

## 2.4 Newton's First Law

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

**KEY WORDS** inertia 惯性 • translational equilibrium 平动平衡 • mass 质量  
• newton's first law 牛顿第一定律 • force 力

### Objective

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Build the skills to answer exam questions on **Newton's first law** — inertia and equilibrium.

**You must be able to:**

- state **Newton's first law** 牛顿第一定律: an object's velocity stays constant unless a net external force acts
- define **inertia** 惯性 as the resistance to a change in motion, measured by **mass** 质量
- state the condition for **translational equilibrium** 平动平衡 (net force zero)
- apply the first law to objects at rest or moving at constant velocity

### 1 Worked examples

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Study these first. Each one shows the method for a question type used later.

#### ■ Equilibrium means balanced forces

An object is in **translational equilibrium** when  $\sum \vec{F} = 0$ . This includes both **at rest** and **constant velocity** — "no net force" does **not** mean "no motion".

#### ■ Inertia and mass

More mass  $\rightarrow$  more inertia  $\rightarrow$  harder to speed up, slow down, or turn. A loaded truck is harder to stop than a bicycle at the same speed.

#### ■ Balancing forces

A crate slides at constant velocity, so the forces balance: if friction is 30 N backward, the applied pull must be 30 N forward.

## 2 Practice

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**2.1** A car moves along a straight road at a **constant**  $20 \text{ m s}^{-1}$ . State the net force on it. [1]

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**2.2** A box sits still on a floor. Friction can act up to 12 N. A push of 7.0 N is applied. State the friction force and whether the box moves. [2]

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**2.3** Explain, using inertia, why passengers lurch forward when a bus brakes suddenly. [2]

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## 3 Exam-style questions

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**3.1** An object is in translational equilibrium. Its velocity must be [1]

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

**A** zero

**B** constant (possibly zero)

**C** increasing

**D** decreasing

**3.2** Which object has the greatest inertia? [1]

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

**A** a 0.5 kg ball

**B** a 2 kg book

**C** a 50 kg crate

**D** a 1 kg brick

**3.3** A 500 N lamp hangs at rest from a single cable.

(a) State the tension in the cable. [1]

(b) State the net force on the lamp, and justify with the first law. [2]