Conceptual Questions: Momentum and Fluids

1. An open railroad car is coasting horizontally along frictionless rails. A girl on board starts throwing coal backward straight off the car. As a result, the railroad car
   a. speeds up
   b. slows down
   c. first speeds up then slows down
   d. travels at a constant speed

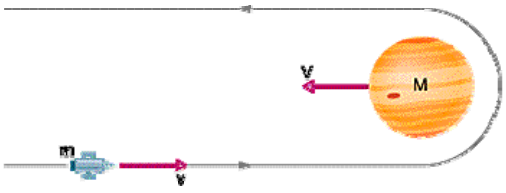
2. A stunt person jumps from a tall building onto a large inflated pad. One reason why the pad reduces the force of impact is because
   a. the interaction time is reduced
   b. the interaction time is increased
   c. the change in velocity is increased
   d. the change in velocity is decreased

3. An open box is sliding across a frictionless icy surface as rain is falling vertically toward the ground. As the box collects the rain
   a. the speed of the box increases.
   b. the momentum of the box increases.
   c. the speed of the box decreases.
   d. the momentum of the box decreases.
   e. the momentum and the speed of the box are constant.

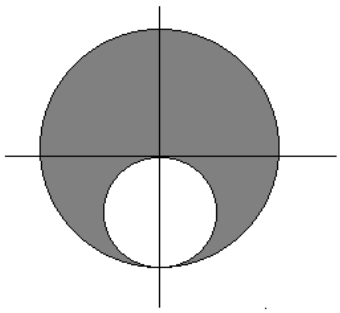
4. A 12.0-gram bullet traveling at 325m/s is imbedded into a .250 kg block that is resting on a frictionless surface. What is the work done <u>on</u> each object?
   a. -634J on bullet, 27.7J on block
   b. -632J on bullet, 27.7J on block
   c. 634J on bullet, 27.7J on block
   d. 632J on bullet, 27.7J on block

5. In the above problem, the reason why the work done on each object is different is because
   a. the force on the bullet is greater than the force on the block.
   b. mechanical energy is converted into heat energy
   c. the block is heavier than the bullet.

6. Spacecraft Voyager 2 (of mass m and speed v relative to the Sun) approaches the planet Jupiter (of mass M and speed V_J relative to the Sun) as shown in Fig. 10-38. The spacecraft rounds the planet and departs in the opposite direction. What is its speed, relative to the Sun, after this slingshot encounter, which can be analyzed as a collision? Assume v = 12 km/s and V = 13 km/s (the orbital speed of Jupiter). The mass of Jupiter is very much greater than the mass of the spacecraft, so M >> m.
   a. 1km/s
   b. 12km/s
   c. 25km/s
   d. 26km/s
   e. 38km/s

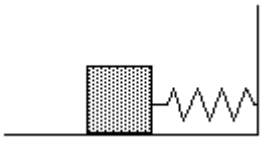


7. A uniform circular plate of radius r and mass m has a circular hole cut out of it having a radius r/2. Find the center of mass of the plate. Assume the origin of the coordinate system is at the center of the plate of radius r.
   a. $\mathbf{R_{cm}}=r/2\mathbf{j}$
   b. $\mathbf{R_{cm}}=r/2\ \mathbf{i}+r/4\mathbf{j}$
   c. $\mathbf{R_{cm}}=r/4\mathbf{j}$
   d. $\mathbf{R_{cm}}=r/6\mathbf{j}$
   e. $\mathbf{R_{cm}}=r/8\mathbf{j}$



8. A railroad car moves at a constant speed of 3.60 m/s under a grain elevator. Grain drops into it at the rate of 610 kg/min. What force must be applied to the railroad car, in the absence of friction, to keep it moving at constant speed?
   a. 2.82N
   b. 10.2N
   c. 36.6N
   d. 131.9N
   e. 2196N

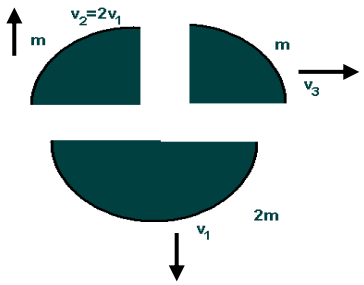
9. A block of mass M is attached to a spring on a horizontal frictionless table. The spring is stretched from its equilibrium position and released. A lump of sticky putty of mass M is dropped onto the block. If the lump of putty hits (and sticks) the block when it has achieved maximum velocity, the change in mechanical energy of the system is equal to the total initial energy
   a. three-fourths of the total initial energy
   b. one-half of the total initial energy
   c. one-fourth of the total initial energy
   d. no energy is lost because this is an inelastic collision



10. Suppose a ping-pong ball and a bowling ball are rolling toward you. Both have the same momentum, and you exert the same force to stop each. How do the time intervals and distances needed to stop them compare?
    a. The time interval and distance are greater for the bowling ball.
    b. Longer time for the bowling ball, longer distance for the ping-pong ball.
    c. The time intervals are the same, but the distance is greater for the ping-pong ball.
    d. The time interval for the bowling ball is greater, but the distances are the same.
    e. The distance and time intervals are the same for both.

