Name: Key

Momentum, Impulse and Momentum Change

Read from **Lesson 1** of the **Momentum and Collisions** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/momentum/u4l1a.html
http://www.physicsclassroom.com/Class/momentum/u4l1b.html

MOP Connection: Momentum and Collisions: sublevels 1 and 2

Momentum

1. The momentum of an object depends upon the object's ________. Pick two quantities.
   (a) mass - how much *stuff* it has
   b. acceleration - the rate at which *the stuff* changes its velocity
   c. weight - the force by which gravity attracts *the stuff* to Earth
   (d) velocity - how fast and in what direction it's *stuff* is moving
   e. position - where the *stuff* is at

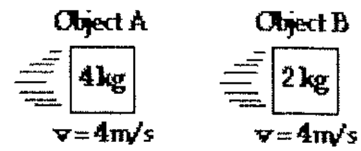
   A, D

2. Momentum is a ___________ quantity.
   a. scalar (b). vector

3. Which are **complete** descriptions of the momentum of an object? Circle all that apply.
   a. 2.0 kg/s (b). 7.2 kg•m/s, right c. 6.1 kg•m/s^2, down
   d. 4.2 m/s, east (e). 1.9 kg•m/s, west f. 2.3 kg•m/s

4. The two quantities needed to calculate an object's momentum are mass and velocity.

5. Consider the mass and velocity values of Objects A and B below. Compared to Object B, Object A has ____ momentum.
   (a) two times the b. four times the
   c. eight times the d. the same
   e. one-half the f. one-fourth the
   g. ... impossible to tell without knowledge of the F and a.



6. Calculate the momentum value of .... (Include appropriate units on your answers.)
   a. ... a 2.0-kg brick moving through the air at 12 m/s.

   24 kg·m/s

   b. ... a 3.5-kg wagon moving along the sidewalk at 1.2 m/s.

   4.2 kg·m/s

7. With what velocity must a 0.53-kg softball be moving to equal the momentum of a 0.31-kg baseball moving at 21 m/s?

   $p_s = p_b \Rightarrow m_s v_s = m_b v_b \Rightarrow 0.53 v_s = 0.31(21)$
   $v_s = 12.3$ m/s

Impulse and Momentum Change

8. Insert these words into the four blanks of the sentence: **mass, momentum, acceleration, time, impact, weight, impulse,** and **force**. (Not every word will be used.)

   In a collision, an object experiences a(n) force acting for a certain amount of time and which is known as a(n) impulse ; it serves to change the momentum of the object.

9. A(n) impulse causes and is equal to a change in momentum.
a. force b. impact c. impulse d. collision

10. Calculate the impulse experienced by ..... (Show appropriate units on your answer.)
a. ... a 65.8-kg halfback encountering a force of 1025 N for 0.350 seconds.

$Impulse = F(\Delta t) = (1025 N)(0.350 s) = 359 N \cdot s$ or $359 kg\ m/s$

b. ... a 0.168-kg tennis ball encountering a force of 126 N that changes its velocity by 61.8 m/s.

$Impulse = \Delta p = m \Delta v = (0.168 kg)(61.8 m/s)$
$= 10.4 kg\ m/s = 10.4 N \cdot s$

11. Determine the impulse (I), momentum change (Δp), momentum (p) and other values.

A 7-ball collides with the 8-ball.

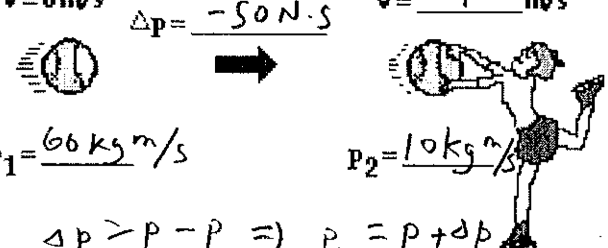
I = −0.3 N·s
Δp = −0.3 kg m/s

m = 0.1 kg, v = 4 m/s → m = 0.1 kg, v = 1 m/s

P_1 = 0.4 kg·m/s P_2 = 0.1 kg m/s

A moving medicine ball is caught by a girl on ice skates.

m = 10 kg, v = 6 m/s
I = −50 N•s
Δp = −50 N·s
m = 10 kg, v = 1 m/s



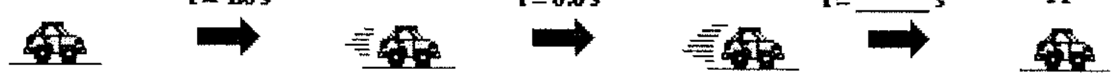
P_1 = 60 kg m/s P_2 = 10 kg m/s

$\Delta p = p_2 - p_1 \Rightarrow p_2 = p_1 + \Delta p$

A car is at rest when it experiences a forward propulsion force to set it in motion. It then experiences a second forward propulsion force to speed it up even more. Finally, it brakes to a stop.

I = 16,000 N·S I = 18,000 N·S I = −34,000 N·S
Δp = 16,000 kg·m/s Δp = 18,000 kg m/s Δp = −34,000 kg m/s

At rest; F_{app} = 4000 N, t = 4.0 s; F_{app} = 6000 N, t = 3.0 s; F_{frict} = 8000 N, t = ____ s; Stopped



P_1 = 0 P_2 = 16 000 N·S P_3 = 34,000 kg m/s P_4 = −34,000 kg·m/s

A tennis ball is at rest when it experiences a forward force to set it in motion. It then strikes a wall where it encounters a force that slows it down and finally turns it around and sends it backwards.

I = 6 N·S I = −6 N·S I = 4.8 N·S
Δp = 6 kg m/s Δp = −6 kg m/s Δp = 4.8 kg m/s

F_{app} = 60 N F_{wall} = 120 N F_{wall} = 120 N

Stopped; t = 0.1 s; Moving Right; t = 0.05 s; v = 0 m/s; t = 0.04 s; Moving Left

P_1 = 0 P_2 = 6 kg m/s P_3 = 0 P_4 = 4.8 kg m/s