SCIENCE · PHYSICS AGES 12–15

Newton's Three Laws of Motion

How forces start, stop and change motion, with an everyday example of each law.

1st law: inertia

With no resultant force, a still object stays still and a moving object keeps the same speed in a straight line.

In real life: seat belts

When a car brakes hard, your body keeps moving forwards. The seat belt supplies the force that slows you down.

2nd law: F = ma

Resultant force = mass × acceleration. A bigger force gives more acceleration; a bigger mass gives less.

In real life: a full trolley

Push a full shopping trolley and an empty one equally hard: the full one, with more mass, speeds up more slowly.

3rd law: interaction pairs

If A pushes or pulls on B, B pushes or pulls on A with a force of the same size and type, in the opposite direction.

In real life: a rocket launch

The rocket pushes exhaust gas down; the gas pushes the rocket up. The two forces act on different objects.

Worked example

A 1,200 kg car has a resultant force of 2,400 N. a = F ÷ m = 2,400 ÷ 1,200 = 2 m/s^2. One newton gives 1 kg an acceleration of 1 m/s^2.

Common mistake

Moving objects do not need a force to keep going. They slow down because friction and air resistance act on them. Third-law pairs never cancel out.

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