Name: ___________Answer Key ___________ Date: ______________________________

Honors Physics Test #6 Review

Momentum

1. Read Chapter 6.

2. Terms to know: momentum, impulse, elastic collision, inelastic collision, explosion

3. Know the various equations for impulse.

4. The linear momentum of an object can be calculated by multiplying the mass of the object by its

   (A) acceleration (B) velocity (C) impulse (D) time

5. The greatest change in momentum will be produced by a ____________________.

   (A) Large force acting over a long time
   (B) Small force acting over a short time
   (C) Large force acting over a short time

6. When a golf club hits a golf ball, the change in momentum of the ball is ___________ the change in momentum of the club.

   (A) equal to (B) greater than (C) less than

7. A system is closed if ____________________.

   (A) No net external forces acts on it
   (B) The momentum of each object in the system remains constant
   (C) The system does not gain or lose mass
   (D) Objects can enter, but not leave, the system

8. An internal force ______________ the total momentum of a closed system.

   (A) Increases (B) decreases (C) does not change

9. A person is standing on roller blades and is holding a heavy ball. If he throws the ball horizontally to the right, what will be his resulting motion? **He will move to the left.**

Directions: Read each question carefully and record your answers in the space provided. Be sure to show all work! Answers should be in significant figures. You will be graded on proper use of the GUESS method. **These will be the same directions on the test. Practice the GUESS method now.**

10. A skater spins with her arms extended at a speed of 11 meters per second. She then whips her arms in to her body to form a circle with a radius of 0.40 meter and spins with a speed of 24 meters per second. Calculate the radius of the circle that she formed with her arms extended.

$$L_b = L_a$$
$$\cancel{m}vr = \cancel{m}vr$$

$$r_b = \frac{v_a r_a}{v_b} = \frac{(24\,\frac{m}{s})(0.40m)}{(11\,\frac{m}{s})} = 0.87m$$

11. What impulse is needed to stop a 0.045 kg mass traveling at a velocity of 42 m/s left?

$$J = m\triangle v = 0.045kg(0\,\tfrac{m}{s} - (-42\,\tfrac{m}{s})) = 1.9N{\bullet}s \text{ right}$$

Left is negative, answer is positive, which is right

12. A force with magnitude of 540 N is used to stop an object with a mass of 65 kg moving at a velocity of 175 m/s right. How long will it take to bring the object to a full stop?

$$t = \frac{m \Delta v}{F} = \frac{(65kg)(0\frac{m}{s} - 175\frac{m}{s})}{(-540N)} = 21s$$

The force opposes the motion so it is negative.

13. In hitting a stationary hockey puck, with a mass of 0.180 kg, a hockey player gives the puck an impulse of 6.0 N·s. At what speed will the puck move toward the goal?

$$\Delta v = \frac{J}{m} = \frac{6.0N \cdot s}{(.180kg)} = 33\frac{m}{s}$$

Speed is a scalar

14. A metal sphere with a mass of 0.803 kg rolls along a frictionless surface at 20.0 m/s and strikes a stationary sphere with a mass of 0.222 kg. The first sphere bounces backwards at a speed of 3.40 m/s. At what speed does the second sphere move away from the point of impact?

Before	After
P_{before} =	P_{after}
$p_1 + p_2$ =	$p_1 + p_2$
$m_1v_1 + m_2v_2$ =	$m_1v_1 + m_2v_2$
(.803 kg)(20.0 m/s) + (.222kg)(0m/s) =	(.803 kg)(-3.40m/s) + (.222 kg)(v_2)
16.1 kg•m/s =	-2.73 kg•m/s + (.222 kg)(v_2)
84.6 m/s =	v_2

Bouncy
Two separate objects before and after

15. John and Chris are building snowmen. Suddenly, a snowball fight breaks out. A snowball with a mass of 0.085 kg hits a snowman's top hat and sticks to it. The hat and snowball, with a combined mass of 0.22 kg, fall off together at 8.0 m/s. How fast was the snowball moving at the moment of impact?

