AP PHYSICS 1 • EXERCISE SHEET

2.4 Newton's First Law

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

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

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 → more inertia → 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

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

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]

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

3 Exam-style questions

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]