Name____

Date __________ Pd____

Unit IX: Worksheet 1

1. Two objects, A & B, have identical <u>velocities</u>. Object A has 3 times the mass of object B. Compare the momentum of each object. Justify your answer.

$$\rho = m*v$$
$$\rho_a = 3m_b*v$$
$$\rho_b = m_b*v$$
$$\rho_b = \rho_a/3$$

2. Two other objects, C and D, have identical masses. Object C has twice the <u>velocity</u> of object D. Compare the momentum of each object. Justify your answer.

$$m_c=m_d$$
$$\rho_c = m_c*2v_d$$
$$\rho_d = m_d*v_d$$
$$\rho_d = \rho_c/2$$

3. While being thrown, a net force of 132 N acts on a baseball (mass = 140g) for a period of 4.5×10^{-2} sec. What is the magnitude of the change in momentum of the ball?

$$\mathbf{F\Delta t = impulse = momentum = m\Delta v}$$
$$\mathbf{132N*(4.5x10^{-2}\ s) = 5.94\ N\text{-}s}$$

4. If the initial speed of the baseball in question 3 is $v_0 = 0.0$ m/s, what will its speed be when it leaves the pitcher's hand?

$$\mathbf{F\Delta t = impulse = momentum = m\Delta v}$$
$$\mathbf{132N*(4.5x10^{-2}\ s) = 5.94\ N\text{-}s = (0.140kg)\Delta v}$$
$$\mathbf{\Delta v = 42.4\ m/s}$$

5. When the batter hits the ball, a net force of 1320 N, opposite to the direction of the ball's initial motion, acts on the ball for 9.0×10^{-3} s during the hit. What is the change in momentum of the ball? What is the final velocity of the ball? (use initial velocity from #4)

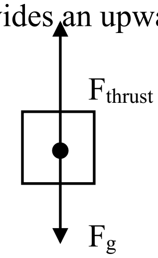
$$\mathbf{F\Delta t = impulse = momentum = m\Delta v}$$
$$\mathbf{1320N*(9.0x10^{-3}\ s) = 11.88\ N\text{-}s = (0.140kg)\Delta v}$$
$$\mathbf{\Delta v = 84.9\ m/s = v_f - v_i = 84.9m/s = v_f - (-- 42.4m/s) = +\ 42.5\ m/s}$$

6. What force does the ball exert on the bat in the question above? Explain.

Newton's 3rd Law: $F_{bat\ on\ ball} = -F_{ball\ on\ bat} = 1320N = -(-1320N)$

7. A rocket, weighing 4.36×10^4 N, has an engine that provides an upward force of 8.90×10^5 N. It reaches a maximum speed of 860 m/s.

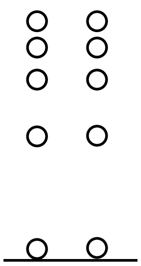
   a. Draw a force diagram for the rocket.



   b. How long must the engine burn in order to reach this speed?

$$\mathbf{F\Delta t = m\Delta v}$$
$$(8.90 \times 10^5\ \text{N} - 4.36 \times 10^4\ \text{N})\ \mathbf{\Delta t} = 4.36 \times 10^3\ \text{N} * 860\text{m/s}$$
$$\mathbf{\Delta t = 4.43s}$$

8. A golf ball that weighs 0.45 N is dropped from a height of 1.0 m. Assume that the golf ball has a perfectly elastic collision with the floor.



   a. In the margin, construct a motion map for the golf ball from the time it is dropped until it reaches its highest point of rebound.

   b. Determine the time required for the ball to reach the floor.

$$\Delta x = .5(10\text{m/s}^2)t^2 = 1.0\text{m}$$
$$t^2 = 0.2\ s^2$$
$$t = 0.45\text{s}$$

   c. What will the instantaneous momentum of the golf ball be immediately *before* it strikes the floor?

$$v_f = at + v_i$$
$$v_f = 10\text{m/s}^2 * 0.45\text{s} = 4.47\text{m/s}$$
$$0.045\text{kg}(4.47\text{m/s}) = 0.20\ \text{kg-m/s}$$

   d. What will be the change in momentum , (Δ**p**) from the instant before the ball collides with the floor until the instant after it rebounds from the floor? (Illustrate with a vector diagram.)

$$\Delta\rho = (0.045\ \text{kg})(4.47\text{m/s} - (-4.47\text{m/s})) = 0.4023\ \text{kg-m/s}$$

   e. Suppose that the golf ball was in contact with the floor for 4.0×10^{-4}s. What was the average force on the ball while it was in contact with the floor?

$$\mathbf{F\Delta t = m\Delta v}$$
$$\mathbf{F = (m\Delta v)/\ \Delta t}$$
$$\mathbf{(0.045kg)(8.94m/s)/(4.0x10^{-4}s) = 1005.8\ N}$$