Before	After
P_{before} =	P_{after}
$p_1 + p_2$ =	$p_{1,2}$
$m_1v_1 + m_2v_2$ =	$(m_1 + m_2)\, v_f$ =
(.085 kg)(v_1) + (0.14 kg)(0m/s) =	(0.22 kg)(8.0 m/s) =
.085 kg (v_1) =	1.8 kg•m/s
+21 m/s =	v_1

Sticky
Two separate objects before, one combined object after

16. A spring is holding two lab cars together, one has a mass of 2.5 kg and the other has a mass of 4.0 kilograms. When the spring is triggered, the cars explode apart. The 4.0 car travels to the right with a speed of 1.4 m/s. What is the velocity of the lighter car?

Before	After
P_{before} =	P_{after}
0 kg•m/s =	$p_1 + p_2$
0 kg•m/s =	$m_1v_1 + m_2v_2$
0 kg•m/s =	(2.5 kg)(v_1) + (4.0 kg)(1.4 m/s) =
- 5.6 kg•m/s =	(2.5 kg)(v_1)
- 2.2 m/s =	v_1
2.2 m/s left =	v_1

Explosion
Two objects at rest before, separate after

17. A 1.0 kilogram mass changes speed from 2.0 m/s to 5.0 m/s. The change in the object's momentum is

(A) 3.0 kg • m/s (B) 21 kg • m/s (C) 29 kg • m/s (D) 9.0 kg • m/s

$\Delta p = m\Delta v$
$= (1.0kg)(5.0\frac{m}{s} - 2.0\frac{m}{s})$

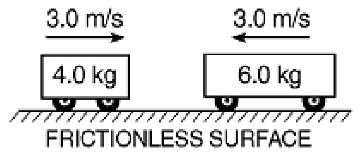
18. A 2.0 kg rifle initially at rest fires a 0.002 kg bullet. As the bullet leaves the rifle with a velocity of 500 meters per second, what is the momentum of the rifle-bullet system?

(A) 2.5 kg • m/s (B) 0.5 kg • m/s (C) 0 kg • m/s (D) 2.0 kg • m/s

$p_b = p_a$
p_b = at rest = 0 kgm/s

19. The diagram below shows a 4.0 kilogram cart moving to the right and a 6.0 kilogram cart moving to the left on a horizontal frictionless surface.

$p_b = p_a$
$p_b = m_1 v_1 + m_2 v_2$
$p_b = (4.0kg)(3.0\frac{m}{s}) + (6.0kg)(-3.0\frac{m}{s})$
$p_b = 12 + (-18)$



Left is negative

When the two carts collide they lock together. The magnitude of the total momentum of the two cart system after the collision is

(A) 30. kg • m/s (B) 6.0 kg • m/s (C) 0.0 kg • m/s (D) 15 kg • m/s

20. A bullet traveling at 5.0×10^2 m/s is brought to rest by an impulse of 50. newton-seconds. What is the mass of the bullet?

(A) 2.5×10^4 kg (B) 1.0×10^1 kg (C) 1.0×10^{-1} kg (D) 1.0×10^{-2} kg

$m = \frac{J}{\Delta v} = \frac{-50N \bullet s}{(0\frac{m}{s} - 5.0\times 10^2\frac{m}{s})}$

21. If the direction of the momentum of an object is west, the direction of the velocity of the object is

(A) north (B) south (C) east (D) west

Momentum and velocity have the same direction

22. The momentum of the object is the product of its

(A) force and displacement (C) mass and velocity
(B) mass and acceleration (D) force and distance

p=mv

23. A 2.0×10^3 kilogram car collides with a tree and is brought to rest in 0.50 second by an average force of 6.0×10^4 newtons. What is the magnitude of the impulse on the car during this 0.50 second interval?

