

Physics 112
Tuesday May 7

Quiz on Friday

momentum

impulse

conservation of momentum

impulse-momentum Theorem

Impulse (j)

$$j = F \Delta t \quad \text{---} \quad \text{N} \cdot \text{s}$$

$$j = \Delta p \quad \text{---} \quad \text{kg} \cdot \text{m/s}$$

$$j = mv_2 - mv_1 \quad \text{---} \quad \text{kg} \cdot \text{m/s}$$

$$j = m(v_2 - v_1) \quad \text{---} \quad \text{kg} \cdot \text{m/s}$$

$$1 \text{ N} \cdot \text{s} = 1 \text{ kg} \cdot \text{m/s}$$

$$j = F \Delta t = \Delta p = mv_2 - mv_1 = m(v_2 - v_1) = m(\Delta v)$$

j = impulse

F = Force

Δt = contact time

Δp = change in momentum

m = mass

v_2 = final velocity

v_1 = initial velocity

Δv = Change in
velocity

Impulse - Momentum Theorem

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

Example:

A volleyball ($m = 0.25 \text{ kg}$) comes over the net at 2.0 m/s . A player hits it straight back at 4.0 m/s . If the ball and player are in contact for 0.040 seconds, determine the force exerted by the player.

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

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

$$F = \frac{0.25 \text{ kg} (-4 - 2) \text{ m/s}}{0.040 \text{ sec}}$$

$$F = -37.5 \text{ N}$$

The -37.5 N indicates that the direction of the applied force is opposite to the direction the ball was originally moving.

Δt = Contact time in seconds between the object applying the force and the object being hit.

→ If contact time is referenced in the question → Impulse or impulse momentum.