Name: Answer Key Period: _____

Practice Physics Final Exam – Standards 48–56

1) A rubber ball and a lump of putty have equal mass. They are thrown with equal speed against a wall. The ball bounces back with nearly the same speed with which it hit. The putty sticks to the wall. Which objects experiences the greater momentum change? 1) A

A. the ball
B. the putty
C. Both experience the same momentum change.
D. cannot be determined from the information given

The ball goes from a + velocity to a − velocity whereas the putty goes from a + velocity to zero.
more velocity change = more momentum change

2) A rubber ball with a speed of 5.0 m/s collides head-on elastically with an identical ball at rest. What is the speed of the initially stopped ball after the collision? 2) J

F. zero
G. 1.0 m/s
H. 2.5 m/s
J. 5.0 m/s

$m_{A1}v_{A1} + m_{B2}v_{B2} = m_Av_{A2} + m_Bv_{B2}$
masses cancel
$5 + 0 = 0 + v_{B2}$
$5 = v_{B2}$

3) A railroad car, of mass 200 kg, rolls with negligible friction on a horizontal track with a speed of 10 m/s. A 70-kg stunt man drops straight down a distance of 4.0 m, and lands in the car. How fast will the car be moving after this happens? 3) A

A. 7.4 m/s
B. 2.8 m/s
C. 4.7 m/s
D. 10 m/s

$m_Av_{A1} + m_Bv_{B1} = (m_A + m_B)v$
$(200)(10) + (70)(0) = (200 + 75)v$ $\quad v = 7.4$ m/s
$2000 + 0 = 275v$
$\frac{2000}{275} = v$

4) A car of mass 1000 kg moves to the right along a level, straight road at a speed of 6.0 m/s. It collides directly with a stopped motorcycle of mass 200 kg. What is the total momentum after the collision? 4) F

F. 6000 kg•m/s to the right
G. zero
H. 10,000 kg•m/s to the right
J. 2000 kg•m/s to the right

$m_Av_{A1} + m_Bv_{B1}$ = momentum after
$(1000)(6) + (200)(0)$ = momentum after
$6000 + 0$ = momentum after
6000 kg m/s

5) When a cannon fires a cannonball, the cannon will recoil backward because the 5) B

A. energy of the cannon is greater than the energy of the cannonball.
B. momentum of the cannonball and cannon is conserved.
C. energy of the cannonball and cannon is conserved.
D. momentum of the cannon is greater than the energy of the cannonball.

In any collision or explosion momentum is always conserved.

6) A constant 9.0-N net force acts for 2.0 s on a 6.0-kg object. What is the object's change of velocity? 6) C

F. 27 m/s
G. 3.0 m/s
H. 110 m/s
J. 9.0 m/s

$J = \Delta p = Ft$
$mv_f - mv_i = Ft$
$m(v_f - v_i) = Ft$
$m\Delta v = Ft$
$\Delta v = \frac{Ft}{m}$

$\Delta v = \frac{(9)(2)}{6}$
$\Delta v = \frac{18}{6}$
$\Delta v = 3$ m/s

7) What is the momentum of a 2000-kg truck traveling at 35 m/s? 7) A

A. 7.0×10^4 kg·m/s
B. 57 kg·m/s
C. 7.0×10^5 kg·m/s
D. 3.5×10^4 kg·m/s

$p = mv$
$p = (2000)(35)$
$p = 70000$ kgm/s
$70000 = 7 \times 10^4$

8) Two equal mass balls (one red and the other blue) are dropped from the same height, and rebound off the floor. The red ball rebounds to a higher position. Which ball is subjected to the greater magnitude of impulse during its collision with the floor? 8) J

F. It's impossible to tell since the time intervals and forces are unknown.
G. Both balls were subjected to the same magnitude impulse.
H. the blue ball
J. the red ball

$J = \Delta p$
Since the red ball went higher it must of had a great velocity leaving the floor, therefore having a greater change in velocity and therefore a greater change in momentum and therefore a greater impulse than the blue ball

9) A small object with momentum 5.0 kg·m/s approaches head-on a large object at rest. The small object bounces straight back with a momentum of magnitude 4.0 kg·m/s. What is the magnitude of the large object's momentum change? 9) C

A. 5.0 kg·m/s
B. 4.0 kg·m/s
C. 9.0 kg·m/s
D. 1.0 kg·m/s

$m_A v_{A1} + m_B v_{B1} = m_A v_{A2} + m_B v_{B2}$
$(5) + 0 = -4 + m_B v_{B2}$
$9 \text{ kgm/s} = m_B v_{B2}$
$\Delta p = 9 - 0 = 9$ kgm/s

10) In a game of pool, the white cue ball hits the #5 ball and stops, while the #5 ball moves away with the same velocity as the cue ball had originally. The type of collision is 10) H

F. inelastic.
G. completely inelastic.
H. elastic.
J. any of the above, depending on the mass of the balls.

When two identical objects collide and "trade" velocities, the collision has to be elastic.

11) A golf ball traveling 3.0 m/s to the right collides in a head-on collision with a stationary bowling ball in a friction-free environment. If the collision is perfectly elastic, the speed of the golf ball immediately after the collision is 11) D

A. much less than 3.0 m/s.
B. slightly greater than 3.0 m/s.
C. equal to 3.0 m/s.
D. slightly less than 3.0 m/s.

Some momentum of the golf ball has to transfer to the bowling ball resulting in a small loss of momentum for the golf ball and thus a slower speed.