$J = Ft = (6.0\times 10^4 N)(0.50s)$

(A) 1.2×10^5 N/s (B) 6.0×10^7 N • kg • s (C) 3.0×10^4 N • s (D) 1.0×10^3 kg • s

24. Which of the following is an acceptable unit for impulse?

$J = \Delta p = m\Delta v$

(A) J • s (B) N • m (C) J/s (D) kg • m/s

25. A rocket with a mass of 1,000 kilograms is moving at a speed of 20 meters per second. The magnitude of the momentum is

(A) 20,000 kg • m/s (B) 50 kg • m/s (C) 200 kg • m/s (D) 400,000 kg • m/s

$p = mv$
$= (1{,}000kg)(20\frac{m}{s})$

26. As the unbalance force applied to an object increases, the time rate of change of the object's momentum

(A) increases (B) decreases (C) remain the same

$\Delta p = F_{net} t$

27. A 1.0 kilogram model rocket's engine is designed to deliver an impulse of 6.0 newton-seconds. If the rocket engine burns for 0.75 second, what average force does it produce?

(A) 4.5 N (B) 80. N (C) 45 N (D) 8.0 N

$$F_{net} = \frac{J}{t} = \frac{6.0Ns}{0.75s}$$

28. If a net force of 10. Newtons acts on a 6.0 kg mass for 8.0 seconds, the total change of momentum of the mass is

(A) 48 kg•m/s (B) 480 kg•m/s (C) 60. kg•m/s (D) 80. kg•m/s

$$\Delta p = F_{net}t = (10.N)(8.0s)$$

29. What is the momentum of a 1,200 kilogram car traveling at 15 m/s due east?

(A) 1.8×10^4 kg•m/s due east
(B) 80. kg•m/s due west
(C) 1.8×10^4 kg•m/s due west
(D) 80. kg•m/s due east

$$p = mv = (1200kg)(15\tfrac{m}{s})$$

30. What is the magnitude of the velocity of a 25 kilogram mass that is moving with a momentum of 100. kilogram-meters per second?

(A) 2500 m/s (B) 40. m/s (C) 4.0 m/s (D) 0.25 m/s

$$v = \frac{p}{m} = \frac{100.\frac{kg \cdot m}{s}}{25kg}$$

31. A student drops two eggs of equal mass simultaneously from the same height. Egg A lands on the tile floor and breaks. Egg B lands intact, without bouncing, on a foam pad lying on the floor. Compared to the magnitude of the impulse on egg A as it lands, the magnitude of the impulse of egg B as it lands is

(A) the same (B) greater (C) less

$$J = \Delta p = m\Delta v$$
same m and Δv

32. A mother pushes her 120 newton child, who is sitting on a swing. If the mother exerts a 10. Newton force on the child for 0.50 second, what is the magnitude of the impulse imparted to the child by the mother?

(A) 240 N•s (B) 60. N•s (C) 5.0 N•s (D) 20. N•s

$$J = F_{net}t = (10.N)(0.50s)$$

33. A 0.050 kilogram bullet is fired from a 4.0 kilogram rifle that is initially at rest. If the bullet leaves the rifle with momentum having a magnitude of 20. kilogram-meter/second, what will be the magnitude of the momentum of the rifle's recoil?

(A) 1,600 kg•m/s (B) 20. kg•m/s (C) 80. kg•m/s (D) 0.25 kg•m/s

$p_b = p_a$
0 kgm/s $= p_1 + p_2$
$p_1 = -p_2$

34. Two rocks weighing 5 newtons and 10 newtons, respectively, fall freely from rest near the Earth's surface. After 3 seconds of free fall, compared to the 5 newton rock, the 10 newton rock has greater

(A) acceleration (B) momentum (C) height (D) speed

$g = -9.81$ m/s^2 | $p = mv$ | All objects fall at the same rate – cover same d with same v

35. A force of 20. Newtons is exerted on a cart for 10. seconds. How long must a 50. Newton force act to produce the same impulse?

