Your notes

GCSE Physics: revision notes

Newton's laws of motion

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Newton's first law

- If the **resultant force** acting on an object is zero: a stationary object stays stationary, and a moving object continues to move at the same speed in the same direction (constant velocity).
- So a **resultant force** is needed to change the speed or direction of an object.
- (Higher) **Inertia** is the tendency of an object to continue in its state of rest or of uniform motion.

Newton's second law

- The acceleration of an object is proportional to the **resultant force** acting on it, and inversely proportional to its mass.
- F = m a: **resultant force** (N) = mass (kg) × acceleration (m/s^2).
- (Higher) **Inertial mass** is a measure of how difficult it is to change the velocity of an object: **inertial mass** = force ÷ acceleration.

Newton's third law

- Whenever two objects interact, the forces they exert on each other are equal in size and opposite in direction.
- The two forces act on different objects and are the same type of force. Example: when you push on a wall, the wall pushes back on you with an equal force.

Required practical: force, mass and acceleration

- Pull a trolley along a bench with a string over a pulley attached to hanging masses. The weight of the hanging masses is the accelerating force.
- Measure the acceleration using **light gates**, or a stopwatch and ruler.

- Vary the force by moving masses from the trolley to the hanger (keeping the total mass constant), then vary the mass of the trolley with a constant force.
- Acceleration is proportional to force, and inversely proportional to mass.

Worked examples

A 1500 kg car accelerates at 2 m/s². Find the resultant force on it.

Use Newton's second law. **F = m × a**

Put the numbers in. **1500 × 2**

Answer: 3000 N

Key terms

Newton's first law	An object's velocity stays the same unless a resultant force acts on it.
Newton's second law	Resultant force = mass × acceleration (F = ma).
Newton's third law	When two objects interact, they exert equal and opposite forces on each other.
Inertia	The tendency of an object to stay at rest or keep moving at constant velocity.
Inertial mass	How difficult it is to change an object's velocity: force ÷ acceleration.
Resultant force	The overall force on an object when all the forces are combined.
Light gate	A sensor that measures when an object passes, used to calculate speed and acceleration.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What happens to a moving object if the resultant force on it is zero?
2. What is Newton's second law?
3. What resultant force gives a 1200 kg car an acceleration of 3 m/s²?
4. A 500 N resultant force acts on a 250 kg motorbike. What is its acceleration?
5. What does Newton's third law say?
6. A swimmer pushes water backwards. What happens?
7. What happens to acceleration if the mass doubles and the force stays the same?
8. What is inertia? (Higher)

Answers

1. It keeps moving at the same velocity
2. F = m a
3. 3600 N

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4. 2 m/s^2
5. When two objects interact, they exert equal and opposite forces on each other
6. The water pushes the swimmer forwards
7. It halves
8. The tendency of an object to stay at rest or keep moving at constant velocity

What to do next

Practise 10 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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