

Momentum

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Newton described momentum as the "quantity of motion".

Ex. Big Football Player Running at 5m/s ← more momentum

Jockey Running 5m/s
No horse

An object's momentum depends on:

- Velocity
- mass

Momentum Formula

p = momentum

m = mass

v = velocity

Actually the greek letter → rho

$$p = m \times v$$

often written as p .

Momentum is a vector → magnitude & direction

$m \times v$ $N \Rightarrow \text{kgm/s}$

Units: kg m/s or Ns

Ex. 1 Calculate the momentum of a 6.2kg pumpkin travelling at a velocity of 5.0m/s west.

$m = 6.2\text{kg}$ $v = 5.0\text{m/s}$

$$m = 6.2 \text{ kg}$$

$$V = 5.0 \text{ m/s west}$$

$$\vec{p} = m \vec{v} = 6.2 \times 5.0 = \boxed{31 \text{ kgm/s west}}$$

Ex. 2 A baseball is 0.14 kg and is moving at 35 m/s N.

a) Find the momentum of the baseball.

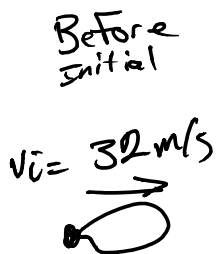
$$p = mv = 0.14 \times 35 = \boxed{4.9 \text{ kgm/s N}}$$

b) What would be the velocity of a 7.6 kg bowling ball with the same momentum?

$$\frac{p}{m} = \frac{mv}{m} \quad v = \frac{p}{m} = \frac{4.9 \text{ kgm/s}}{7.6 \text{ kg}} = \boxed{0.64 \text{ m/s N}}$$

Ex. 3 Remember $\Delta = \text{final} - \text{initial}$

a) A 0.5 kg water balloon is thrown against a wall at 32 m/s. It burst against the wall (stops). What is the change in momentum of the balloon?



$$\Delta p = p_f - p_i \quad m = 0.5 \text{ kg}$$

$$\Delta p = m v_f - m v_i$$

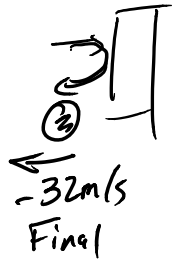
$$\Delta p = m (v_f - v_i)$$

$$\Delta p = 0.5 (0 - 32)$$

$$\Delta p = -16 \text{ kgm/s}$$

b) A 0.5 kg bouncy ball is travelling at the wall with a velocity of 32 m/s. It bounces off with a velocity of -32 m/s. Find the Δp . How does this compare to the water balloon?

32 m/s
 \rightarrow
 Initial



$$\Delta p = m(v_f - v_i)$$

$$\Delta p = 0.5(-32 - 32)$$

$$\Delta p = -32 \text{ kgm/s}$$

This is double the change in momentum of the water balloon.