The Law of Conservation of Momentum

Pre-Lecture Questions

Problem Set #18 (due next time)

Lecture Outline

1. Understanding the Law of Conservation of Linear Momentum
2. Applying the Law of Conservation of Linear Momentum
3. Summary of the Course to Date

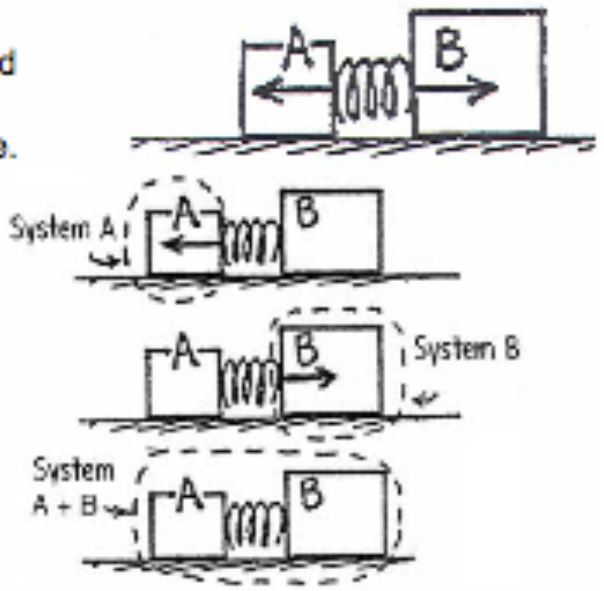
Pre-Class Summary:

When a system of objects is "isolated" that is, it feels no forces from outside the system, the total momentum of the system stays fixed.

The Law of Conservation of Linear Momentum
"The total linear momentum of an isolated systems of objects remains constant."

The Law of Conservation of Linear Momentum is very useful for understanding collisions.

When the compressed spring is released, Blocks A and B will slide apart. There are three systems to consider, indicated by the closed dashed lines below—A, B, and A + B. Ignore the vertical forces of gravity and the support force of the table.



a. Does an external force act on System A? [Y] [N]

Will the momentum of System A change? [Y] [N]

b. Does an external force act on System B? [Y] [N]

Will the momentum of System B change? [Y] [N]

c. Does an external force act on System A + B? [Y] [N]

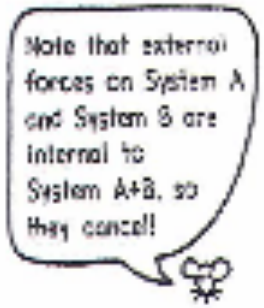
Will the momentum of System A + B change? [Y] [N]

Billiard ball A collides with billiard ball B at rest. Isolate each system with a closed dashed line. Draw only the external force vectors that act on each system.

System A

System B

System A + B



a. Upon collision, the momentum of System A [increases] [decreases] [remains unchanged].

b. Upon collision, the momentum of System B [increases] [decreases] [remains unchanged].

c. Upon collision, the momentum of System A + B [increases] [decreases] [remains unchanged].

Example 1: A homerun can leave the bat at about 110mph (49m/s), while an average fastball heads toward the batter at about 92mph (41m/s). The mass of a baseball is 145g while a typical bat has a mass of 36oz (1.0kg). The (center-of-mass) speed of the bat when it strikes the ball is about 50mph (22m/s). Find the speed of the bat just after hitting the ball.

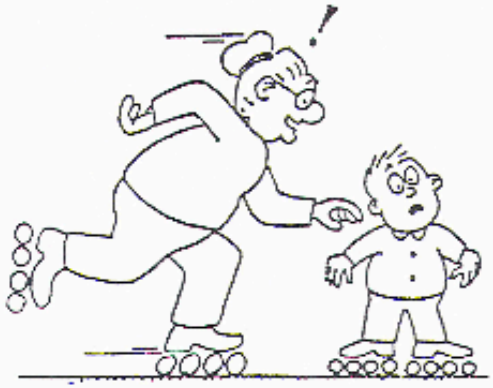
Conservation of Momentum During a Bunt!

Conservation of Momentum During a Homer!

. Granny whizzes around the rink and is suddenly confronted with Ambrose at rest directly in her path. Rather than knock him over, she picks him up and continues in motion without "braking."

Consider both Granny and Ambrose as two parts of one system. Since no outside forces act on the system, the momentum of the system before collision equals the momentum of the system after collision.

a. Complete the before-collision data in the table below.



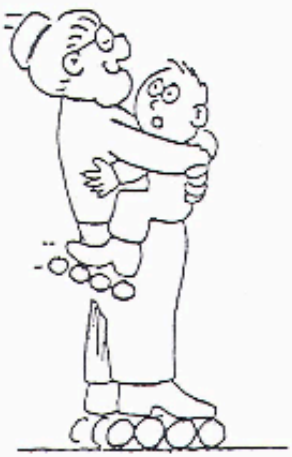
BEFORE COLLISION	
Granny's mass	80 kg
Granny's speed	3 m/s
Granny's momentum	_____
Ambrose's mass	40 kg
Ambrose's speed	0 m/s
Ambrose's momentum	_____
Total momentum	_____

b. After collision, Granny's speed [increases] [decreases].

c. After collision, Ambrose's speed [increases] [decreases].

d. After collision, the total mass of Granny + Ambrose is _____.

e. After collision, the total momentum of Granny + Ambrose is _____.



f. Use the conservation of momentum law to find the speed of Granny and Ambrose together after collision. (Show your work in the space below.)

New speed _____

Example 2: In a poorly thought out prank, a prankster places a firecracker in an apple. The explosion breaks it into three pieces of equal mass that fly off horizontally. The first piece heads off northeastward at 20.0m/s. The second piece heads off at 60° south of east at 16.3m/s. Find the speed and direction of the third piece.

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