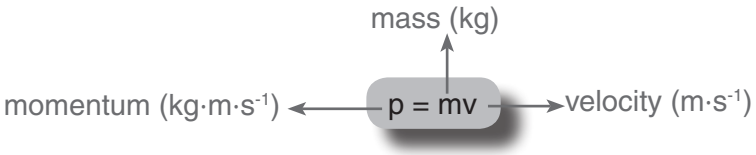
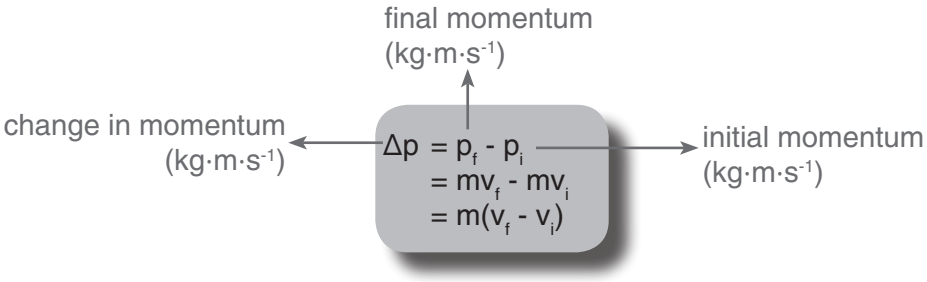
Summary

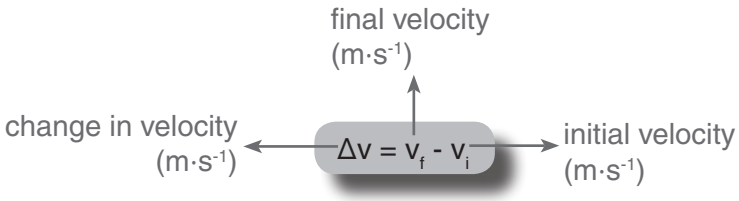
- Momentum is the product of mass and velocity of an object.

  Symbol format:



  Unit: kg·m·s^{-1} in the direction of the velocity.
- Momentum is influenced by:
  - mass of object (scalar, no direction);
  - velocity of object (vector).
- Momentum is a vector, thus it has magnitude and direction. Direction is indicated as a positive, +, or a negative, -, direction. Remember to interpret the sign as a direction in your final answer.
- Change in momentum:





  Remember to choose a direction as positive.
- Change in momentum (assuming all masses and speeds are the same):
  - If an object does not change direction during a collision, the change in momentum is smaller.
  - If an object comes to rest during a collision, the change in momentum is larger.
  - If an object changes direction during a collision, the change in momentum is the largest.
  - A collision is completely elastic if the total kinetic energy of the system just before the collision is equal to the total kinetic energy just after the collision.
  - Kinetic energy = ½mv^2
- Newton's second law in terms of momentum: the net force on an object is equal to the rate of change in momentum of the object.
-

$$F_{net} = \frac{\Delta p}{\Delta t}$$
$$= \frac{m(v_f - v_i)}{\Delta t}$$
$$= ma$$

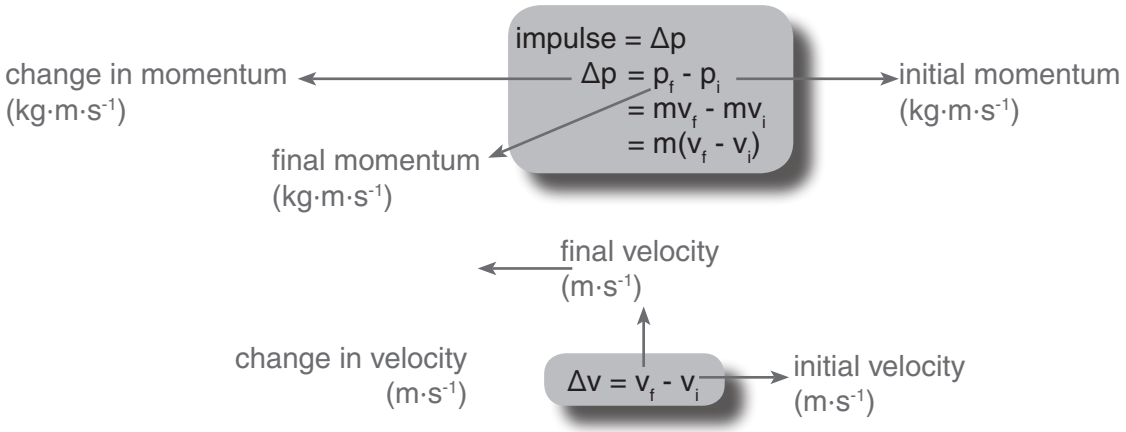
Summary

- Law of conservation of linear momentum:
  In a closed system, the vector sum of the linear momentum of all the objects before a collision/explosion is equal to the vector sum of the linear momentum of all the objects after the collision/explosion.
  OR
  In a closed system, the total linear momentum stays constant in magnitude and direction.

$$\Sigma p_{\text{before collision}} = \Sigma p_{\text{after collision}}$$
$$\Sigma p_i = \Sigma p_f$$

- A **closed/isolated system** is a system in which no external forces are exerted on the objects in the system. External forces are forces such as friction, air resistance, brakes, etc.

- The change in momentum is known as **impulse**.



- A collision is completely elastic if the total kinetic energy of the system just before the collision is equal to the total kinetic energy just after the collision.
  Kinetic energy = $\frac{1}{2}mv^2$

- **Impulse** is the product of the net force on an object and the time that the force is applied on that object.

  Symbol format: