Test: *Momentum*

Multiple Choice: *Choose the letter of the best answer. 3 points each.*

1. _____ A ball with an initial speed of 5 m/s has an elastic collision with an identical ball which is initially at rest. If the first ball has a speed of 3 m/s after the collision, what is the speed of the second ball after the collision?
   a. 2 m/s.   b. 3 m/s.   c. 4 m/s.   d. 5 m/s.   e. can't tell.

2. _____ What happens to kinetic energy during an elastic collision?
   a. Duh - it is conserved the whole time because energy is always conserved.
   b. Some of it turns into heat or sound.
   c. Some of it briefly turns into potential energy before turning back into kinetic energy.
   d. It adds up to zero because the objects are going in the opposite direction.

3. _____ Why does bubble wrap help fragile objects survive shipping?
   I. It decreases the impulses on the object.
   II. It decreases the forces on the object.
   a. I only.   b. II only.   c. I & II.   d. None of those are correct.

4. _____ Is it possible for a little moth to have more momentum than a massive truck?
   a. No because the moth would need to fly close to the speed of light, which is ridiculous.
   b. No because the truck would wipe out the moth in a collision.
   c. Yes because there are some really large South American moths.
   d. Of course it is possible.

5. _____ You drop a ball onto the ground and it bounces back up to the height from which you dropped it. You can correctly conclude
   a. Only momentum was conserved in the collision with the ground.
   b. A lot of energy was transformed into random thermal energy during the collision.
   c. The momentum of the ball never changed.
   d. The collision with the ground was elastic.

6. _____ What impulse is needed to stop a 1500 kg car that has a momentum of 45,000 kg·m/s?
   a. 30 N·s.   b. 45,000 N·s.   c. 6.75 x 10^7 N·s.   d. answer depends on the time.

Questions 7 to 9 refer to the following:
   Some students do a lab in which they placed two carts next to each other in the middle of a track, one with a compressed spring. They then released the spring and measured the velocities of the carts right after the spring was released. (They were both at rest before release.) They did a few trials, each time adding mass to one of the carts.

7. _____ As they added mass to one of the carts, which of the following was true:
   I. The total kinetic energy was always zero.
   II. The more massive cart had more kinetic energy.
   III. The total kinetic energy stayed the same.
   a. I only.   b. II only.   c. III only.   d. I & III only.   e. All were true.

8. _____ As they added mass to one of the carts, which of the following was true:
   I. The total momentum was always zero.
   II. The more massive cart had more momentum.
   III. The more massive cart was moving slower.
   a. I only.   b. II only.   c. III only.   d. I & III only.   e. All were true.

9. _____ Assume cart A had a mass of 0.5 kg and cart B had a mass of 1.0 kg. If A had a speed of 0.80 m/s after releasing the spring, what was the speed of cart B after releasing the spring?
   a. 0.40 m/s.   b. 0.57 m/s.   c. 0.80 m/s.   d. 1.13 m/s.   e. 1.60 m/s.

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10. _____ Imagine you are standing in the hallway when you realize it is time for physics. Not wanting to be late, you walk quickly down the hall suddenly gaining momentum. How was momentum conserved?
    a. The momentum was stored inside your body before you turned it into actual momentum.
    b. Momentum is not conserved in this case because of friction.
    c. The air around you is pushed backwards with the same amount of momentum.
    d. You pushed the earth backwards with the same amount of momentum that you gained.
    e. I can't imagine being late for physics class.

11. _____ A projectile in flight explodes into several fragments. The total momentum of the fragments immediately after the explosion
    a. is less than the momentum of the projectile immediately before the explosion.
    b. is more than the momentum of the projectile immediately before the explosion.
    c. is the same as the momentum of the projectile immediately before the explosion.
    d. has been changed into the kinetic energy of the fragments.
    e. has been changed into radiant energy.

Problems 12 to 15 refer the following (which are only 2 points each.)
    Here's the classic! A train smashes into a car that is stupidly sitting on the tracks. Which experiences the greater (in terms of magnitude):

12. _____ Change in Velocity?
    a. the same.   b. the car.   c. the train.   d. can't tell.

13. _____ Force?
    a. the same.   b. the car.   c. the train.   d. can't tell.
14. _____ Impulse?
    a. the same.   b. the car.   c. the train.   d. can't tell.

15. _____ Change in momentum?
    a. the same.   b. the car.   c. the train.   d. can't tell.

NAME: _____

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Problem Solving: *Show all work.*

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16. A velcro dart (6.5 grams) is fired into the back of a toy truck (45 grams) initially at rest. The dart sticks to the truck, and the pair travels 75 cm in 1.25 seconds. How fast was the dart traveling as it left the dart gun?

17. A 300 gram ball has a velocity of 12 m/s to the right when it experiences a force directed to the left shown in the diagram. What is the final velocity of the ball?
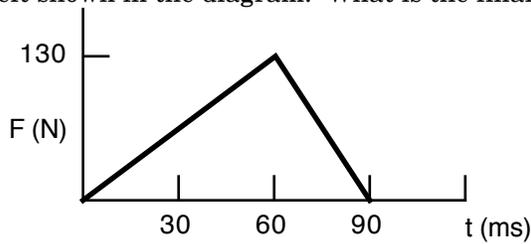

18. A mass m has a velocity v_i when it crashes and sticks to a mass M. The pair then slide a distance d up a hill with a base angle ø. What was the initial speed v_i of the mass m before the collision? There is no friction.
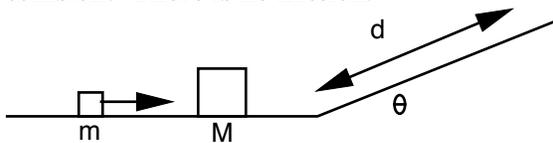
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19. A 250 gram pendulum is pulled back a height of 40 cm and released. At the bottom of its swing, it collides elastically with a 350 gram pendulum. How high does the 350 gram pendulum swing after the collision?

m

h

M
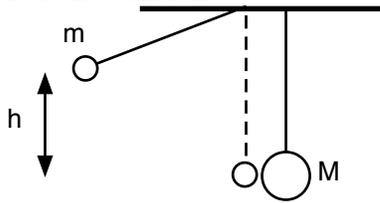
20. A 2.5 kg object has an initial velocity of $11\mathbf{i}$ m/s. It collides with another mass initially at rest - giving the second mass a momentum of $7\mathbf{i} + 12\mathbf{j}$ kg·m/s. What is the velocity of the 2.5 kg object right after the collision?

21. Imagine that there are two blobs of clay: a 3 kg blob traveling with a velocity of 7 m/s at an angle of 30º and a 2 kg blob with a velocity of 12 m/s at an angle of 20º, as shown in the diagram. They collide and stick to each other. In what direction does the combined clay blob travel? (Give your answer as degrees to the left or right of vertical.)

3 kg

30º

20º

2 kg