

Conceptual Physics Momentum and Impulse Take Home Exam

Multiple Choice

Identify the choice that best completes the statement or answers the question.

Write notes in the margin explaining your answer

- ___ 1. The momentum change of an object is equal to the
- impulse acting on it.
 - velocity change of the object.
 - force acting on it.
 - force acting on it times its velocity.
 - object's mass times the force acting on it.
- ___ 2. In order to increase the final momentum of a golf ball, we could
- increase the force acting on it.
 - follow through when hitting the ball.
 - increase the time of contact with the ball.
 - swing as hard as possible.
 - all of the above
- ___ 3. Momentum of a system is conserved only when
- there are no internal forces acting on the system.
 - the system is not moving.
 - there are no forces acting on the system.
 - there is no net external force acting on the system.
 - the system has zero momentum.
- ___ 4. A car traveling along the highway needs a certain amount of force exerted on it to stop. More stopping force may be required when the car has
- less stopping distance.
 - more momentum.
 - more mass.
 - all of the above
 - none of the above
- ___ 5. When you jump off a step, you usually bend your knees as you reach the ground. By doing this, the time of the impact is about 10 times more what it would be in a stiff-legged landing, and the average force on your body is reduced by
- less than 10 times.
 - about 10 times.
 - more than 10 times.
- ___ 6. The momentum of an object is defined as the object's
- mass times its velocity.
 - force times the time interval.
 - force times its acceleration.
 - mass times its acceleration.
 - velocity times the time interval.
- ___ 7. Which has more momentum, a large truck moving at 30 miles per hour or a small truck moving at 30 miles per hour?
- Both have the same momentum.

- b. The small truck
 - c. The large truck
- _____ 8. Compared to a sports car moving at 30 miles per hour, the same sports car moving at 60 miles per hour has
- a. twice as much momentum.
 - b. four times as much momentum.
 - c. the same momentum.
- _____ 9. If the momentum of an object changes and its mass remains constant,
- a. it is accelerating (or decelerating).
 - b. there is a force acting on it.
 - c. its velocity is changing.
 - d. all of the above
 - e. none of the above
- _____ 10. The reason padded dashboards are used in cars is that they
- a. look nice and feel good.
 - b. decrease the impulse in a collision.
 - c. increase the force of impact in a collision.
 - d. decrease the momentum of a collision.
 - e. increase the time of impact in a collision.
- _____ 11. A table tennis ball launcher is fired. Compared to the force on the ball, the force on the launcher is
- a. larger.
 - b. the same.
 - c. smaller.
- _____ 12. A table tennis ball launcher is fired. Compared to the impulse on the ball, the impulse on the launcher is
- a. smaller.
 - b. larger.
 - c. the same.
- _____ 13. A collision is considered elastic if
- a. there is no lasting deformation.
 - b. the objects don't stick together.
 - c. the objects that collide don't get warmer.
 - d. after the collision, the objects have the same shape as before the collision.
 - e. all of the above
- _____ 14. Suppose a girl is standing on a pond where there is no friction between her feet and the ice. In order to get off the ice, she can
- a. bend over touching the ice in front of her and then bring her feet to her hands.
 - b. walk very slowly on tiptoe.
 - c. get on her hands and knees and crawl off the ice.
 - d. throw something in the direction opposite to the way she wants to go.
 - e. all of the above will work
- _____ 15. Which of the following has the largest momentum?
- a. A large truck parked in a parking lot
 - b. A tightrope walker crossing Niagara Falls
 - c. The science building at your school
 - d. A pickup truck traveling down the highway
 - e. A dog running down the street

- ___ 16. A freight train rolls along a track with considerable momentum. If it were to roll at the same speed but had twice as much mass, its momentum would be
- zero.
 - unchanged.
 - quadrupled.
 - doubled.
- ___ 17. A cannon recoils from launching a cannonball. The speed of the cannon's recoil is small because the
- impulse on the cannon is less than the impulse on the cannonball.
 - cannon has far more mass than the cannonball.
 - momentum of the cannon is unchanged.
 - force against the cannon is relatively small.
 - none of the above
- ___ 18. Suppose a cannon is made of a strong but very light material. Suppose also that the cannonball is more massive than the cannon itself. For such a system
- conservation of momentum would not hold.
 - conservation of energy would not hold.
 - the target would be a safer place than where the operator is located.
 - the force on the cannonball would be greater than the force on the cannon.
 - recoil problems would be lessened.
- ___ 19. Two objects, A and B, have the same size and shape, but A is twice as heavy as B. When they are dropped simultaneously from a tower, they reach the ground at the same time, but A has a higher
- acceleration.
 - momentum.
 - speed.
 - all of the above
 - none of the above
- ___ 20. In order to catch a ball, a baseball player moves his or her hand backward in the direction of the ball's motion. Doing this reduces the force of impact on the player's hand principally because
- the time of impact is decreased.
 - the time of impact is increased.
 - the velocity of the hand is reduced.
 - the momentum of impact is reduced.
 - none of the above
- ___ 21. A cannon fires a cannonball. The speed of the cannonball will be the same as the speed of the recoiling cannon
- if the mass of the cannonball equals the mass of the cannon.
 - because momentum is conserved.
 - because velocity is conserved.
 - because both velocity and momentum are conserved.
 - none of the above
- ___ 22. The force of an apple hitting the ground depends upon
- the speed of the apple just before it hits.
 - the time of impact with the ground.
 - whether or not the apple bounces.
 - air resistance on the apple as it falls.
 - all of the above

