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Kraemer Scrimmage Science Olympiad - Hovercraft Test-Answer Key

1. If the change in momentum occurs over a long time, the hitting force is _____.

- a. **small**
- b. large
- c. unchanged
- d. unpredictable

2. When can a 1000-kg car and a 2000-kg truck have the same momentum? (Give two examples)

1st example: They have the same momentum when the car travels twice as fast as the truck.

2nd example: If they were both at rest, they would certainly have the same momentum — zero.

3. A moving object possesses impulse.

- a. True
- b. **False**

4. If a boxer gets punched in the face and makes the time of contact three times longer by riding with the punch, by how much is the force reduced?

The force will be one-third as great as it would have been if he hadn't pulled back.

5. If the boxer instead moves into the punch and shortens the contact time by half, by how much is the force increased?

The force will be two times greater than it would have been if he had held his head still. Forces of this kind account for many knockouts.

6. Consider carts gliding on an air track. Suppose that a gliding cart with a mass of 0.5 kg bumps into, and sticks to, a stationary cart that has a mass of 1.5 kg, If the speed of the gliding cart before impact is 4 m/s, how fast will the coupled carts glide after collision?

1 m/s or 1 meter/second

7. A boy pulls with a force of 20 N on a 300-N wagon. What acceleration does the wagon have and how far will it move in 2 seconds? Assume that the wagon starts from rest and assume there are no frictional forces opposing the motion of the wagon.

acceleration = 0.0654 m/s/s or 0.0654 m/s² Distance = 1.31 meters

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8. A 5.0 g bullet leaves the muzzle of a rifle with a speed of 320 m/s. What force (assumed constant) is exerted on the bullet while it is traveling down the 0.82 meter long barrel of the rifle?

312 N or 312 Newtons

9. An automobile manufacturer claims that its super-deluxe sportswear will accelerate uniformly from rest to a speed of 38.9 m/s in 8.00 seconds. (a) Determine the acceleration of the car. (b) Find the distance the car travels in the first 8 seconds.

(a) acceleration = + 4.86 m/s/s or + 4.86 m/s²

(b) distance = 156 meters

10. A golf ball is released from rest from the top of a very tall building. Neglecting air resistance, calculate the position and velocity of the ball after 3.00 seconds.

velocity = -29.4 m/s

position = -44.1 m

The minus signs for v indicate that the velocity vector is directed downward, and the minus sign for position indicate displacement in the negative y direction.

11. An Alaskan rescue plane drops a package of emergency rations to a stranded party of explorers. If the plane is traveling horizontally at 40 m/s at a height of 100 m above the ground, where does the package strike the ground relative to the point at which it was released?

180 meters

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12. Which of the following statements is correct?

- (a) It is possible for an object to have motion in the absence of forces on the object.
- (b) It is possible to have forces on an object in the absence of motion of the object.
- (c) Neither (a) nor (b) is correct.
- (d) Both (a) and (b) are correct.**

13. An object experiences no acceleration. Which of the following cannot be true for the object?

- (a) A single force acts on the object.**
- (b) No forces act on the object.
- (c) Forces act on the object, but the forces cancel.

14. You push an object, initially at rest, across a frictionless floor with a constant force for a time interval t , resulting in a final speed of v for the object. You then repeat the experiment, but with a force that is twice as large. What time interval is now required to reach the same final speed v ?

- (a) $4t$
- (b) $2t$
- (c) t
- (d) $t/2$**
- (e) $t/4$

15. A rock of mass m is dropped to the ground from a height h . A second rock, with mass $2m$, is dropped from the same height. When the second rock strikes the ground, what is its kinetic energy?

- (a) twice that of the first rock**
- (b) four times that of the first rock
- (c) the same as that of the first rock
- (d) half as much as that of the first rock
- (e) impossible to determine

16. You are traveling along a freeway at 65 mi/h. Your car has kinetic energy. You suddenly skid to a stop because of congestion in traffic. Where is the kinetic energy your car once had?

- (a) It is all in internal energy in the road.
- (b) It is all in internal energy in the tires.
- (c) Some of it has transformed to internal energy and some of it transferred away by mechanical waves.**
- (d) It is all transferred away from your car by various mechanisms.

17. The tendency of an object to resist change in its motion is known as

- (a) mass.
- (b) inertia.**
- (c) force.
- (d) balance.

18. Balanced forces acting on an object

- (a) always change the object's motion.
- (b) sometimes change the object's motion.
- (c) never change the object's motion.**
- (d) are not related to motion.

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19. Forces can be added together only if they are

(a) acting on the same object.

(b) balanced forces.

(c) unaffected by gravity.

(d) substantial.

20. According to Newton's third law of motion, when a hammer strikes and exerts force on a nail, the nail

(a) creates a friction with the hammer.

(b) disappears into the wood.

(c) exerts an equal force back on the hammer.

(d) moves at a constant speed.

21. The product of an object's mass and velocity is called its

(a) inertia.

(b) momentum.

(c) acceleration.

(d) force.