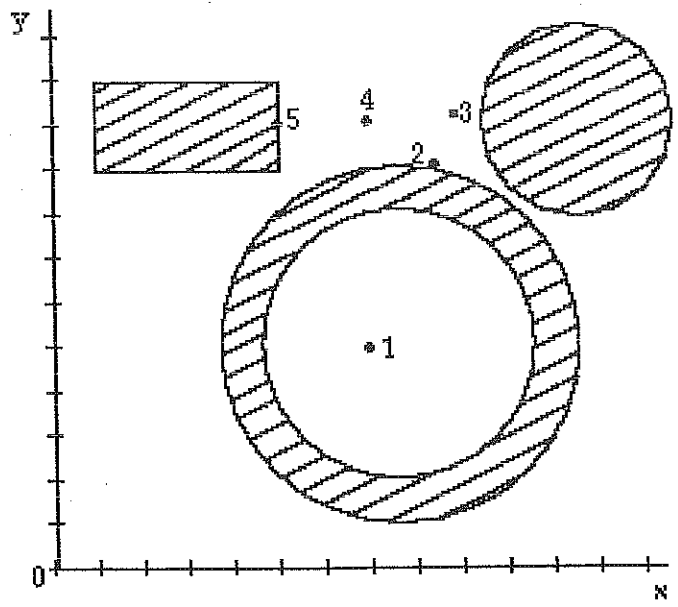
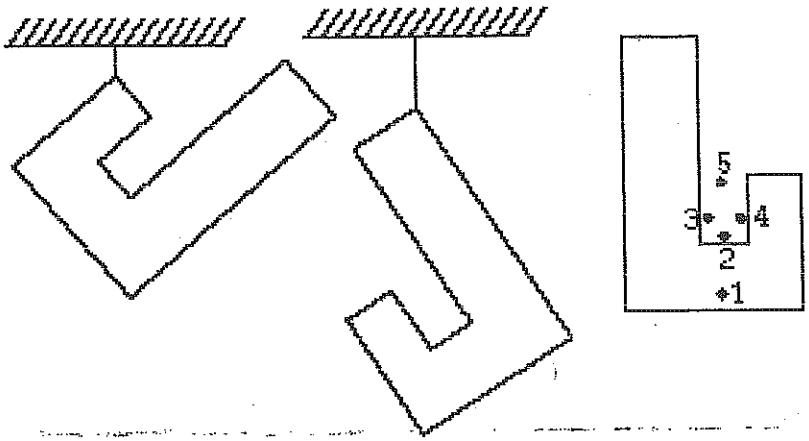
A. P. "C" Momentum Practice

1. 

The mass of the rectangle in the figure is M, the mass of the ring is M, and the mass of the circle is 3M. The center of mass of the system with respect to the origin O is located at point

a. 1 b. 2 c. 3 d. 4 e. 5

2. 

The figure shows a piece of sheet metal suspended in two positions by a string. From the way the metal hangs, you can see that the center of gravity is nearest point

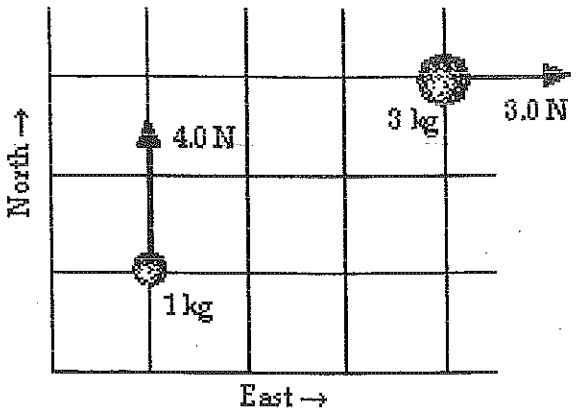
a. 1 b. 2 c. 3 d. 4 e. 5

3. A boy is standing at the stern (back) of a boat that is 8.0 m long. There is no friction between the boat and the water. The boy has a mass of 63 kg and the boat has a mass of 780 kg. The bow (front) of the boat is touching a dock and the fore-and-aft axis of the boat is perpendicular to the dock. The boy walks from the stern of the boat to the bow. When he reaches the bow, his distance from the dock is

a. 7.6 m b. 0.65 m c. 0.51 m d. 0.56 m e. 1.3 m

4. The earth has mass 5.89×10^{24} kg. The moon has mass 7.36×10^{22} kg and is 3.84×10^{5} km from the earth. How far from the center of the earth is the center of mass of the earth–moon system?

a. 4.7×10^{3} km b. 7.4×10^{3} km c. 1.9×10^{5} km d. 2.1×10^{5} km e. 3.8×10^{3} km

5. 

