

Exercise walk-through

4.1

Linear Momentum

AP Physics C: Mechanics

Linear momentum

Mass in motion

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

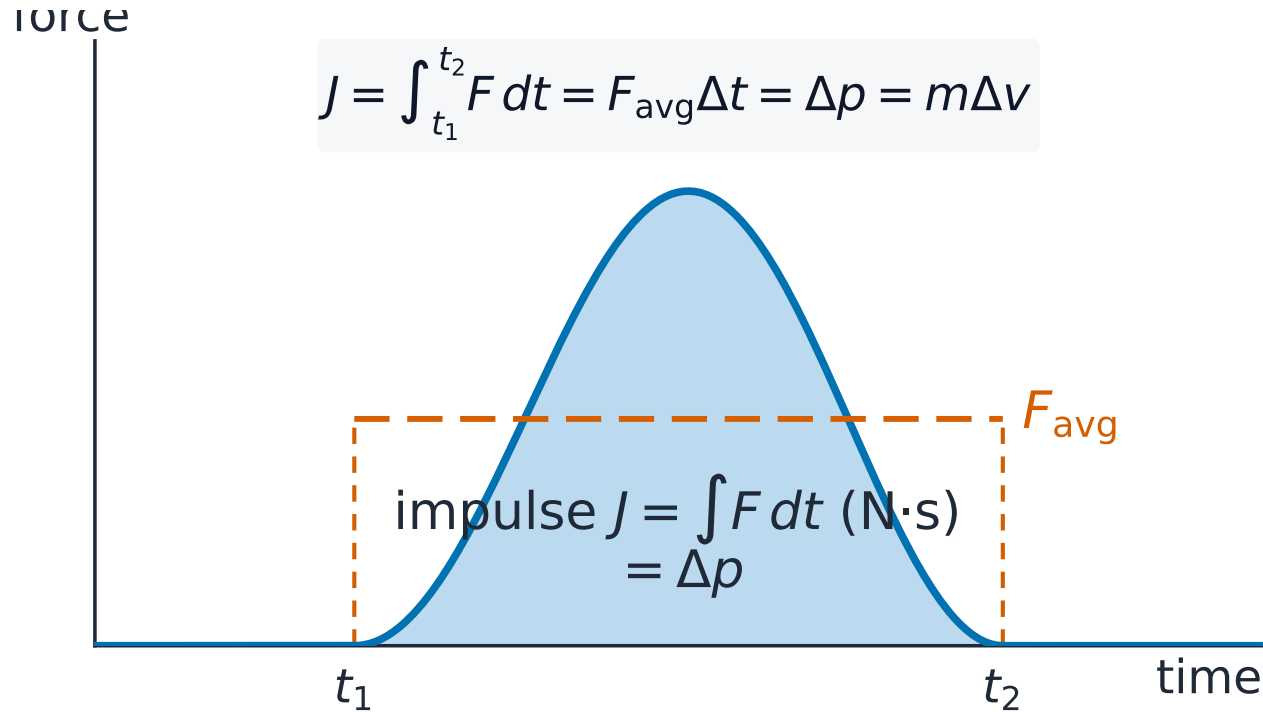
A **vector** . A **system** 's total
 $= M\vec{v}_{cm}$.

Momentum grows with **both** mass and speed – a heavy slow object can match a light fast one.



