Momentum

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- Momentum is defined as the mass of an object times its velocity.

$$p = mv$$

Examples

- What is the momentum of a 1500 kg car traveling at a velocity of 25 m/s?
  - 37500 kgm/s
- How fast must a 80 kg football player run to have a momentum of 37500 kgm/s?
  - 468.8 m/s

- Momentum can also be related to the net force acting on an object:

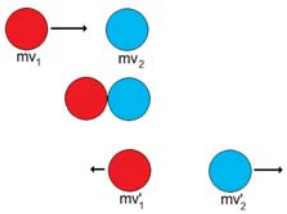
$$F = \frac{\Delta p}{\Delta t}$$

Example

- Water leaves a hose at a rate of 1.5 kg/s with a speed of 20 m/s and is aimed at the side of a car which stops it. What is the force of the water on the car?
- If the water splashes back, will the force be greater or less?

Conservation of Momentum

- The concept of momentum is particularly important because, under normal circumstances, momentum is a conserved quantity.
- Shortly before Newton's time it had been observed that the vector sum of the momentum of two colliding objects remains constant.



Before

$mv_1 + mv_2$

After

$mv_1' + mv_2'$

$$mv_1 + mv_2 = mv_1' + mv_2'$$

Law of Conservation of Momentum

- The total momentum of an isolated system of bodies remains constant.
  - System: objects interacting with each other
  - Isolated system: the only forces present are those between the objects of the system