

4.1 Linear Momentum

Name: _____ Class: _____ Date: _____

Total: 15 marks**KEY WORDS** momentum 动量 • vector 矢量 • kinetic energy 动能

Objective

Build the skills to answer exam questions on **linear momentum**.**You must be able to:**

- calculate **momentum** 动量: $\vec{p} = m\vec{v}$
- treat momentum as a vector (direction matters)
- find momentum from mass and velocity, or velocity from momentum
- state the unit of momentum (kg m s^{-1})

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Momentum is mass times velocity

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

A 3 kg ball at 4 m s^{-1} has $p = 3 \times 4 = 12 \text{ kg m s}^{-1}$.

■ Momentum is a vector

Its direction is the direction of the velocity. Taking right as positive, a 2 kg ball moving left at 5 m s^{-1} has $p = -10 \text{ kg m s}^{-1}$.

■ Comparing momenta

A heavy slow object can have the same momentum as a light fast one: 10 kg at 2 m s^{-1} and 2 kg at 10 m s^{-1} both have $p = 20 \text{ kg m s}^{-1}$.

2 Practice

Now apply the methods above.

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]

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

3 Exam-style questions

3.1 Momentum is calculated as [1]

- | | |
|---|---|
| A | B |
| C | D |
- A $\frac{1}{2}mv^2$

B mv

C ma

D Fd

3.2 Which quantity is a vector? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A mass

B speed

C momentum

D kinetic energy

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

(a) Find its momentum. [2]

(b) State the direction of the momentum. [1]

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]

(b) State which has the greater momentum. [1]