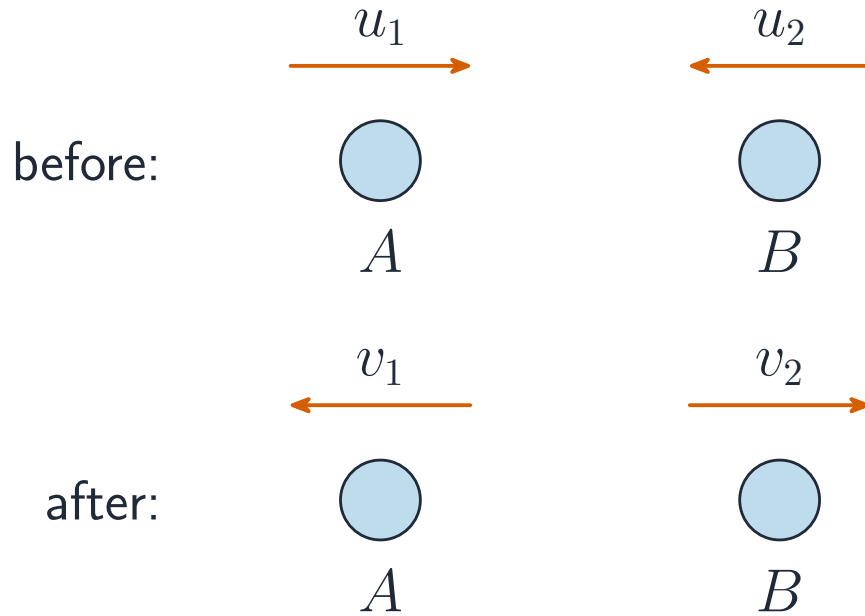
Newton's cradle

Impulse is the area under the force-time curve



Impulse is the area under the force-time curve, equal to the average force times the contact time

A head-on collision



A head-on collision: total momentum before equals total momentum after

Exercises 2.1-2.3

2.1 A 5 kg object moves at 3 m s^{-1} . Find its momentum. [2]

2.2 State the unit of momentum. [1]

2.3 Taking right as positive, find the momentum of a 2 kg ball moving left at 6 m s^{-1} . [2]

Exercises 2.1-2.3

2.1 A 5 kg object moves at 3 m s^{-1} . Find its momentum. [2]

2.1

- $p = mv = 5 \times 3 = 15 \text{ kg m s}^{-1}$

2.2 State the unit of momentum. [1]

2.2

- kg m s^{-1}

2.3 Taking right as positive, find the momentum of a 2 kg ball moving left at 6 m s^{-1} . [2]

2.3

- $p = 2 \times (-6) = -12 \text{ kg m s}^{-1}$

Exercises 2.4·3.1

2.4 An object has momentum 24 kg m s^{-1} and mass 4 kg . Find its speed. [2]

3.1 Momentum is calculated as [1]

☐

A $\frac{1}{2}mv^2$

B mv

C ma

D Fd

Exercises 2.4·3.1

2.4 An object has momentum 24 kg m s^{-1} and mass 4 kg . Find its speed. [2]

2.4

- $v = p/m = 24/4 = 6 \text{ m s}^{-1}$

3.1 Momentum is calculated as [1]

☐

A $\frac{1}{2}mv^2$

B mv

C ma

D Fd

3.1 B

- $p = mv$

Exercise 3.2

3.2 Which quantity is a vector?

[1]

☐

A mass

B speed

C momentum

D kinetic energy

Exercise 3.2

3.2 Which quantity is a vector?

[1]

☐

A mass

B speed

C momentum

D kinetic energy

3.2 C

- momentum is a vector

Exercise 3.3 (a)

3.3 A 1200 kg car moves east at 15 m s^{-1} .

(a) Find its momentum.

[2]

Exercise 3.3 (a)

3.3 A 1200 kg car moves east at 15 m s^{-1} .

(a) Find its momentum.

[2]

(a)

- $p = 1200 \times 15 = 1.8 \times 10^4 \text{ kg m s}^{-1}$

Exercise 3.3 (b)

3.3 A 1200 kg car moves east at 15 m s^{-1} .

(b) State the direction of the momentum.

[1]

Exercise 3.3 (b)

3.3 A 1200 kg car moves east at 15 m s^{-1} .

(b) State the direction of the momentum.

[1]

(b)

- East

Exercise 3.4 (a)

3.4 Object A: 8 kg at 3 m s^{-1} . Object B: 2 kg at 12 m s^{-1} .

(a) Find each momentum.

[2]

Exercise 3.4 (a)

3.4 Object A: 8 kg at 3 m s^{-1} . Object B: 2 kg at 12 m s^{-1} .

(a) Find each momentum.

[2]

(a)

- A: 24 kg m s^{-1} ; B: 24 kg m s^{-1}

Exercise 3.4 (b)

3.4 Object A: 8 kg at 3 m s^{-1} . Object B: 2 kg at 12 m s^{-1} .

(b) State which has the greater momentum.

[1]

Exercise 3.4 (b)

3.4 Object A: 8 kg at 3 m s^{-1} . Object B: 2 kg at 12 m s^{-1} .

(b) State which has the greater momentum.

[1]

(b)

- Equal