A 1.0-kg mass is acted on by a net force of 4.0 N and a 3.0-kg mass is acted on by a net force of 3.0 N, in the directions shown. The acceleration of the center of mass of this system is approximately

a. 1.3 m/s^2, 53° N of E
b. 1.8 m/s^2, 45° N of E
c. 4.0 m/s^2, due north
d. 5.0 m/s^2, N of E
e. 7.0 m/s^2, 53° N of E

6. An automobile of mass 1300 kg has an initial velocity of 7.20 m/s toward the north and a final velocity of 6.50 m/s toward the west. The magnitude and direction of the change in momentum of the car are

a. 1.26×10^4 kg · m/s at 48° S of E
b. 1.26×10^4 kg · m/s at 48° S of W
c. 1.26×10^4 kg · m/s at 48° N of W
d. 1.78×10^4 kg · m/s at 48° N of W
e. 910 kg · m/s at 48° S of E

7. For this question, assume that all velocities are horizontal and that there is no friction. Two skaters A and B are on an ice surface. A and B have the same mass M = 90.5 kg. A throws a ball with mass m = 200 g toward B with a speed v = 21.5 m/s relative to the ice. B catches the ball and throws it back to A with the same speed. After A catches the ball, his speed with respect to the ice is

a. 4.3×10^3 m/s b. 4.3 m/s c. 4.8×10^{-2} m/s d. 9.5×10^{-2} m/s e. 0.34 m/s

8. Momentum is conserved in which of the following?

a. elastic collisions
b. inelastic collisions
c. explosions
d. collisions between automobiles
e. all of these

9. For a system consisting of two particles that undergo an elastic collision,

a. momentum is conserved but the total energy is not conserved.
b. neither the kinetic energy nor the momentum is conserved.
c. neither the total energy nor the momentum is necessarily conserved.
d. the mechanical energy is conserved but momentum is not conserved.
e. both kinetic energy and momentum are conserved.

10. If a body moves in such a way that its linear momentum is constant, then

a. its kinetic energy is zero.
b. the sum of all the forces acting on it must be zero.
c. its acceleration is greater than zero and is constant.
d. its center of mass remains at rest.
e. the sum of all the forces acting on the body is constant and nonzero.

11. A bullet with a mass of 20 g and a speed of 960 m/s strikes a block of wood of mass 4.5 kg resting on a horizontal surface. The bullet gets embedded in the block. The speed of the block immediately after the collision

a. cannot be found because we don't know whether the surface is frictionless.
b. is 0.21 km/s
c. is 65 m/s
d. is 9.3 m/s
e. is none of these.

12. A 40-kg girl, standing at rest on the ice, gives a 60-kg boy, who is also standing at rest on the ice, a shove. After the shove, the boy is moving backward at 2.0 m/s. Ignore friction. The girl's speed is

a. zero b. 1.3 m/s c. 2.0 m/s d. 3.0 m/s e. 6.0 m/s

13. A moving particle is stopped by a single head-on collision with a second, stationary particle, if the moving particle undergoes

a. an elastic collision with a second particle of much smaller mass.
b. an elastic collision with a second particle of much greater mass.
c. an elastic collision with a second particle of equal mass.
d. an inelastic collision with a second particle of any mass.
e. any type of collision in which the coefficient of restitution is zero.

14. Two bodies A and B move toward each other with speeds of 80 cm/s and 20 cm/s, respectively. The mass of A is 140 g and that of B is 60 g. After a head-on, perfectly elastic collison the speed of B is

a. 8.0 cm/s b. 20 cm/s c. 92 cm/s d. 1.2 m/s e. 1.3 m/s

15. A block of wood with a mass M = 4.65 kg is resting on a horizontal surface when a bullet with a mass m = 18 g and moving with a speed v = 725 m/s strikes it. The coefficient of friction between the block and the surface is $\mu = 0.35$. The distance the block moves across the surface is

a. 1.1 m b. 3.3 m c. 0.41 m
d. 11 m e. none of these.

16. A mass $m_1 = 2.5$ kg is connected to another mass $m_2 = 4.0$ kg by a compressed spring. Both masses are at rest on a frictionless surface. When the spring is released, the masses are pushed apart and a total energy of 16.8 J is given to the two masses.

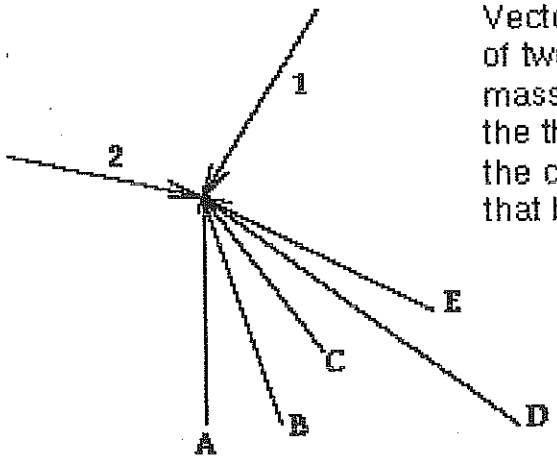
The speed of mass m_1 is

a. 3.2 m/s b. 2.9 m/s c. 1.8 m/s d. 8.3 m/s e. 5.4 m/s

17. A bullet of mass m and velocity u strikes and becomes imbedded in a wooden block of mass M, which is initially at rest on a frictionless surface. The ratio of the velocity of the system after collision to the initial velocity of the bullet is

a. (M + m)/m b. (M + m)/M c. M/(m + M) d. m/(m + M) e. M/(m - M)

18.



