Controlling a Collision

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: sublevel 3

Review:

1. A halfback (m = 80 kg), a tight end (m = 100 kg), and a lineman (m = 120 kg) are running down the football field. Consider their ticker tape patterns below.

Lineman →. . . . . .

Tight End →. . . . . .

Halfback →. . . . . .

The lineman's velocity is 3 m/s (right). The tight end's velocity is 6 m/s and the halfback's velocity is 9 m/s. Which player has the greatest momentum and how much momentum does he have? Halfback Explain. 3·120 = 360 6·100 = 600 9·80 = 720

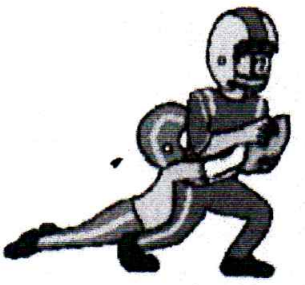
2. A football fullback is running down the field at constant speed until he encounters a defensive back. The dot diagram depicts the motion of the fullback.

. . . . . ↓

Indicate on the dot diagram (by means of an arrow) the approximate location at which the fullback-defensive back collision occurs.

Which direction (right or left) does the force upon the fullback act? _____ Explain how you know.

← he slows down



What happens to the momentum of the fullback upon colliding with the defensive back?

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Using the F•t = m•Δv Equation to Analyze Impulses and Momentum Changes:

3. Two cars of equal mass are traveling down Lake Avenue with equal velocities. They both come to a stop over different lengths of time. The dot diagrams for each car are shown below.

Car A . . . . . 

Car B . . . . . 

Which car (A or B) experiences the greatest acceleration? A Explain. same Δv, Δt↓

Which car (A or B) experiences the greatest change in momentum? same Explain.

Which car (A or B) experiences the greatest impulse? same Explain.

Same Δv, Same mass

Which car (A or B) experiences the greatest force? A Explain. F↑ · t↓ = Δp

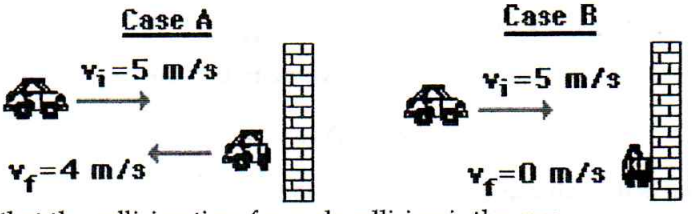
4. When a boxer recognizes that he/she will be hit by an opposing fist, he/she rides the punch. Use physics to explain why.

$F \cdot T = I$, increase t, $\downarrow$ force

5. Mountain climbers use nylon safety ropes due to their tendency to stretch considerably under stress. Use physics to explain why.

$\uparrow$ Time $\downarrow$ Force

Consider the diagram at the right for the next three questions. The diagram depicts **Before** and **After** velocities of an 800-kg car in two different collisions with a wall. In case A, the car rebounds upon collision. In case B, the car hits the wall, crumples up and stops. Assume that the collision time for each collision is the same.



_____ 6. In which case does the car experience the greatest momentum change?
a. Case A b. Case B c. Both the same d. Insufficient information

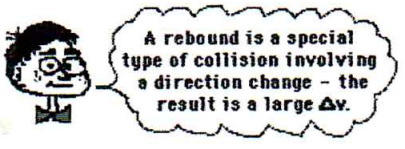
$\Delta v = 9$

_____ 7. In which case does the car experience the greatest impulse?
a. Case A b. Case B c. Both the same d. Insufficient information

$\Delta v = 9$

_____ 8. The impulse encountered by the 800-kg car in case A has a magnitude of ___ N•s.
a. 0 b. 800 c. 3200 d. 4000
e. 7200 f. Not enough information to determine.

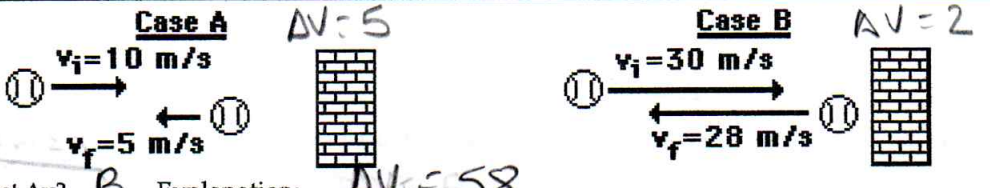
$\Delta 9 \cdot 800 = 7200$



9. Evaluate the potential hazard to a passenger involved in a head-on collision in which the two cars stick together compared to when they rebound upon impact. Explain.

Rebound can increase Δp and therefor $\uparrow$ Force

10. The diagram below depicts the changes in velocity of a ball that undergoes a collision with a wall. Indicate which case (A or B) has the greatest change in velocity, greatest acceleration, greatest momentum change, and greatest impulse. Support each answer.



$\Delta V = 5$ $\Delta V = 2$

Greatest Δv? B Explanation: $\Delta V = 58$

Greatest a? B Explanation: $\Delta V = 58$

Greatest Δp? B Explanation: $\Delta V = 58$ vs 15, same Mass

Greatest FΔt? B Explanation: $\rightarrow$

$-5 - +10 = 15$ $-28 - 30 = 58$