11. Two pucks of mass m_1 and m_2 are lying on a frictionless table and connected by a spring of force constant k. A horizontal force F_1 is exerted only on m_1 along the spring away from m_2. What is the magnitude of the acceleration of the center of mass of the system?
    a. F_1/m_1
    b. $F_1/(m_1+m_2)$
    c. $(F_1+k\Delta x)/(m_1m_2)$, where Δx is the amount the spring is stretched.
    d. $(m_1+m_2)F_1/(m_1m_2)$

12. The figure shows the behavior of a projectile just after it has broken up into 3 pieces. What was the speed of the projectile the instant before it broke up?
    a. v_3
    b. $v_3/3$
    c. $v_3/4$
    d. $4v_3$
    e. $(v_1+v_2+v_3)/4$



13. Why does a rocket accelerate when fired horizontally?
    a. Exhaust gases push against outside air
    b. Exhaust gases, which the rocket pushes backward, push the rocket forward
    c. Outside air exerts more force on the back of the rocket that on the front
    d. Exhaust speed is greater than the rocket speed
    e. Atmospheric pressure at the back of the rocket is reduced

14. Why do you land with your knees bent when you jump off a tall chair?
    a. To reduce your change in velocity of your body.
    b. To increase the interaction time on your bones.
    c. To increase the stopping force.

15. A very massive object traveling at 10 m/s strikes a very light object, initially at rest. The very light object takes off in the direction of travel of the heavy object. If the collision is elastic, the speed of the lighter object is
    a. 0.0 m/s
    b. 5.0m/s
    c. 10.0m/s
    d. 15.0m/s
    e. 20.0m/s

16. An 80kg person sits on the left end of a rowboat (that's in a calm lake), and a 120kg person sits at the right end of a rowboat. The rowboat is 10m long. How far does the rowboat move if the two people switch positions?
    a. 6.0m
    b. 4.0m
    c. 2.0m
    d. 1.0m

17. The momentum of a system may be conserved even when the mechanical energy is not. This statement is
    a. true
    b. false

18. The velocity of the center of mass of a system equals the total momentum of the system divided by the total mass of the system. This statement is
    a. true
    b. false

19. In a perfectly inelastic collision, all of the kinetic energy of the objects is lost. This statement is
    a. true
    b. false

20. In an elastic 2-D collision, the relative speed after the collision equals the relative speeds before the collision. This statement is
    a. true
    b. false

21. A ball of mass m and velocity v slides without rolling. A second ball rolls with velocity center of mass velocity v. Which ball has more energy?
    a. the first ball
    b. the second ball
    c. both balls have the same energy.

22. A bowling ball traveling with a speed v collides with a ping-pong ball moving at a speed v, but in the opposite direction. One can conclude that the change in momentum of the ping-pong ball is
    a. less that that of the bowling ball
    b. greater than that of the bowling ball
    c. the same as that of the bowling ball.

23. A bowling ball traveling with a speed v collides with a ping-pong ball moving at a speed v, but in the opposite direction. One can conclude that the impulse imparted to the ping-pong ball is
    a. less that that of the bowling ball
    b. greater than that of the bowling ball
    c. the same as that of the bowling ball.

24. A person standing on a horizontal frictionless floor might be able to move by
    a. walking
    b. crawling slowly
    c. exhaling vertically
    d. rolling
    e. throwing a shoe

25. The upward buoyancy force on a 20 ton floating ship is
    a. 20 tons b. less than 20 tons c. more than 20 tons d. need to know shape of ship

26. A boat carrying a large boulder is floating on a lake. The boulder is thrown overboard and sinks. The water level in the lake (with respect to the shore)
    a. rises.
    b. sinks.
    c. remains the same.

27. Two objects of the same volume are placed in water. Object A floats and Object B sinks. The greater buoyant force is on
    a. object A
    b. object B
    c. both are same

28. Two objects of the same mass are placed in water. Object A floats and Object B sinks. The greater buoyant force is on
    a. object A
    b. object B
    c. both are same

29. If the gauge pressure is tripled, the absolute pressure will
    a. not change
    b. be reduced by a factor of 3
    c. triple
    d. not enough information is given to determine what happens.

30. In a hydraulic arrangement with two pistons, the small piston has a radius of 5.00 cm, and the large piston has a radius of 20.0 cm. A force of 512 N on the large piston would lift a weight of _____ Newtons on the small piston.
    a. 4N
    b. 16N
    c. 32N
    d. 64N
    e. 128N

31. You wear snowshoes in the snow because snowshoes help reduce the _____against the snow.
    a. force
    b. pressure
    c. mass

32. A 50g piece of copper and 50g piece of aluminum rest at the bottom of a container filled with water. The buoyant force is greater on
    a. the lead object
    b. the aluminum object
    c. the same on both

33. A wood box falls off a ship that is floating on a lake. The box floats. As a result, the level of the water in the lake a. rises b. falls c. neither rises nor falls

34. You place a water pump on a cliff 15m above a lake. You run a long pipe from the pump into the lake. The goal is to pump some water for your use. Which of the following is true about your system?
    a. This will always work; the size and suction power of the pump won't matter.
    b. This will work if the pump's suction is sufficient.
    c. This will never work.

35. As an object sinks in a fluid, the buoyant force acting on it
    a. decreases
    b. increases
    c. doesn't change

36. A diameter of a stream of water from a faucet decreases as the distance from the faucet's spout increases. This is a result of
    a. Archimedes' Principle
    b. Pascal's Principle
    c. Bernoulli's Principle

37. If you stand on the ground with one foot, the force of your body against the ground
    a. increases b. decreases c. stays same, compared to having both feet on the ground

38. and the pressure of your foot against the ground
    a. increases b. decreases c. stays same, compared to having both feet on the ground

39. When that delicious milkshake goes up the straw to your eagerly awaiting lips,
    a. the shake is being sucked up by the low pressure in your mouth
    b. the shake is being pushed up by the air in the room

40. Your blood pressure is higher
    a. at the top of your head.
    b. at your chest.
    c. at your feet.