The cart’s change of momentum is

1. 30 kg m/s.
2. 10 kg m/s.
3. -10 kg m/s.
4. -20 kg m/s.
5. -30 kg m/s.
A 10 g rubber ball and a 10 g clay ball are thrown at a wall with equal speeds. The rubber ball bounces, the clay ball sticks. Which ball exerts a larger impulse on the wall?

1. They exert equal impulses because they have equal momenta.
2. The clay ball exerts a larger impulse because it sticks.
3. Neither exerts an impulse on the wall because the wall doesn’t move.
4. The rubber ball exerts a larger impulse because it bounces.
Objects A and C are made of different materials, with different “springiness,” but they have the same mass and are initially at rest. When ball B collides with object A, the ball ends up at rest. When ball B is thrown with the same speed and collides with object C, the ball rebounds to the left. Compare the velocities of A and C after the collisions. Is \( v_A \) greater than, equal to, or less than \( v_C \)?

1. \( v_A > v_C \)
2. \( v_A < v_C \)
3. \( v_A = v_C \)
To get off a frozen lake, a 70.0 kg person with ice skates (ignore friction) throws a 0.150 kg object horizontally, directly away from the shore with a speed of 20.0 m/s. How fast is the person moving right after throwing the object?

1. 0.0429 m/s
2. 0.135 m/s
3. 1.17 m/s
4. 0.00289 m/s
5. 0.673 m/s
To get off a frozen lake, a 70.0 kg person with ice skates (ignore friction) throws a 0.150 kg object horizontally, directly away from the shore with a speed of 20.0 m/s. If the person is 5.00 m from the shore, how long does it take for them to reach the shore?

1. 34.0 s
2. 99.7 s
3. 117 s
4. 12.5 s
5. 314 s
The two particles are both moving to the right. Particle 1 catches up with particle 2 and collides with it. The particles stick together and continue on with velocity $v_f$. Which of these statements is true?

1. $v_f = v_2$
2. $v_f$ is less than $v_2$
3. $v_f$ is greater than $v_2$, but less than $v_1$
4. $v_f = v_1$
5. $v_f$ is greater than $v_1$
A sports car weighing 500 kg and traveling at 27 m/s east fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s north. Which vector could represent the net momentum before and after the collision?

Net momentum changes during the collision.
A sports car weighing 500 kg and traveling at 27 m/s fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s in a direction at right angles to it. The wreckage becomes locked and travels 18 m before coming to rest. How many stages should this problem be broken into?

1. 1
2. 2
3. 3
A sports car weighing 500 kg and traveling at 27 m/s fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s in a direction at right angles to it. The wreckage becomes locked and travels 18 m before coming to rest. What analysis should be used to work the collision stage?

1. Kinematics
2. Mechanics
3. Impulse
4. Conservation of Momentum
5. Conservation of Energy
A sports car weighing 500 kg and traveling at 27 m/s fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s in a direction at right angles to it. The wreckage becomes locked and travels 18 m before coming to rest. What analysis should be used for the sliding to rest stage?

1. Kinematics (x, v, a)
2. Mechanics (forces)
3. Impulse
4. Conservation of Momentum
5. Conservation of Energy
6. Combination of Kinematics and Mechanics
A sports car weighing 500 kg and traveling at 27 m/s east fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s north. What is the velocity vector of the car + truck mess right after the collision.

1. \( <45.1, 22.3> \text{ m/s} \)
2. \( <-12.3, 88.9> \text{ m/s} \)
3. \( <31.9, -22.2> \text{ m/s} \)
4. \( <12.1, 21.6> \text{ m/s} \)
5. \( <6.49, 15.2> \text{ m/s} \)
Example:

A sports car weighing 500 kg and traveling at 27 m/s fails to stop at an intersection and crashes into a 1600 kg delivery truck traveling at 20 m/s in a direction at right angles to it. The wreckage becomes locked and travels 18 m before coming to rest. Find the coefficient of kinetic friction between the road and the car + truck system during the sliding-to-rest stage. (Answer: 0.77)
A spaceship of mass $2.0 \times 10^6$ kg is cruising at a speed of $5.0 \times 10^6$ m/s when the antimatter reactor fails, blowing up the ship in three pieces. One section, having a mass of $5.0 \times 10^5$ kg, is blown straight backward in the negative $x$-direction with a speed of $2.0 \times 10^6$ m/s. A second piece, with mass $8.0 \times 10^5$ kg, continues forward at $1.0 \times 10^6$ m/s. If the original spaceship was traveling in the $+x$ direction, which axis can’t the third piece be traveling along?

1. $x$
2. $y$
3. $z$
4. either $x$ or $z$
5. either $z$ or $y$
Ice skaters often end their performances with spin turns, where they spin very fast about their center of mass with their arms folded in and legs together. Upon ending, their arms extend outward, proclaiming their finish. Not quite as noticeably, one leg goes out as well. Suppose that the moment of inertia of a skater with arms out and one leg extended is 3.2 kg·m² and for arms and legs in is 0.80 kg·m². If she starts out spinning at 5.0 rev/s, what is her angular speed (in rev/s) when her arms and one leg open outward?

1. 0.83 rev/s
2. 3.91 rev/s
3. 7.85 rev/s
4. 1.25 rev/s
5. 20.8 rev/s
A gigantic hole is bored out of the earth, towards the center, on the equator. A ball is dropped from the center of the hole. Remembering angular momentum, you are asked which path, relative to the earth, is the ball most likely to follow and why? (ignore air resistance)