- ___ 23. Recoil is noticeable if you throw a heavy ball while standing on roller skates. If instead you go through the motions of throwing the ball but hold onto it, your net recoil velocity will be
- small but noticeable.
 - the same as before.
 - zero.
- ___ 24. A 1-N apple falls to the ground. The apple hits the ground with an impact force of
- 1 N.
 - 2 N.
 - 4 N.
 - 9.8 N.
 - Not enough information to say
- ___ 25. A karate expert executes a swift blow and splits a cement block with her bare hand.
- The forces on both the block and the expert's hand have the same magnitude.
 - The times of impact on both the block and the expert's hand are the same.
 - The impulses on both the block and the expert's hand have the same magnitude.
 - all of the above
 - none of the above
- ___ 26. A moving freight car runs into an identical car at rest on the track. The cars couple together. Compared to the velocity of the first car before the collision, the velocity of the combined cars after the collision is
- zero.
 - one half as large.
 - the same.
 - twice as large.
 - More information is needed to say.
- ___ 27. Two gliders having the same mass and speed move toward each other on an air track and stick together. After the collision, the velocity of the gliders is
- twice the original velocity.
 - one half the original velocity.
 - zero.
 - the same as the original velocity.
 - There is not enough information to say.
- ___ 28. A piece of putty moving with 2 units of momentum strikes and sticks to a heavy bowling ball that is initially at rest. After the putty sticks to the ball, both are set in motion with a combined momentum that is
- less than 2 units.
 - 2 units.
 - more than 2 units.
 - There is not enough information to say.
- ___ 29. The force that accelerates a rocket into outer space is exerted on the rocket by
- the exhaust gases.
 - Earth's gravity.
 - atmospheric pressure.
 - rocket's wings.
 - none of the above
- ___ 30. If all people, animals, trains and trucks all over the world began to walk or run towards the east, then
- Earth would spin a bit slower.

- b. Earth's spin would not be affected at all.
 - c. Earth would spin a bit faster.
- ___ 31. Suppose an astronaut in outer space wishes to toss a ball against a very massive and perfectly elastic concrete wall and catch it as it bounces back. If the ball is as massive as the astronaut, then
- a. the astronaut's time between catches will decrease as the game progresses.
 - b. the astronaut will never catch the first bounce.
 - c. the astronaut will catch one bounce only.
 - d. none of the above
- ___ 32. A table tennis ball moving forward with 5 units of momentum strikes and bounces backward off a heavy bowling ball that is initially at rest and free to move. The bowling ball is set in motion with a momentum of
- a. less than 5 units.
 - b. 5 units.
 - c. more than 5 units.
 - d. not enough information.
- ___ 33. Superman is at rest in space when he throws an asteroid that has more mass than he does. Which moves faster, Superman or the asteroid?
- a. Superman
 - b. The asteroid
 - c. They both move at the same speed.
- ___ 34. A cannonball shot from a long-barrel cannon travels faster than one shot from a short-barrel cannon because the cannonball receives a greater
- a. force.
 - b. impulse.
 - c. both A and B
 - d. neither A nor B
- ___ 35. While roller-skating, Granny collides with her tiny grandson Ambrose who is at rest. Ignoring any friction effects, Ambrose's speed after the collision will be greatest when
- a. Granny catches him and they both move together.
 - b. he and Granny make a bouncing collision, each going in opposite directions.
- ___ 36. A small economy car (low mass) and a limousine (high mass) are pushed from rest across a parking lot, equal distances with equal forces. The car that receives the greater impulse is the
- a. limousine.
 - b. small economy car.
 - c. neither A nor B (same for each).
- ___ 37. A 2-kg ball is thrown at 3 m/s. What is the ball's momentum?
- a. 2 kg·m/s
 - b. 3 kg·m/s
 - c. 6 kg·m/s
 - d. 9 kg·m/s
 - e. none of the above

True/False

Indicate whether the statement is true or false.

- ___ 38. Momentum is defined as an object's mass times its velocity.

- ___ 39. If the net external force acting on a system is zero, then the total momentum of the system is zero.
- ___ 40. Impulses are normally smaller when bouncing takes place.
- ___ 41. Perfectly elastic collisions between large objects are uncommon in the everyday world.
- ___ 42. If a net force acts on a system, the system's momentum will change.

Essay

- 43. A railroad diesel engine coasting at 12 km/h runs into a stationary flatcar. The diesel weighs 5 times as much as the flatcar. Assuming the cars couple together, how fast are they moving after the collision?

Problem

- 44. A 5-kg blob of clay moving horizontally at 4 m/s has a head-on collision with a 4-kg blob of clay that moves toward it at 2 m/s. What is the speed of the two blobs stuck together immediately after the collision?
- 45. A 10-kg bowling ball moving at 4 m/s bounces off a spring at about the same speed that it had before bouncing. What is the change in momentum of the bowling ball?
- 46. A 65-kg free-floating astronaut fires 0.10-kg of gas at a speed of 50 m/s from her propulsion pistol. What is the astronaut's recoil speed?