(A) 10. s (B) 2.0 s (C) 5.0 s (D) 4.0 s

$$J = F_{net}t = (20.N)(10.s)$$
$$J = 2.0 \times 10^2 Ns$$
$$t = \frac{J}{F_{net}} = \frac{2.0 \times 10^2 Ns}{50.N}$$

36. Which type of collision results in the greatest change in momentum of each object?

(A) Elastic (B) Inelastic (C) Explosion (D) Oblique (E) Head-on

37. In which type of collision is the sum of both object's momentum equal to zero?

(A) Elastic (B) Inelastic (C) Explosion (D) Oblique (E) Head-on

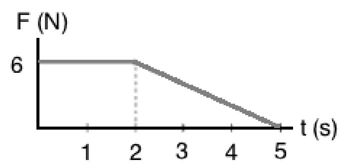
38. Which collision results in both objects having the same velocity after colliding?

(A) Elastic (B) Inelastic (C) Explosion (D) Oblique (E) Head-on

39. A hockey puck is sliding on the ice with a momentum of 5 kg • m/s when it is struck by a hockey stick giving it an impulse of 100 N • s in the direction of motion of the puck. Afterward, the momentum of the puck is

(A) 500 kg • m/s (B) 105 kg • m/s (C) 100 kg • m/s (D) 50 kg • m/s (E) 20 kg • m/s

40. A force acts on a mass as shown in the force vs. time graph.



The change in momentum of the mass between 2s and 5 s is

(A) 9 kg • m/s (B) 18 kg • m/s (C) 21 kg • m/s (D) 30 kg • m/s (E) 42 kg • m/s

41. A cannonball is fired from a cannon so that the cannon recoils backward as the ball is fired forward. Which of the following statements is true?

(A) The velocity of the cannonball is equal and opposite to the velocity of the cannon
(B) The mass of the cannonball and the cannon must be equal
(C) The momentum of the cannonball must be greater than the magnitude of the momentum of the cannon
(D) The momentum of the cannon must be equal to the magnitude of the momentum of the cannonball
(E) The momentum of the cannon must be greater than the magnitude of the momentum of the cannonball

42. A 5,000 kg railroad car collides and sticks to a stationary railroad car of mass 7,000 kg and they move off together at a speed of 5 m/s. What was the speed of the 5,000 kg car before the collision?

(A) 5 m/s (B) 12 m/s (C) 14 m/s (D) 35 m/s (E) 60 m/s

43. Which of the following quantities are conserved in an elastic collision?

(A) momentum only
(B) momentum & potential energy
(C) kinetic energy only
(D) momentum and kinetic energy
(E) momentum and velocity

44. A 1 kg pool ball moving at +10 m/s strikes a 2 kg pool ball that is initially at rest. Which of the following statements is true immediately after the elastic collision?

(A) The 1 kg pool ball is at rest
(B) The 2 kg ball must have a negative velocity
(C) The 2 kg ball's speed must be less than 10 m/s
(D) The two pool balls stick together
(E) The total kinetic energy of the two pool balls must be equal to 100 J

45. A horizontal force *F* acts on a block of mass m that is initially at rest on a floor of negligible friction. The force acts for a time *t* and moves the block a displacement *d*. The change in momentum of the block is

(A) $\frac{F}{t}$ (B) $\frac{m}{t}$ (C) Fd (D) Ft (E) mt

Answers:

4. B
5. A
6. A
7. A
8. C
9. to the left
10. 0.87 m
11. 1.9 Ns right
12. 21 s
13. 33 m/s
14. 84.6 m/s
15. 21 m/s
16. 2.2 m/s left
17. A
18. C
19. B
20. C
21. D
22. C
23. C
24. D
25. A
26. A
27. D
28. D
29. A
30. C
31. A
32. C
33. B
34. B
35. D
36. A
37. C
38. B
39. B
40. A
41. D
42. B
43. D
44. C
45. D