7) Two people of unequal mass are initially standing still on ice with negligible friction. They then simultaneously push each other horizontally. Afterward, which of the following is true?

(A) The kinetic energies of the two people are equal.
(B) The speeds of the two people are equal.
(C) The momenta of the two people are of equal magnitude.
(D) The center of mass of the two-person system moves in the direction of the less massive person.
(E) The less massive person has a smaller initial acceleration than the more massive person.

8) A railroad car of mass m is moving at speed v when it collides with a second railroad car of mass M which is at rest. The two cars lock together instantaneously and move along the track. What is the speed of the cars immediately after the collision?

(A) $\frac{v}{2}$
(B) $\frac{mv}{M}$
(C) $\frac{Mv}{m}$
(D) $\frac{(m+M)v}{m}$
(E) $\frac{mv}{m+M}$

9) Which of the following is true when an object of mass m moving on a horizontal frictionless surface hits and sticks to an object of mass $M > m$, which is initially at rest on the surface?

(A) The collision is elastic.
(B) All of the initial kinetic energy of the less-massive object is lost.
(C) The momentum of the objects that are stuck together has a smaller magnitude than the initial momentum of the less-massive object.
(D) The speed of the objects that are stuck together will be less than the initial speed of the less-massive object.
(E) The direction of motion of the objects that are stuck together depends on whether the hit is a head-on collision.

10) An empty sled of mass M moves without friction across a frozen pond at speed v_0. Two objects are dropped vertically into the sled one at a time: first an object of mass m and then an object of mass $2m$. Afterward the sled moves with speed v_f. What would be the final speed of the sled if the objects were dropped into it in reverse order?

(A) $\frac{v_f}{3}$
(B) $\frac{v_f}{2}$
(C) v_f
(D) $2v_f$
(E) $3v_f$

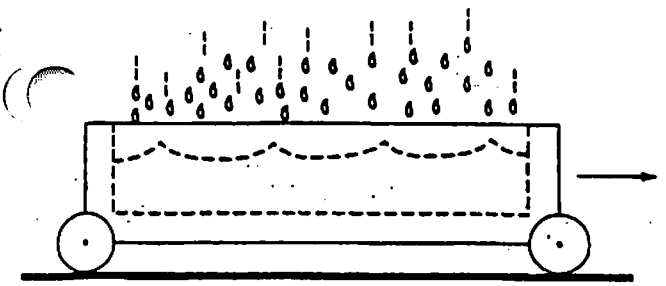
11) How does an air mattress protect a stunt person landing on the ground after a stunt?

(A) It reduces the kinetic energy loss of the stunt person.
(B) It reduces the momentum change of the stunt person.
(C) It increases the momentum change of the stunt person.
(D) It shortens the stopping time of the stunt person and increases the force applied during the landing.
(E) It lengthens the stopping time of the stunt person and reduces the force applied during the landing.

12) Two objects, A and B, initially at rest, are "exploded" apart by the release of a coiled spring that was compressed between them. As they move apart, the velocity of object A is 5 m/s and the velocity of object B is -2 m/s. The ratio of the mass of object A to the mass of object B, m_A/m_B, is

(A) 4/25
(B) 2/5
(C) 1/1
(D) 5/2
(E) 25/4

Momentum (pg. 1)

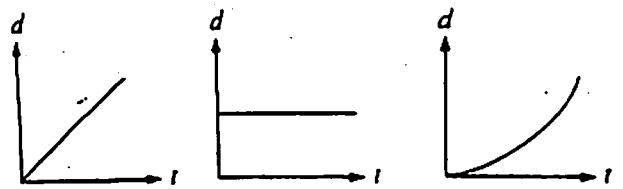


An open cart on a level surface is rolling without frictional loss through a vertical downpour of rain, as shown above. As the cart rolls, an appreciable amount of rainwater accumulates in the cart. The speed of the cart will

(A) increase because of conservation of momentum
(B) increase because of conservation of mechanical energy
(C) decrease because of conservation of momentum
(D) decrease because of conservation of mechanical energy
(E) remain the same because the raindrops are falling perpendicular to the direction of the cart's motion

...ions 2 & 2

Three objects can only move along a straight, level path. The graphs below show the position d of each of the objects plotted as a function of time t.



2) The magnitude of the momentum of the object is increasing in which of the cases?

(A) II only
(B) III only
(C) I and II only
(D) I and III only
(E) I, II, and III

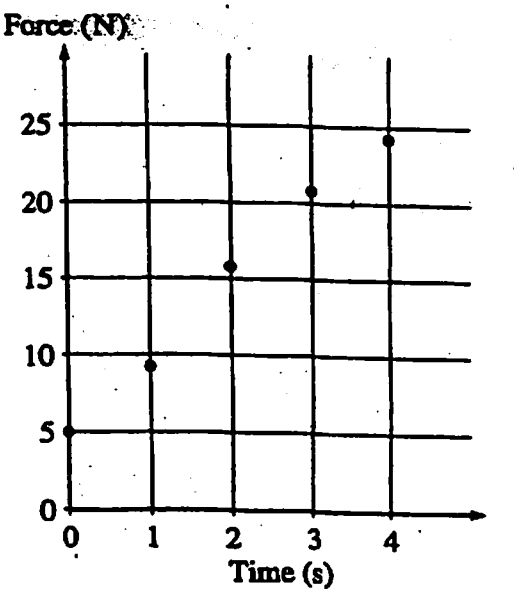
The sum of the forces on the object is zero in which of the cases?

(A) II only
(B) III only
(C) I and II only
(D) I and III only
(E) I, II, and III

4) A ball of mass 0.4 kg is initially at rest on the ground. It is kicked and leaves the kicker's foot with a speed of 5.0 m/s in a direction 60° above the horizontal. The magnitude of the impulse imparted by the ball to the foot is most nearly

(A) 1 N·s
(B) $\sqrt{3}$ N·s
(C) 2 N·s
(D) $\frac{2}{\sqrt{3}}$ N·s
(E) 4 N·s

Questions 5 & 6



A student obtains data on the magnitude of force applied to an object as a function of time and displays the data on the graph above.

5) **The slope of the "best fit" straight line is most nearly**

(A) 5 N/s
(B) 6 N/s
(C) 7 N/s
(D) 8 N/s
(E) 10 N/s

6) **The increase in the momentum of the object between t = 0 s and t = 4 s is most nearly**

(A) 40 N·s
(B) 50 N·s
(C) 60 N·s
(D) 80 N·s
(E) 100 N·s