Physics 112
Thursday Nov 30th

Impulse
Impulse - Momentum

Impulse

$j = F\Delta t$

$j = \Delta p$

$= m(v_2 - v_1)$

Impulse-Momentum

$F\Delta t = m(v_2 - v_1)$

A volleyball (m = 0.50 kg) come over the net at 5.0 m/s and is hit straight back at 8.0 m/s. If the player's hand and volleyball were in contact for 0.025 seconds, determine the force the player's hand exerted on the ball.

$$F\Delta t = m(v_2 - v_1)$$

$$F = \frac{m(v_2 - v_1)}{\Delta t}$$

+5.0 m/s → ← -8.0 m/s

$$F = \frac{0.5\,kg(-8.0 - 5.0)}{0.025}$$

$$F = (-)260\ N$$

(-) opposite direction to which the ball was originally moving.

Why is it important to follow through when hitting a baseball?

$$F\Delta t = m(v_2 - v_1)$$

- If you follow through or not, the following variables will not change → F, m, v_1

$$F\Delta t = m(v_2 - v_1)$$

$$F\Delta t = m(v_2 - v_1)$$

- By following through, we increase the contact time (Δt)

- If (Δt) increases, then v_2 must also increase so that both sides of equal sign remain the same.

Explain why it is important for vehicles to crumple upon impact.

$$F \Delta t = m(v_2 - v_1)$$

- The following variables will not change if the vehicle crumples or not → m - car's mass
  v_2 - stopped (0 m/s)
  v_1 - velocity of car before impact

$$F \Delta t = m(v_2 - v_1)$$

$$F \Delta t = m(v_2 - v_1)$$

- If the vehicle crumples, this will increase (Δt). If Δt goes up, then F must go down to equal the value on the other side of the equal sign.

F is what you feel!

Green text

p 209 (41, 43, 44 & 46)
p 213 (45 & 47)

41. a) $j = F\Delta t$

$= 9.1\ N \times 0.0025\ sec$

$= 0.022\ N \cdot s$ [East]

$= 2.2 \times 10^{-2}\ N \cdot s$ [East]

b) $j = F\Delta t$

$= 4.2\ N \times 0.0086\ sec$

$= 3.6 \times 10^{-2}\ N \cdot s$ [South]

43.

$$J = F\Delta t$$

$$\frac{J}{F} = \Delta t$$

$$\frac{2.0\ N\cdot s}{55\ N} = \Delta t$$

$$0.036\ sec = \Delta t$$

$$3.6 \times 10^{-2}\ seconds = \Delta t$$

contact time

44. a) $j = F\Delta t = m(v_2 - v_1)$

$j = m(v_2 - v_1)$

$j = 0.300\ kg(-9.2 - 44)$

$j = -16\ kg \cdot m/s$

$j = -16\ N \cdot s$

$j = 16\ N \cdot S$ [South]

(b) $j = F\Delta t$

$-16\ N \cdot S = -2.5 \times 10^3\ N\ (\Delta t)$

$0.0064 = \Delta t$

6.4×10^{-3} seconds $= \Delta t$

46.

$W = Fd$

$W = \Delta KE$

$W = KE_2 - KE_1$

$KE_2 = 0$ (stopped)

$W = -KE_1$

$Fd = -\frac{1}{2}mv^2$

$F(1) = -\frac{1}{2}(75)(28)^2$

$F = -29400\,N$

45. a) $j = m(v_2 - v_1)$

$= 0.150\ kg(0 - 44\ m/s)$

$= -6.6\ kg \cdot m/s$

b) $j = m(v_2 - v_1)$

$= 5.0\ kg(0 - 8\ m/s)$

$= -40\ kg \cdot m/s$

c) $j = m(v_2 - v_1)$

$= 12000\ kg(0 - 2.5\ m/s)$

$= -30\ 000\ kg \cdot m/s$

47.

$$j = F\Delta t$$

$$F = \frac{j}{\Delta t} = \frac{2.5 \text{ N}\cdot\text{s}}{0.055 \text{ s}}$$

$$F = 45 \text{ N}$$

$v_1 = 0$

$$j = m(v_2 - v_1)$$

$$2.5 \text{ N}\cdot\text{s} = 0.060\text{kg}(v_2)$$

$$\boxed{42 \text{ m/s} = v_2}$$