12) A 1200-kg ferryboat is moving south at 20 m/s. What is the magnitude of its momentum? 12) H

F. 1.7×10^{-3} kg·m/s
G. 6.0×10^2 kg·m/s
H. 2.4×10^4 kg·m/s
J. 2.4×10^3 kg·m/s

$p = mv$
$p = (1200)(20)$
$p = 24000$ kgm/s
$24000 = 2.4 \times 10^4$ kgm/s

13) A Ping-Pong ball moving east at a speed of 4 m/s, collides with a stationary bowling ball. The Ping-Pong ball bounces back to the west, and the bowling ball moves very slowly to the east. Which object experiences the greater magnitude impulse during the collision? 13) A

A. Neither; both experienced the same magnitude impulse.
B. the Ping-Pong ball
C. the bowling ball
D. It's impossible to tell since the velocities after the collision are unknown.

Both experience the same Force (Newton's 3rd Law) during the same amount of time. Therefore same impulse
$J = Ft$

14) A 2.0-kg mass moves with a speed of 5.0 m/s. It collides head-on with a 3.0 kg mass at rest. If the collision is perfectly inelastic, what is the speed of the masses after the collision? 14) G

F. 10 m/s
G. 2.0 m/s
H. 2.5 m/s
J. 0, since the collision is inelastic

$m_A v_{A1} + m_B v_{B1} = (m_A + m_B)v$

$(2)(5) + (3)(0) = (2+3)v$

$10 = 5v$

$2 \text{ m/s} = v$

15) A freight car moves along a frictionless level railroad track at constant speed. The car is open on top. A large load of coal is suddenly dumped into the car. What happens to the velocity of the car? 15) A

A. It decreases.
B. It remains the same.
C. It increases.
D. cannot be determined from the information given

In an inelastic collision the final velocity of the objects is always less than the initial velocities.

16) When a light beach ball rolling with a speed of 6.0 m/s collides with a heavy exercise ball at rest, the beach ball's speed after the collision will be, approximately, 16) H

F. 3.0 m/s.
G. 12 m/s.
H. 6.0 m/s.
J. 0.

A beach ball will most likely not move a heavy exercise ball resulting in an initial and final velocity for the exercise ball to be zero.

$m_A v_{A1} + m_B v_{B1} = m_A v_{A2} + m_B v_{B2}$

$m_A(6) + 0 = m_A v_{A2} + 0$

$m_A(6) = m_A v_{A2}$

$6 \text{ m/s} = v_{A2}$

17) A handball of mass 0.10 kg, traveling horizontally at 30 m/s, strikes a wall and rebounds at 24 m/s. What is the change in the momentum of the ball? 17) C

A. 0.60 kg·m/s
B. 1.2 kg·m/s
C. 5.4 kg·m/s
D. 72 kg·m/s

$\Delta p = mv_2 - mv_1$

$= (.1)(-24) - (.1)(30)$

$= -2.4 - 3$

$= -5.4 \text{ kg m/s}$

18) A railroad freight car, mass 15,000 kg, is allowed to coast along a level track at a speed of 2.0 m/s. It collides and couples with a 50,000-kg second car, initially at rest and with brakes released. What is the speed of the two cars after coupling? 18) F

F. 0.46 m/s
G. 0.60 m/s
H. 1.2 m/s
J. 1.8 m/s

$m_A v_{A1} + m_B v_{B1} = (m_A + m_B)v$

$(15000)(2) + (50000)(0) = (15000 + 50000)v$

$30{,}000 + 0 = 65{,}000v$

$\frac{30{,}000}{65{,}000} = \frac{65{,}000v}{65{,}000}$

$.46 \text{ m/s} = v$

19. A 2500 kg car is driving at a velocity of 25 m/s. The car suddenly hits a tree and stops. If the car stops in 0.2 seconds calculate the force the tree exerts on the car.

What do you know?	$m = 2500\ kg$ $\quad v_2 = 0\ m/s$ $v_1 = 25\ m/s$ $\quad t = .2\ sec$
What formula?	$J = \Delta p = mv_2 - mv_1 = Ft$
Substitute in values	$(2500)(0) - (2500)(25) = F(.2)$
Calculations	$\frac{0 - 62500}{.2} = \frac{F(.2)}{(.2)}$
Answer	$-312{,}500\ N = F$

20. Two bumper cars head towards each other and experience an elastic collision. Car A has a mass of 400 kg and Car B has a mass of 600 kg. Car A has an initial velocity 4 m/s and Car B had an initial velocity of -2 m/s. Car B had a final velocity of 2.8 m/s. What is the final velocity of Car A?

What do you know?	$m_A = 400\ kg$ $\quad v_{A1} = 4\ m/s$ $\quad v_{A2} = ?$ $m_B = 600\ kg$ $\quad v_{B1} = -2\ m/s$ $\quad v_{B2} = 2.8\ m/s$
What formula?	$m_A v_{A1} + m_B v_{B1} = m_A v_{A2} + m_B v_{B2}$
Substitute in values	$(400)(4) + (600)(-2) = (400)v_{A2} + (600)(2.8)$
Calculations	$1600 + (-1200) = 400 v_{A2} + 1680$ $400 = 400 v_{A2} + 1680$ $\frac{-1280}{400} = \frac{400 v_{A2}}{400}$
Answer	$-3.2\ m/s = v_{A2}$