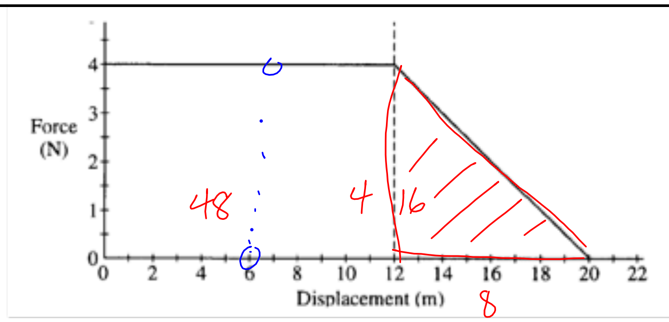
Review

Put in your own words – what is momentum and what is impulse?

What does it mean that momentum is conserved?

Warm-Up



A 0.20 kg object moves along a straight line. The net force acting on the object varies with the object's displacement as shown in the graph above. The object starts from rest at displacement x = 0 and time t = 0 and is displaced a distance of 20 m. Determine each of the following.

A. The acceleration of the particle when its displacement x is 6 m.

B. The time taken for the object to be displaced the first 12 m.

C. The amount of work done by the net force in displacing the object the first 12 m.

D. The speed of the object at x = 12 m.

E. The final speed of the object at displacement x = 20 m.

F. The change in the momentum of the object as it is displaced from x = 12 m to x = 20 m

Example 1

A 0.150 kg baseball moving at +26.0 m/s is brought to rest by a catcher would exerts a constant force of -390.0 N on the ball.

A. How long does it take to bring the ball to a stop?

B. Using your kinematic formulas, how far (x) does the ball travel before coming to a stop?

$J = \Delta p$

$F \cdot \Delta t = mV_f - mV_o$

$\Delta t = 0.01\ s$

$x = ?$

$V_o = 26\ m/s$

$V = 0\ m/s$

$t = 0.01\ s$

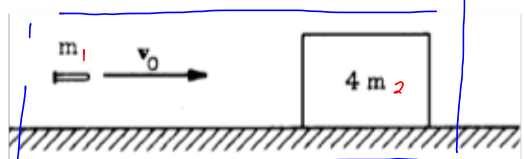
$V = V_o + at$

$x = \frac{1}{2}(V + V_o)t$

$X = 0.13\ m$

Example 2

A bullet of mass m and velocity v_o is fired toward a block of mass 4m. The block is initially at rest on a frictionless horizontal surface. The bullet penetrates the block and emerges with a velocity of $1/3v_o$



A. Determine the final speed of the block.

B. Determine the loss in kinetic energy of the bullet.

Lost $\frac{4}{9}mv_o^2$

C. Determine the gain in the kinetic energy of the block.

$KE = \frac{1}{2}mv^2$

$P_o = P_f$

$m_1v_{1o} + m_2v_{2o} = m_1v_{1f} + m_2v_{2f}$

$mv_o + (4m)(0) = m(\frac{1}{3}v_o) + (4m)v$

$\frac{3}{3}mv_o = \frac{1}{3}mv_o + 4mv$

$\frac{2}{3}mv_o = 4mv$

$\frac{2}{3}v_o = 4v$

$\frac{1}{6}v_o = v$ ← velocity of block

Before: $\frac{1}{2}mv_o^2$

After: $\frac{1}{2}m(\frac{1}{3}v_o)^2$

$\frac{1}{2}m\frac{1}{9}v_o^2$

$\frac{1}{18}mv_o^2$

$\Delta KE = \frac{1}{18}mv_o^2 - \frac{1}{2}mv_o^2$

$\Delta KE = \frac{1}{18}mv_o^2 - \frac{9}{18}mv_o^2$

$\Delta KE = \frac{-8}{18}mv_o^2$

$\Delta KE = -\frac{4}{9}mv_o^2$

Collisions!!

Three different kinds of collisions

- IMPORTANT: In ALL collisions, momentum is conserved.
  - Elastic Collisions
  - Inelastic Collisions
  - Total Inelastic Collisions

Collisions!

Elastic

'Perfect Physics world'

Perfect Rebound.
no loss of energy

Momentum is conserved

KE is conserved
$\frac{1}{2}mv_o^2 = \frac{1}{2}mv_f^2$

Inelastic

Total Inelastic