

Newton's Third Law

4.5.6.2.3 · Forces · revision notes

Newton's Third Law says that whenever two objects interact, the forces they exert on each other are equal and opposite. You need to identify these pairs of forces and not confuse them with balanced forces on a single object, especially in equilibrium situations.

Key facts

- Third Law: interacting objects exert equal and opposite forces on each other
- Third Law pair: same size, opposite directions, same type of force, different objects
- Third Law pairs never cancel, because they act on different objects
- Balanced forces act on the SAME object
- Book on a table: weight of book $\leftrightarrow$ book pulls Earth up; table pushes book up $\leftrightarrow$ book pushes table down

Notes

The law

- Whenever two objects interact, the forces they exert on each other are **equal and opposite**.
- If object A exerts a force on object B, then object B exerts a force of the same size on object A, in the opposite direction.

Features of a Third Law pair

- The two forces are the same size.
- They act in opposite directions.
- They are the same type of force (both gravitational, both normal contact forces, both frictional, and so on).
- They act on **different** objects, so they never cancel each other out.

Examples

- Walking: your foot pushes backwards on the ground; the ground pushes forwards on your foot (both are friction forces).
- Rocket: the engine pushes exhaust gas backwards; the gas pushes the rocket forwards.
- Swimming: your hands push the water backwards; the water pushes you forwards.
- Gravity: the Earth pulls an apple down with a force equal to the apple's weight; the apple pulls the Earth up with a force of the same size.

How to answer each type of question

Give the partner force

2 marks

Grade 5

1. Swap the two objects: 'A on B' becomes 'B on A'.
2. Give the same size and the opposite direction.

Example. A boy pushes on a wall with a force of 150 N.
State the size and direction of the force that the wall exerts on the boy.

Model answer. 150 N (1)
away from the wall, in the opposite direction to the boy's push (1)

Don't lose marks

- ✗ Saying that the weight of a resting object and the normal contact force on it are a Third Law pair.
- ✗ Thinking that Third Law pairs cancel, so nothing can move. They act on different objects, so they do not cancel.
- ✗ Saying that in a collision the heavier or faster object exerts a bigger force. The forces on the two objects are always equal in size.
- ✗ Giving the partner force in the same direction as the original force. It is always opposite.

More tips

Memory tricks

- Third Law pairs: 'A on B' and 'B on A'. Just swap the names of the objects.
- If both forces are drawn on the same object, they are not a Third Law pair.
- Pair checklist: same size, same type, opposite directions, different objects.

Exam technique

- When describing a Third Law pair, name both objects in each force: 'the force of the Earth on the ball' and 'the force of the ball on the Earth'.
- Give both the size and the direction of the partner force.
- Use the phrases 'equal and opposite' and 'act on different objects' in explanations.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 4

State Newton's Third Law

Whenever two objects interact, the forces they exert on each other are equal and opposite.

Grade 5

Identify Third Law partner forces

If a boy pushes a wall with 150 N, the wall pushes the boy with 150 N in the opposite direction.

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