Momentum

- Moving inertia
  - Remember inertia is a property of matter measured by mass
- Momentum is a vector (pay attention to signs)

$\rho = mv$

ρ = momentum (kg*m/s)

m = mass (kg)

v = velocity (m/s)

Practice

What is the momentum of a 25 kg gazelle that is running at 6 m/s?

Mass = 25 kg

Velocity = 6 m/s

ρ = ?

$\rho = mv$

$\rho = (25\ kg)(6\ m/s)$

$\rho = 150$ kg*m/s

Impulse

- **Change in momentum ($\Delta\rho$ = J)**
- **Impulse = J**
- **Newton's 2nd law**
  - **He did not say force is equal to the mass times acceleration.**
  - **He said that a force causes a change in momentum over time.**

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

F = Force (N)

t = time (s)

$\Delta\rho$ = Impulse (Ns = kg*m/s)

Impulse

$$J = \Delta\rho = (mv_f - mv_i) = m(v_f - v_i) = Ft$$

$\Delta\rho$ = impulse (Ns)
J = impulse (Ns)
m = mass (kg)
v_f = final velocity (m/s)
v_i = initial velocity (m/s)
F = force (N)
t = time (sec)

WATCH YOUR SIGNS FOR INITIAL AND FINAL VELOCITY. . .

Practice

- A racquet ball (mass of 0.0427 kg) with a velocity of 60 m/s is hit by a racquet and rebounds in the opposite direction with a velocity of 80 m/s.

1) What is the impulse of the racquet ball?

2) If the ball was in contact with the racquet for 0.003 seconds, how much force did the racquet provide on the ball?

m = 0.0427 kg

v_i = 60 m/s

V_f = -80 m/s

J = ?

$J = m(v_f - v_i)$

$J = 0.0427kg(-80\ m/s - 60\ m/s)$

$J = -5.98$ Ns

Practice, cont.

J = -5.98 Ns

$\Delta\rho$ = -5.98 Ns

t = 0.003 s

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

$$F = \frac{-5.98Ns}{0.003s}$$

$$F = -1993.3N$$