Momentum Worksheet (p. 1)
Physics
Answer completely on your own paper.

Momentum problems

1.What is the momentum of a 0.50 kg hockey puck traveling at 50.0 m/s east?

25 kg·m/s east

2. A 1.5 kg football is thrown with a momentum of 22.5 kg·m/s forward. What is the velocity of the football?

15 m/s forward

3. The momentum of a 0.2 kg bullet is 100 kg·mi/h. How fast is the bullet traveling?

500 mi/h

4. What would be the momentum of a 1500 kg truck moving at 20 m/s? Would this momentum be different on the moon? Explain and give new momentum if necessary. *30,000 kg·m/s*

Impulse and Conservation of momentum

5. Which has a greater momentum, a heavy truck at rest or a moving skateboard?

6. Can you run fast enough to have the same momentum as an automobile rolling at 1 mi/h? Justify your answer.

7. For the same force, which cannon gives the larger speed to a cannonball - a long cannon or a short one? Explain.

8. Why might a glass survive a fall onto a carpeted floor but not onto a concrete floor?

9. Why would it be a bad idea to have the back of your hand up against the outfield wall when you catch a long fly ball?

10. Which undergoes the greatest change in momentum: (a) a baseball that is caught, (b) a baseball that is thrown, or (c) a baseball that is caught and then thrown back, if the baseballs have the same speed just before being caught and just after being thrown?

11. It's not the fall that hurts you, it's the sudden stop! Use the language of math to verify this statement with a real example.

12. Explain why it is a good thing that you did not bounce in the previous question.

13. When a bullet is fired, its momentum changes! And the momentum of the recoiling rifle changes. So momentum is not conserved for the bullet, and momentum is not conserved for the rifle. Why can we say that when a rifle fires a bullet, momentum is conserved? Why does the bullet by itself not violate the law of conservation of momentum?

14. The momentum of a train traveling at 50 m/s is equal in magnitude to the momentum of a 10,000 kg plane that is traveling at 2500 m/s. What is the mass of the train? If the two collide head-on what will be the velocity of the resulting pile of metal? *500,000 kg*

15. Railroad car A rolls at a certain speed and makes a perfectly elastic collision with car B of the same mass. After the collision, car A is observed to be at rest. How does the speed of car B compare with the initial speed of car A?

16 If the same two cars in the previous question stick together after colliding inelastically, how does their speed after the collision compare with the initial speed of car A.

Momentum Worksheet (p. 2)
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17. Two automobiles, each of mass 1000 kg, are moving at the same speed, 20 m/s, when they have an inelastic collision. In what direction and at what speed does the wreckage move if one car was driving north and the other south?

18. A railroad diesel engine is four times as massive than a freight car. If the diesel engine coasts at 5 km/h into a freight car that is initially at rest, how fast do the two coast after they couple together? *4 km/h*

Concept-Development Practice Page 7-1

Momentum

19. A moving car has momentum. If it moves twice as fast, its momentum is _____ as much.

20. Two cars, one twice as heavy as the other, move down a hill at the same speed. Compared to the lighter car, the momentum of the heavier car is _____ as much.

21. The recoil momentum of a cannon that kicks is
(more than) (less than) (the same as)
the momentum of the cannonball it fires.

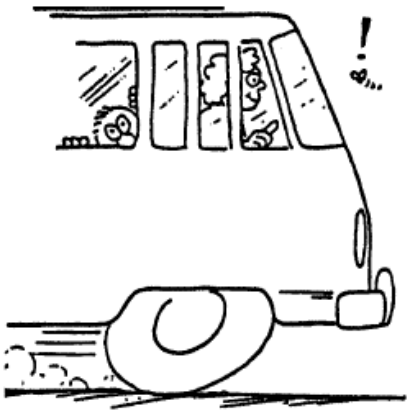
22. If a man firmly holds a cannon when fired, then the momentum of the cannonball is equal to the recoil momentum of the
(cannon alone) (cannon–man system) (man alone)

23. 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 front window.

a. Compared to the force that acts on the bug, how much force acts on the bus?
(more) (the same) (less)

b. The time of impact is the same for both the bug and the bus. Compared to the impulse on the bug, this means the impulse on the bus is
(more) (the 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* of momentum of the bug is
(more) (the same) (less)



d. Which undergoes the greater acceleration?
(bus) (both the same) (bug)

e. Which, therefore, suffers the greater damage?
(bus) (both the same) (the bug of course!)

Conceptual PHYSICS

Momentum Worksheet (p. 3)
Physics
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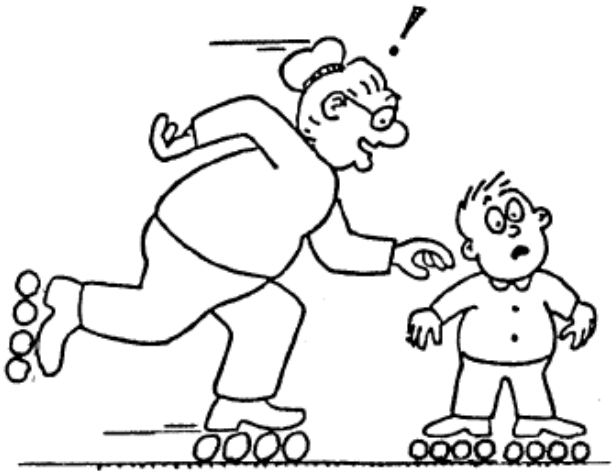
24. Granny whizzes around the rink and is suddenly confronted with Ambrose at rest directly in her path. Rather than knock him over, she picks him up and continues in motion without "braking."



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 collision equals the momentum of the system after collision.

a. Complete the before-collision data in the table below.

BEFORE COLLISION	
Granny's mass	80 kg
Granny's speed	3 m/s
Granny's momentum	_____
Ambrose's mass	40 kg
Ambrose's speed	0 m/s
Ambrose's momentum	_____
Total momentum	_____

b. After collision, does Granny's speed increase or decrease?

_____

c. After collision, does Ambrose's speed increase or decrease?

_____

d. After collision, what is the total mass of Granny + Ambrose?

_____

e. After collision, what is the total momentum of Granny + Ambrose?

_____

f. Use the conservation of momentum law to find the speed of Granny and Ambrose together after collision. (Show your work in the space below.)

New speed =_____

Conceptual PHYSICS