Vectors 1 and 2 are the momentum vectors of two equal masses, m_1 and m_2. A third equal mass, m_3, has a momentum such that when the three masses collide and stick together the combined mass has zero velocity. The vector that best represents the momentum of mass m_3 is

a. **A** b. **B** c. **C** d. **D** e. **E**

19. An 1810-kg truck traveling eastward at 64.4 km/h collides at an intersection with a 905-kg automobile traveling northward at 96.5 km/h. The vehicles lock together and immediately after the collision are headed in which direction?

a. 30° N of E b. 37° N of E c. 45° N of E d. 53° N of E e. 67° N of E

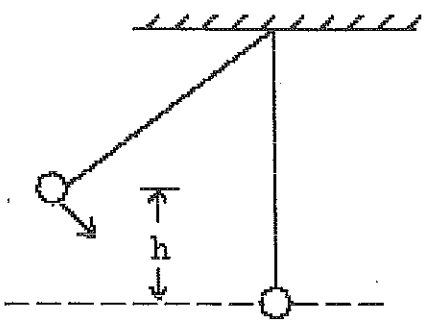
20. A projectile with a mass 6M is fired at a speed of 400 m/s at an angle of 60° above the horizontal. At the highest point of its trajectory, the projectile is broken into two equal pieces by an internal explosion. Just after the explosion, one of the two pieces is known to be traveling vertically downward at a speed of 300 m/s. The magnitude of the velocity of the other half of the projectile is

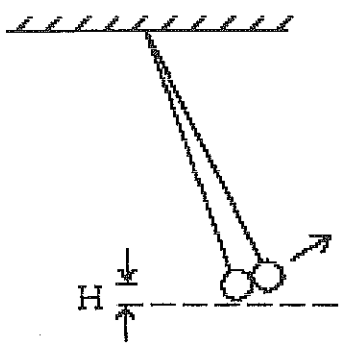
a. 500 m/s b. 1.50 km/s c. 400 m/s d. 710 m/s e. 123 m/s

21. In a real collision,

a. kinetic energy is conserved.
b. linear momentum is conserved in the absence of external forces.
c. both momentum and kinetic energy are conserved.
d. neither momentum nor kinetic energy is conserved.
e. the extent to which momentum and kinetic energy are conserved depends on the coefficient of restitution.

22.





Two identical masses are hung on strings of the same length. One mass is released from a height h above its free-hanging position and strikes the second mass; the two stick together and move off. They rise to a height H given by

a. 3h/4 b. h/4 c. h/2
d. h e. none of these.

23. You shoot an arrow with a mass of 0.54 kg at 45° above the horizontal. The bow exerts a force of 125 N for 0.65 s. With no air resistance, the maximum height the arrow reaches is

a. 1.2 km b. 5.4 m c. 0.57 km d. 0.29 km e. 0.61 km

24. While in horizontal flight at a speed of 20 m/s, a baseball of mass 0.11 kg is struck by a bat. After leaving the bat, the baseball has a speed of 29 m/s in a direction opposite to its original direction. The magnitude of the impulse given the ball is

a. 0.99 kg · m/s b. 5.4 kg · m/s c. 2.2 kg · m/s d. 3.2 kg · m/s e. 0.55 kg · m/s

25. An automatic rifle fires 0.040-kg projectiles at a speed of 800 m/s. If the gunner holding the rifle in her hands can exert an average force of 160 N against the gun, the maximum number of projectiles she can fire in one minute is

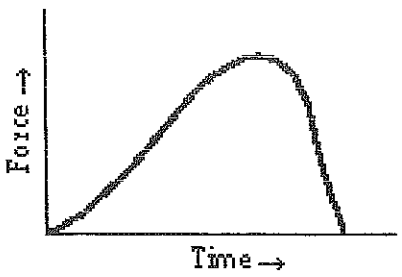
a. 15 b. 300 c. 800 d. 4000 e. 48,000

26. The force exerted on a body of mass 10 kg varies with time according to

$$F = 20t + 10$$

where the units are SI. If the velocity of the body was zero at t = 0, its velocity at t = 5 s is

a. 11 m/s b. 16 m/s c. 23 m/s d. 30 m/s e. 0.11 km/s

27. 

What is the physical significance of the area under the curve shown in the figure?

a. work b. impulse c. velocity d. acceleration e. mass