First and Third Laws

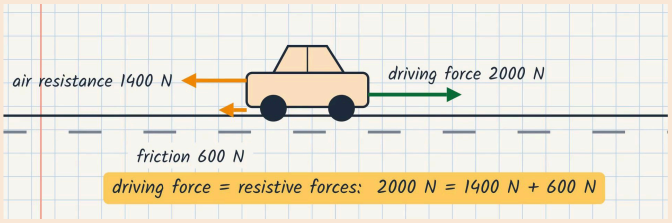
Newton's laws of motion

1 Newton's First Law



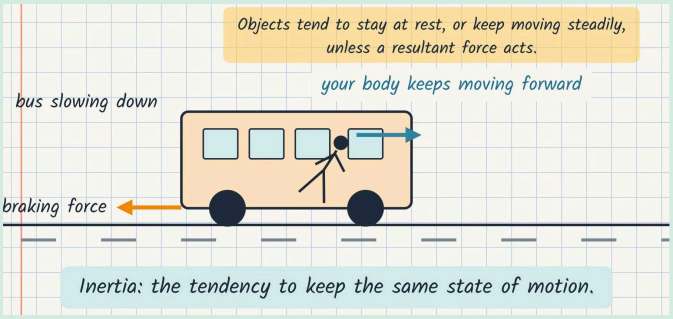
- If the **resultant force** on an object is **zero**, a still object stays still, and a moving object keeps the **same speed in the same direction**.
- A force **changes** motion; you don't need one to keep motion going. An air-hockey puck glides on with almost no force. A bike slows because of **friction and air resistance**.

2 Steady speed



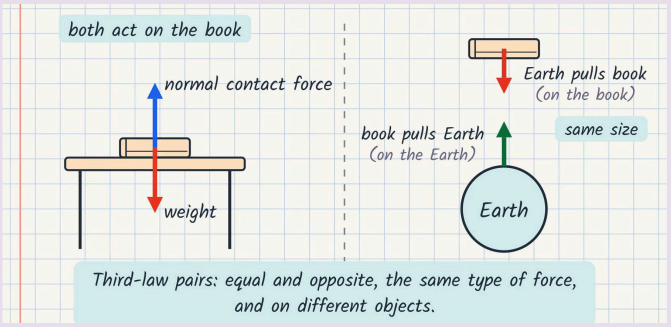
- At a steady velocity the resultant force is **zero**: the **driving force** = **resistive forces** (e.g. 2000 N = 1400 N air resistance + 600 N friction).
- A bigger driving force gives a **resultant force forward**, so the car speeds up. A resultant force can also **change direction** (turning a corner).

3 Inertia (Higher)



- **Inertia** is the tendency of an object to stay at rest, or keep moving steadily, unless a resultant force acts.
- When a bus brakes suddenly, your body tends to keep moving forward, so you **lurch forward**.

4 Newton's Third Law



- When two objects interact, the forces they exert on each other are **equal and opposite**: push a wall with 30 N and it pushes back on you with 30 N.
- A third-law pair acts on **different objects**, so the forces never cancel. A book's weight and the table's push are **balanced forces on one object**, not a pair; the book's partner force is the book pulling the Earth up.

Exam tip

If something moves at a constant velocity, say "the resultant force is zero": that's the phrase examiners are looking for.

Check yourself

1. A plane flies at a steady speed in a straight line. What is the resultant force on it?
2. A swimmer pushes the water backwards. What does the water do to the swimmer?

Answers: 1. Zero (0 N): the forces are balanced 2. Pushes the swimmer forwards with an equal force