

Conceptual Momentum (ANSWER KEY)

Answer the following Questions

1. Imagine you were an astronaut drifting in space several meters from your spacecraft. The only thing you have with you is a sack filled with moon rocks. Using the concepts of impulse and momentum, how could you return to your spaceship?

Throw the bag in the opposite direction.

2. Ever tried to stop a 150 pound cannonball fired towards you at 30 miles per hour? No, probably not. But you may have tried to brace yourself in a car collision. How are the two situations similar?

They have the same momentum

3. You are sitting at a baseball game when a foul ball comes in your direction. You prepare to catch it barehanded. In order to catch it safely, should you move your hands toward the ball, hold them still, or move them in the same direction as the moving ball? Explain.

Move it back to increase the time decreasing the force. The total change in momentum (impulse) is the same but the force is reduced.

4. Would a head-on collision between two cars be more damaging to the occupants if the cars stuck together or if the cars rebounded upon impact?

Rebounding has a greater change in momentum so by rebounding there is a greater impulse which means potentially a greater force.

5. A boxer being hit with a right-cross punch wishes to roll with the punch to extend time for best results, whereas a karate expert delivers a force in a short time for best results. Isn't there a contradiction here? Explain.

No, the boxer wants less force so he increases the time while the other wants a greater force so he decreases time.

6. Why does a fire hose recoil, or kick backward, when the water is turned on? Explain using the ideas of momentum and impulse.

Water is applying force in one direction, the friction of the water in the hose is pushing back.

7. A Mack truck and a Ford Escort have a head-on collision. Which vehicle will experience the greater force of impact? Which vehicle will experience the greater impulse? Which vehicle will experience the greater change in momentum? Which vehicle will experience the greater acceleration?

Same impulse on both. The car will have a greater acceleration.

8. Air bags do not take the place of seat belts. Air bags provide additional protection. They are intended to be used in conjunction with seat belts to increase safety. Why are air bags effective? How does the air bag protect you? Explain using the concepts of impulse and momentum.

Air bags increase the time in an accident which decreases the force.

9. There are several other safety designs that employ the concept of spreading out the time interval of a force. Describe how the devices listed perform this task: the bumper, a collapsible steering wheel, frontal crush zones, padding on the dashboard

All add time.

10. Why are cars made with bumpers that can be pushed in during a crash?

Increase the time of the collision.

11. In a movie, the hero jumps straight down from a bridge onto a small boat that continues to move with no change in velocity. What physics is being violated here?

Conservation of momentum

12. If the momentum of an object is changing while its mass remains constant, then what else is happening to the object?

The velocity must change.

13. During the Egg-Throwing Demonstration: Which egg experienced the greater impulse, the egg that hit the wall or the egg that hit the bed sheet? (Be careful here!) Which egg experienced the greater force of impact? Which egg experienced the greater time of impact?

They both experience the same impulse, the time of the collision is greater for the bed sheet.

Name: _____

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14. A softball player slides into second base. What happened to her momentum?

Her momentum is changed to zero.

15. Your friend says that the law of momentum conservation is violated when a ball rolls down a hill and gains momentum. What do you say? Explain.

No, the earth is moving up as the ball moves down. The earth's upward motion is EXTREMELY small because it is so MASSIVE.

16. Two bullets of equal mass are shot at equal velocities at blocks of wood on a smooth ice rink. One bullet, made of rubber, bounces off the wood. The other bullet, made of aluminum, burrows into the wood. Which bullet makes the wood move faster? Why?

The bouncing bullet.

17. A lunar vehicle is tested on earth at a speed of 10 km/h. When it travels as fast on the moon, is its momentum more, less, or the same? Explain.

Same momentum

18. Why is it advantageous for a boxer to roll with the punch? Why should he avoid moving into an oncoming punch?

Increases the time decreasing the force.

19. 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?

There is no way to increase the time of impact because you cannot pull your hand back. Therefore you will bruise your hand.

20. True or False. A heavy object will always have a greater momentum than a lighter object.

False. What about a fast moving object?