

Beverly Hills High School -- Physics -- Quest #6 -- 50 points

SHOW ALL YOUR WORK. Write the appropriate equations for everything AND be sure to put the proper units on all your answers. Pencils only -- calculators okay. Ten points apiece for the problems.


1) Granny is roller skating with her grandson Donnie. Granny has a mass of 76 kg and Donnie has a mass of 43 kg. Donnie is motionless when Granny comes around the track at 12.5 m/s and wraps her arms around Donnie. Assuming no friction, what will be the final velocity of the two people?

2) A boy shoots a pea from his pea shooter directly at a 150 g baseball, sitting motionless on the table. He shoots the pea at a speed of 40 m/s. The pea bounces right back at him. If the pea has a mass of 5 g and the baseball is free to roll without friction, what is the final velocity of the pea and the baseball? Assume a perfectly elastic collision. (Hint: You'll need to write both conservation laws first.)

3) A 125 kg spaceman is floating at rest relative to his spacecraft in deep space. He throws his toolkit at 6.35 m/s away from himself. If the spaceman recoils backwards at 0.85 m/s, find the mass of the toolkit.

- 4) A train of mass 4500 kg is rolling eastward down the track at 20 m/s. Another train, of mass 3500 kg, is rolling westward at 25 m/s. The two trains couple. a) What will their final velocity be and b) how far will they have traveled 30 seconds after colliding?

Multiple Choice. Write the letter that best answers each of the following. Two points apiece.

- _____ 5) When two ice skaters initially at rest push off one another, their final momenta are
- a) equal in magnitude and direction
 - b) equal in magnitude but opposite in direction
 - c) in the same direction but of different magnitudes
 - d) in opposite directions and possibly of different magnitudes
- _____ 6) A shopping cart weighing 12 kg moves with a speed of 5 m/s. A 3 kg food container falls into the shopping cart. What is the speed of the shopping cart after the container falls?
- a) 1 m/s
 - b) 2 m/s
 - c) 3 m/s
 - d) 4 m/s
 - e) 5 m/s
- _____ 7) Two billiard balls move on a frictionless surface with speeds of v and $v/2$, as shown. Both of the balls have the same mass, and the collision is perfectly elastic. What is the sum of the velocities of the two balls after the collision?
- a) $v/2$
 - b) v
 - c) $3v/2$
 - d) $2v$
 - e) $5v/2$
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- _____ 8) A bullet is shot into a block of wood. Look at statements I, II and III. Which choices are true?
- I) This is an inelastic collision.
 - II) Momentum is conserved.
 - III) Kinetic energy is conserved.
- a) Only I is true
 - b) Only I and II are true.
 - c) All three are true.
 - d) Only I and III are true.
 - e) Only II and III are true.
- _____ 9) A firecracker, initially at rest, explodes into two pieces, one twice as massive as the other
- a) The pieces go in opposite directions; the heavier piece goes twice as fast.
 - b) The pieces go in the same direction; the heavier piece goes twice as fast.
 - c) The pieces go in opposite directions; the lighter piece goes twice as fast.
 - d) The pieces go in the same direction; the lighter piece goes twice as fast.