

Momentum Concepts

Concepts

A. What is momentum?

$$\vec{p} = m\vec{v}$$

"inertia in motion"

B. What are the units of momentum?

$$\text{kg} \cdot \text{m/s}$$

C. Is momentum a *vector* or a *scalar*?

vector! direction matters - in 1D that means it can be + or -

Equation

1. What is the momentum of a 1200 kg car moving at 20 m/s?

$$p = mv = (1200)(20) = 24,000 \text{ kg} \cdot \text{m/s}$$

2. What is the momentum of a 0.5 kg cart moving at 1.2 m/s?

$$p = mv = (0.5)(1.2) = 0.6 \text{ kg} \cdot \text{m/s}$$

3. What is the momentum of a 40 gram bullet traveling at 350 m/s? (Careful of units!)

$$(40 \text{ gram}) \left(\frac{1 \text{ kg}}{1000 \text{ gram}} \right) = 0.04 \text{ kg} \rightarrow p = mv = (0.04)(350) = 14 \text{ kg} \cdot \text{m/s}$$

4. Who has more momentum, a 75 kg person running at 3 m/s or a 150 kg person running at 3 m/s?

$$p_1 = (75)(3) = 225 \text{ kg} \cdot \text{m/s}$$

$$p_2 = (150)(3) = 450 \text{ kg} \cdot \text{m/s} \leftarrow \text{More!}$$

5. Who has more momentum, a 75 kg person running at 3 m/s or 225 kg person walking at 1 m/s?

$$p_1 = (75)(3) = 225 \text{ kg} \cdot \text{m/s}$$

$$p_2 = (225)(1) = 225 \text{ kg} \cdot \text{m/s}$$

> same momentum.

6. How fast is a 5 kg ball moving if it has a momentum of 75 kg•m/s?

$$p = mv$$

$$75 = (5)v$$

$$v = 15 \text{ m/s}$$

Momentum Concepts

7. What is the mass of a car that has a momentum of 38,000 kg•m/s when it is moving at 20 m/s?

$$p = mv \quad 38,000 = m(20) \quad \boxed{m = 1900 \text{ kg}}$$

8. How fast does a 75 kg person have to travel to have a momentum of 400 kg•m/s?

$$p = mv \quad 400 = (75)v \quad \boxed{v = 5.3 \text{ m/s}}$$

9. What happens to your momentum if you double your speed?

it would also double

10. What happens to your momentum if you triple your speed?

also triple

11. Two objects have the same momentum, but different masses. How could this be?

They have different velocities! (Bigger mass is going slower)

$$mV = Mv$$

12. Is it possible for two things to have different speeds, yet have the same momentum?

Sure! That just means They have different masses. Just like #11!

13. Which is going faster, a 1200 kg car with a momentum of 30,000 kg•m/s or a 1750 kg car with a momentum of 35,000 kg•m/s?

$$\textcircled{1} p = mv \quad 30,000 = (1200)v \quad \underline{v = 25 \text{ m/s}} \quad \leftarrow \text{Faster!}$$

$$\textcircled{2} p = mv \quad 35,000 = (1750)v \quad \underline{v = 20 \text{ m/s}}$$

Answers:

- | | | | | |
|---------------------------|--------------------------------|------------------------------------|------------------|------------------|
| 1) 24,000 kg•m/s | 2) 0.6 kg•m/s | 3) 14 kg•m/s | 4) 150 kg person | 5) same! |
| 6) 15 m/s | 7) 1900 kg | 8) 5.33 m/s | 9) also doubles | 10) also triples |
| 11) smaller one is faster | 12) sure - if masses different | 13) 1200 kg car (25 m/s vs 20 m/s) | | |