

Midterm 4 for Calculus-Based Physics-1: Mechanics (PHYS150-O1)

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1 Definition of Momentum

1. Which of the following quantities has units of momentum?
 - 4 m/s
 - 8 kg m/s
 - 10 m/s²
 - 3 N m
2. Which two properties of a system must be true for momentum to be conserved?
 - The mass must be constant, and there must be no net external force.
 - The mass must be constant, and there must be no internal forces.
 - There must be no net external force, and the velocity vectors must sum to zero.
 - There must be no internal forces and no net external force.
3. In which of the following situations will momentum be conserved?
 - An object skids to a stop due to surface friction.
 - After a rocket has launched vertically upward, and has run out of fuel.
 - A hockey puck glides along frictionless ice and rebounds off of a wall.
 - A sheet of paper falls to the ground at constant velocity and then rests on the ground.
4. What is the momentum of a 10 kg meteorite traveling through space at 1 km/s?

2 Conservation of Momentum

1. A 100 gram meteorite breaks into two smaller ones. The two final velocities are observed to be equal, and in the same direction as the original velocity. What are the masses of the two pieces, if momentum is conserved?
2. Two protons interact and scatter off of each other. The mass of both particles cannot change. If one proton has a velocity of $v_1 = -10^6$ m/s, and the other has $v_2 = 10^6$ m/s, what are the final velocities? Draw a diagram of the initial state and the final state.

3 Classifying Interactions

1. What quantity is conserved in an *elastic* interaction but not in an *inelastic* interaction?
 - Gravitational potential energy
 - Kinetic energy
 - Momentum
 - Internal forces
2. If an interaction is *totally* inelastic, what is the final velocity?
 - Less than the initial velocity
 - Such that the kinetic energy decreases
 - Such that the final momentum is zero
 - The final velocity is zero
3. The notation $n \rightarrow n$ means many-to-many, or several particles scattering off of each other. Which of the following is true of $n \rightarrow n$ interactions?
 - They must be at least partially elastic
 - They can only be totally elastic
 - They must be inelastic
 - They must be totally inelastic
4. The notation $n \rightarrow n$ means many-to-many, or several particles scattering off of each other. Which of the following is true of $n \rightarrow n$ interactions?
 - They must be elastic
 - They cannot be inelastic
 - They must be inelastic
 - They cannot be inelastic
5. A 1 kg particle has $v_1 = 0$ m/s, and it interacts with a 2 kg particle with velocity $v_2 = 2$ m/s. If the collision is inelastic, what is the final velocity of the combined system?
6. A 1 kg particle has $v_1 = -1$ m/s, and it interacts with a 1 kg particle with velocity $v_2 = 1$ m/s. If the collision is elastic, what is the final velocity of each particle?