Unit 6: Momentum, Impulse, and Conservation of Momentum

Section I: Momentum and Impulse

1. Calculate the momentum a 0.001 kg fly flying 5 m/s has.

$p = mv = (0.001\text{kg})(5\text{m/s}) = 0.005\text{kg}\cdot\text{m/s}$

2. A force of 20 N acts on a 2.0 kg mass for 10 s. What is the impulse and change in speed?

$J = Ft = 20\text{N}(10\text{s}) = 200\text{N}\cdot\text{s}$

$J = m\Delta v$

$\Delta v = \frac{J}{m} = \frac{200\text{N}\cdot\text{s}}{2.0\text{kg}} = 100\text{m/s}$

3. Before a collision, a 25 kg object is moving at + 12 m/s. Find the impulse that acted on the object if, after the collision, it moves at:

A) + 8.0 m/s

$J = Ft = \Delta p = mv_f - mv_i$

$J = (25\text{kg})(8\text{m/s}) - (25\text{kg})(12\text{m/s})$

$J = -100\text{kg}\cdot\text{m/s}$

B) – 8.0 m/s

$J = mv_f - mv_i$

$J = (25\text{kg})(-8\text{m/s}) - (2\text{kg})(12\text{m/s})$

$J = -500\text{kg}\cdot\text{m/s}$

4. An 80 kg crash test dummy is traveling 35 m/s in a car and slams into a wall, causing it to come to a complete stop. The crash test dummy experiences a force of 4000 N. Find the time it took the dummy to come to a stop.

$J = Ft = mv_f - mv_i$

$t = \frac{mv_f - mv_i}{F} = \frac{-(80\text{kg})(35\text{m/s})}{4000\text{N}} = 0.7\text{s}$

5. A 5 kg object has a velocity of 8 m/s. An unbalanced force acts on the objects of 3 s, causing its velocity to decrease to 2 m/s. Calculate the magnitude of the force.

$J = Ft = mv_f - mv_i$

$F = \frac{mv_f - mv_i}{t} = \frac{(5\text{kg})(2\text{m/s}) - (5\text{kg})(8\text{m/s})}{3\text{s}} = -10\text{N}$