Lesson 2 Impulse Solutions

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Key idea: impulse $\leftrightarrow$ change in momentum

$\Delta \rightarrow$ final - initial

$\Delta \vec{p} = \vec{p}_f - \vec{p}_i$

$\Delta \vec{p} = m\vec{v}_f - m\vec{v}_i = \vec{F}\Delta t$

1. 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.

(Ans: force, time, impulse, momentum)

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

$\vec{p} = m\vec{v}_f - m\vec{v}_i$

$\Delta \vec{p} = \vec{p}_f - \vec{p}_i$ $\quad \vec{p} = F\Delta t$

3. Calculate the impulse experienced by
a. ... a 65.8-kg halfback encountering a force of 1025 N for 0.350 seconds.

$\Delta \vec{p} = F\Delta t = (1025)(.35) = 359 \ N \cdot s$

4. A force of 20.0 N west is applied to a 3.00 kg object for 4.00 seconds. Calculate the impulse experienced by the object.
(Ans: 80 Ns west)

$\Delta \vec{p} = \vec{F}\Delta t = 20(4) = 80 \ N \cdot s$

(Ans: 80 Ns west)

$\Delta \vec{p} = \vec{F}\Delta t = 20(4) = 80 \ N \cdot s$

(Ans: 80 Ns west)

5. A 1200 kg car traveling at 20.0 m/s north changes speeds to 30.0 m/s south. What is the impulse experienced by the car?

$\Delta \vec{p} = m\vec{v}_f - m\vec{v}_i = (1200)(-30) - 1200(20) = -60000 \ kg\,m/s$

$= 60000 \ kg\,m/s$ @ South

6. A 1500 kg car accelerates from 55.0 km/h to 90.0 km/h. Calculate the magnitude of the impulse experienced by the car.
(Ans: 14600 kg m/s)

$\Delta \vec{p} = m\vec{v}_f - m\vec{v}_i = 1500\left(\frac{90}{3.6}\right) - 1500\left(\frac{55}{3.6}\right) = 14600 \ kg\,m/s$

7) a) If the boxer in Figure 6.8 is able to increase the duration of impact three times as long by riding with the punch, by how much will the force of impact be reduced? time 3 x bigger, F is 3 x smaller

b) If the boxer instead moves into the punch such as to decrease the duration of impact by half, by how much will the force of impact be increased? force will be 2 x larger

c) A boxer being hit with a punch contrives to extend time for best results, whereas a karate expert delivers a force in a short time for best results. Isn't there a contradiction here?

(Ans: a. the force will be divided by 3 (so 1/3 as large as before)
b. the force will double
c. No. A karate expert wants the force to be as large as possible (so time of impact is small), and a boxer being hit wants the force to be as small as possible (so time of impact is large))