

2.4 Newton's First Law

Name: _____ Class: _____ Date: _____

Total: 13 marks

Objective

Build the skills to answer exam questions on **Newton's first law**.

You must be able to:

- state **Newton's first law** 牛顿第一定律: an object keeps constant velocity unless a net force acts
- describe **inertia** 惯性 as the resistance to a change in motion
- apply the **equilibrium** 平衡 condition: net force zero means constant velocity (or rest)
- relate mass to inertia

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.

■ The law of inertia

With no net force, an object at rest stays at rest and a moving object keeps a constant velocity in a straight line. Motion needs no force to continue – only a *change* in motion needs one.

■ Equilibrium

If the net force is zero, the object is in equilibrium: either at rest or moving at constant velocity. On a free-body diagram, the forces balance.

■ Mass is inertia

More mass means more inertia – harder to start, stop, or turn. A loaded truck resists changes in motion far more than a bicycle.

2 Practice

Now apply the methods above.

2.1 State what happens to a moving object when no net force acts on it. [1]

2.2 Define inertia in one sentence. [1]

2.3 A crate moves at constant velocity. State the net force on it. [1]

2.4 Which has more inertia: a 1 kg ball or a 10 kg ball? [1]

3 Exam-style questions

3.1 An object moves at constant velocity. The net force on it is [1]

- **A** in the direction of motion
- **B** opposite to the motion
- **C** zero
- **D** equal to its weight

3.2 Inertia depends on an object's [1]

- **A** velocity
- **B** mass
- **C** colour
- **D** position

3.3 A hovering drone stays perfectly still in mid-air.

(a) State the net force on it. [1]

(b) Name the two forces that must balance. [2]

3.4 A passenger lurches forward when a bus suddenly brakes.

(a) Explain this using inertia. [2]

(b) State whether a force pushes the passenger forward.

[1]

4 Go further

You are ready for more on this subtopic:

- work through the interactive **2.4 Newton's First Law** lesson on the **Learn** page;
- read the **Force and Translational Dynamics** section of the AP Physics C: Mechanics handout on the **Know** page for the full explanation and worked diagrams.

Solutions

2.1 It keeps moving at constant velocity in a straight line.

2.2 Inertia is an object's resistance to a change in its motion.

2.3 Zero (it is in equilibrium).

2.4 The 10 kg ball (more mass, more inertia).

3.1 C —constant velocity means zero net force.

3.2 B —inertia depends on mass.

3.3 (a) Zero. (b) Weight (down) and the upward lift/thrust (up).

3.4 (a) The passenger's inertia keeps them moving forward while the bus decelerates beneath them. (b) No —no forward force acts; it is the absence of one.