

Systems of Particles – Set 2

1

An object with a mass of $5m_p$ explodes at rest breaking into three pieces. One of the pieces with a mass of m_p travels in the x direction at 30.0 m/s. Another piece with a mass of $2m_p$ travels in the y direction at 20.0 m/s.

- a) What is the magnitude and direction of the velocity of the last piece?
- b) What is the kinetic energy released in the explosion?

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A 4.0 kg puck is sliding along a frictionless surface when it explodes into two parts, one moving 30 m/s due north and the other at 5.0 m/s 30° north of east. What was the original velocity (x and y components) of the puck?

A spring loaded ball is dropped from 10m. After falling 2m, the spring springs and the ball splits into two pieces, one with a mass m the other with a mass $2m$. The spring acts only in the horizontal direction.

a) What is the velocity (both x and y components) of the center of mass as the pieces hit the ground?

b) How long does it take the center of mass to get to the ground?

c) If the x component of the velocity of the lighter half is 4 m/s after the spring springs, how far apart are the two halves when they hit the ground? (assume that the spring springs VERY quickly)

A 20.0 kg projectile is fired at an angle of 60.0 degrees above the horizontal with a speed of 80.0 m/s. At the highest point of its trajectory, it explodes into two fragments with equal mass. The force of the explosion acts purely in the horizontal direction. One chunk falls vertically to the ground. Where does the second chunk land? How much energy was released in the explosion?

Billy and Sally are once again standing on the ice wearing ice skates (standing on a frictionless surface) initially at rest. They are holding the opposite ends of a rope that is stretched out between them. Placed exactly halfway between them is a delicious steaming hot apple pie and they both want it. They pull on the rope and begin moving towards the pie (and each other). Sally has a mass of 65kg and Billy has a mass of 80kg.

Who gets to the pie first? How far away from the pie is the loser when the winner gets there?

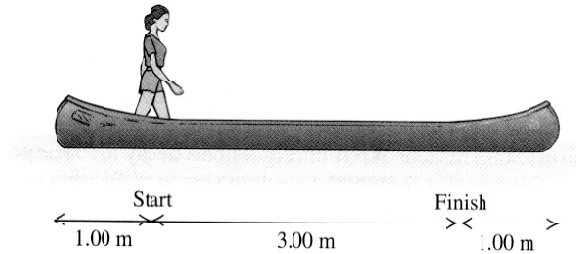
HINT: Question: How does the *position* of the center of mass change as they move?

Answer: It doesn't.

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A 45 kg woman stands up in a 60 kg canoe of length 5.0 m. She walks from a point 1 m from one end to a point one meter from the other end. Ignoring resistance due to the water, how far does the canoe move?



HINT: Consider the canoe as a point mass at its center of mass.

Question: How does the *position* of the center of mass change as they move?

Answer: It doesn't.