

Momentum Problems

Name: _____

Date: _____ Period: _____

1. A moving car has momentum. If it moves twice as fast its momentum is _____ as much.
2. Two cars, one twice as heavy as the other, move down a hill at the same speed. Compared to that of the lighter car, the momentum of the heavier car is _____ as much.
3. The recoil momentum of a gun that kicks is (more than) (less than) (the same as) the momentum of the bullet it fires.
4. Suppose you are traveling in a bus at highway speed on a nice summer day and the momentum of an unlucky bug is suddenly changed as it splatters onto the windshield.
 - a. Compared to the force that acts on the bug, how much force acts on the bus ? (more) (same) (less)
 - b. The time of impact is the same for the bug and the bus. Compared to the impulse on the bug, this means that the impulse on the bus is
(more) (same) (less)
 - c. Although the momentum of the bus is very large compared to the momentum of the bug, the change in momentum of the bus compared to the change in momentum of the bug is
(more) (same) (less)
 - d. Which undergoes the greater acceleration ? (bug) (bus) (same)
 - e. Which, therefore, suffers the greater damage ? (bug) (bus) (same)
5. Granny whizzes around the skating rink and is suddenly confronted with her grandson Ambrose at rest directly in her path. Rather than knock him over, she picks him up and continues in motion without "braking". Consider both Granny and Ambrose as two parts of one system. Since no outside forces act on the system, the momentum of the system before the collision is equal to the momentum of the system after the collision.
 - a. Complete the following table:

Before collision:	Granny's mass <u>80kg</u>	Granny's speed <u>3m/s</u>	Granny's Momentum

	Ambrose's mass <u>40kg</u>	Ambrose's speed <u>0m/s</u>	Ambrose's Momentum _____
	Total momentum of Ambrose + Granny _____		
 - b. After the collision Granny's speed (increases) (decreases)
 - c. After the collision Ambrose's speed (increases) (decreases)
 - d. After the collision what is the total mass of granny + Ambrose ? _____
 - e. Use the conservation of momentum law to find the speed of Granny & Ambrose together after the collision (show your work below)

New Speed: _____

6. (Show your work in the space below) Air hockey puck #1 (mass 0.15kg) traveling at 4.7 m/s in the positive x direction, collides with another puck (#2) initially at rest. Puck #1 heads off at a direction of 20° (measured from the + x axis) and puck #2 heads off at -35° . After the collision:

a. What are the x and y components of the velocity of puck #1 ?

b. What are the x and y components of the velocity of puck #2 ?

7. A child spinning on a tire swing has learned how to slow down the rate of spinning. She moves her arms and legs away from the axis of rotation thus increasing her _____. The principle of _____, dictates that this increase causes a(n) _____ in her angular velocity.

8. When some stars run out of nuclear fuel they become neutron stars. Assuming that the moment of inertia decreases by a factor 5×10^{-10} , how many revolutions per second will a star make (if it is currently rotating at 1 revolution per month) when it shrinks to the size of a neutron star ?

9. The moment of inertia of a muddy bike wheel is 7 kg m^2 and it is rotating at a rate of 12 radians per second. When the mud flies off, the new moment of inertia is 5 kg m^2 . What is the new angular velocity of the wheel after the mud flies off ? (assume that the bike is upside down and the wheels are able to spin freely)