

Exercise walk-through

Newton's Third Law ■ 2.3

eXercise

You must be able to

- state **Newton's third law** 牛顿第三定律: forces occur in equal, opposite pairs between two interacting objects
- identify the two objects involved and the force each exerts on the other
- explain that the pair acts on **different objects**, so the two forces never cancel
- apply the law to contact, **tension** 张力, and gravitational interactions

Method — Identifying a third-law pair

“A pushes B” is paired with “B pushes A” — equal in size, opposite in direction, on the **two different objects**. A swimmer pushes the water backward; the water pushes the swimmer forward.

Method — Why the pair does not cancel

The two forces act on **different objects**, so they never appear on the same free-body diagram — and forces cancel only when they act on the **same** object.

Method — The gravity pair

Earth pulls you down with force mg ; you pull Earth upward with the **same** force mg .
Earth's enormous mass means its acceleration is negligible.

Practice 2.1 ■ 1 mark

A hammer hits a nail with a force of 50 N. State the force the nail exerts on the hammer.

Solution 2.1

Worked steps

50 N in the opposite direction, acting on the hammer **B1**.

Practice 2.2 ■ 2 marks

A person stands still on the ground. Identify the third-law partner of the person's weight.

Solution 2.2

Worked steps

the gravitational pull of the person **on the Earth** **B1**, equal in size and directed upward on the Earth **B1**.

Practice 2.3 ■ 2 marks

Explain why the two forces of a Newton's third law pair can never cancel out.

Solution 2.3

Method: Why the pair does not cancel

Worked steps

the two forces act on **different** objects (B1); forces can cancel only when they act on the **same** object (B1).

Exam-style 3.1 ■ 1 mark

A car tyre pushes back on the road with 2000 N. The road pushes on the tyre

- A** forward with 2000 N
- B** backward with 2000 N
- C** forward with a smaller force
- D** with zero force

Solution 3.1

A forward with 2000 N



B backward with 2000 N

C forward with a smaller force

D with zero force

Worked steps

A.

Exam-style 3.2 ■ 1 mark

Which statement about a Newton's third law pair is correct?

- A** the two forces act on the same object
- B** the two forces are equal in size and opposite in direction
- C** the larger object exerts the larger force
- D** the two forces always cancel

Solution 3.2

Method: Identifying a third-law pair

- A the two forces act on the same object
- B the two forces are equal in size and opposite in direction** 
- C the larger object exerts the larger force
- D the two forces always cancel

Worked steps

B.

Exam-style 3.3 ■ 1 mark

A book of weight 8.0 N rests on a table.

- (a) State the third-law partner of the book's weight.
- (b) State the third-law partner of the normal force the table exerts on the book.
- (c) Explain why the book's weight and the normal force on the book are **not** a third-law pair.

Solution 3.3

Worked steps

(a) the gravitational pull of the book on the Earth (upward, on the Earth) **B1**. (b) the force of the book pushing down on the table **B1**. (c) they act on the **same** object (the book) and are different types of force (gravity and contact); a third-law pair must act on two **different** objects **B1**.