

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

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

- Momentum is a _____ quantity.
 - scalar
 - vector

- Which are **complete** descriptions of the momentum of an object? Circle all that apply.

- 2.0 kg/s
- 7.2 kg•m/s, right
- 6.1 kg•m/s², down
- 4.2 m/s, east
- 1.9 kg•m/s, west
- 2.3 kg•m/s

- The two quantities needed to calculate an object's momentum are _____ and _____.

- Consider the mass and velocity values of Objects A and B below. Compared to Object B, Object A has _____ momentum.

- two times the
- four times the
- eight times the
- the same
- one-half the
- one-fourth the
- ... impossible to tell without knowledge of the F and a.



- Calculate the momentum value of (Include appropriate units on your answers.)

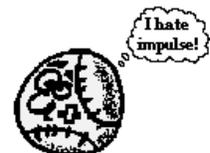
- ... a 2.0-kg brick moving through the air at 12 m/s.
- ... a 3.5-kg wagon moving along the sidewalk at 1.2 m/s.

- 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?

Impulse and Momentum Change

- 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) _____ acting for a certain amount of _____ and which is known as a(n) _____; it serves to change the _____ of the object.



Momentum and Collisions

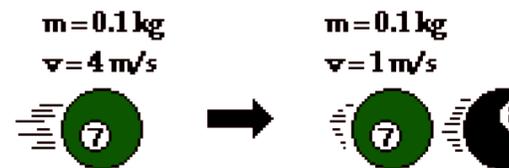
9. A(n) _____ causes and is equal to a change in momentum.
 a. force b. impact c. impulse d. collision
10. Calculate the impulse experienced by (Show appropriate units on your answer.)
 a. ... a 65.8-kg halfback encountering a force of 1025 N for 0.350 seconds.
 b. ... a 0.168-kg tennis ball encountering a force of 126 N that changes its velocity by 61.8 m/s.

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

A 7-ball collides with the 8-ball.

$I = \underline{\hspace{2cm}}$
 $\Delta p = \underline{\hspace{2cm}}$

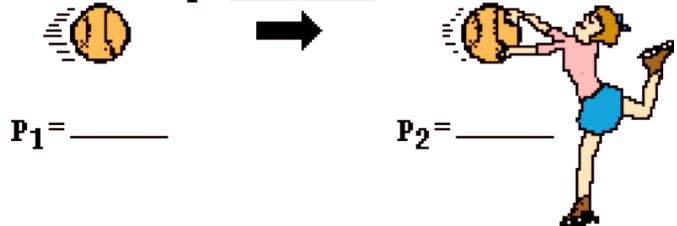
$m = 0.1 \text{ kg}$ $m = 0.1 \text{ kg}$
 $v = 4 \text{ m/s}$ $v = 1 \text{ m/s}$



$P_1 = \underline{\hspace{2cm}}$ $P_2 = \underline{\hspace{2cm}}$

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

$m = 10 \text{ kg}$ $I = -50 \text{ N}\cdot\text{s}$ $m = 10 \text{ kg}$
 $v = 6 \text{ m/s}$ $\Delta p = \underline{\hspace{2cm}}$ $v = \underline{\hspace{2cm}} \text{ m/s}$

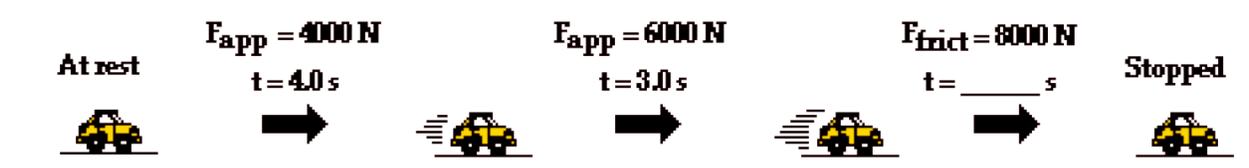


$P_1 = \underline{\hspace{2cm}}$ $P_2 = \underline{\hspace{2cm}}$

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.

$I = \underline{\hspace{2cm}}$ $I = \underline{\hspace{2cm}}$ $I = \underline{\hspace{2cm}}$
 $\Delta p = \underline{\hspace{2cm}}$ $\Delta p = \underline{\hspace{2cm}}$ $\Delta p = \underline{\hspace{2cm}}$

At rest $F_{\text{app}} = 4000 \text{ N}$ $F_{\text{app}} = 6000 \text{ N}$ $F_{\text{frict}} = 8000 \text{ N}$ **Stopped**
 $t = 4.0 \text{ s}$ $t = 3.0 \text{ s}$ $t = \underline{\hspace{2cm}} \text{ s}$

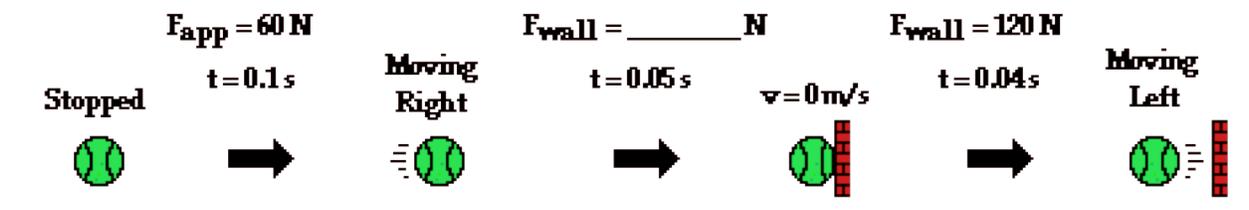


$P_1 = \underline{\hspace{2cm}}$ $P_2 = \underline{\hspace{2cm}}$ $P_3 = \underline{\hspace{2cm}}$ $P_4 = \underline{\hspace{2cm}}$

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.

$I = \underline{\hspace{2cm}}$ $I = \underline{\hspace{2cm}}$ $I = \underline{\hspace{2cm}}$
 $\Delta p = \underline{\hspace{2cm}}$ $\Delta p = \underline{\hspace{2cm}}$ $\Delta p = \underline{\hspace{2cm}}$

Stopped $F_{\text{app}} = 60 \text{ N}$ **Moving Right** $F_{\text{wall}} = \underline{\hspace{2cm}} \text{ N}$ $v = 0 \text{ m/s}$ $F_{\text{wall}} = 120 \text{ N}$ **Moving Left**
 $t = 0.1 \text{ s}$ $t = 0.05 \text{ s}$ $t = 0.04 \text{ s}$



$P_1 = \underline{\hspace{2cm}}$ $P_2 = \underline{\hspace{2cm}}$ $P_3 = \underline{\hspace{2cm}}$ $P_4 = \underline{\hspace{2cm}}$