SCIENCE FOUNDATIONS

# Normal force and tension

### Difficulty level: Intermediate

### Science Foundations

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## *Overview of the concept*

This is how you work out the forces in everyday things, like a book resting on a table, a picture hanging from a nail, or a dog pulling on its leash. The table pushes up on the book just as hard as the book pushes down, which is why the book stays put. A picture hook holds only if it can take the pull of the wire, and a dog walker feels the same pull in their hand. Knowing normal force and tension tells you how surfaces and ropes push and pull back, so you can tell what will hold and what will snap.



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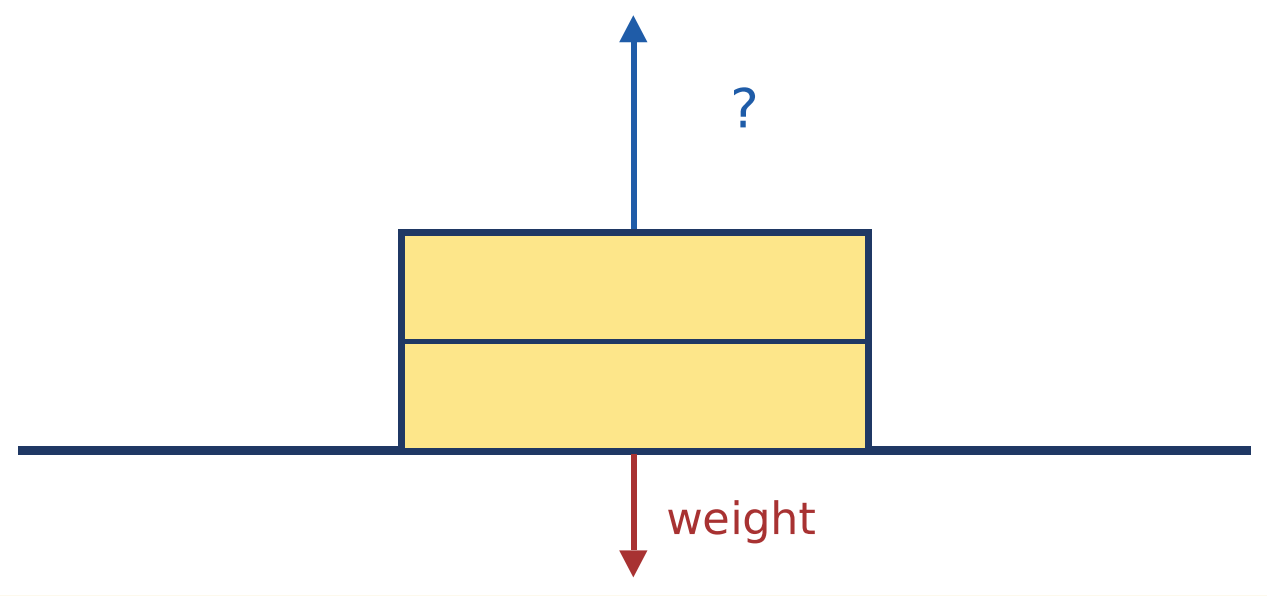
## Worked examples

EXAMPLE 1

**Q** Find the normal force on a 10 kg book resting on a flat table.




### SOLUTION

Find the weight:

10 × 9.8 = 98 N downward

At rest, the normal force balances the weight.

State the normal force: 98 N upward

The result is normal force 98 N upward.

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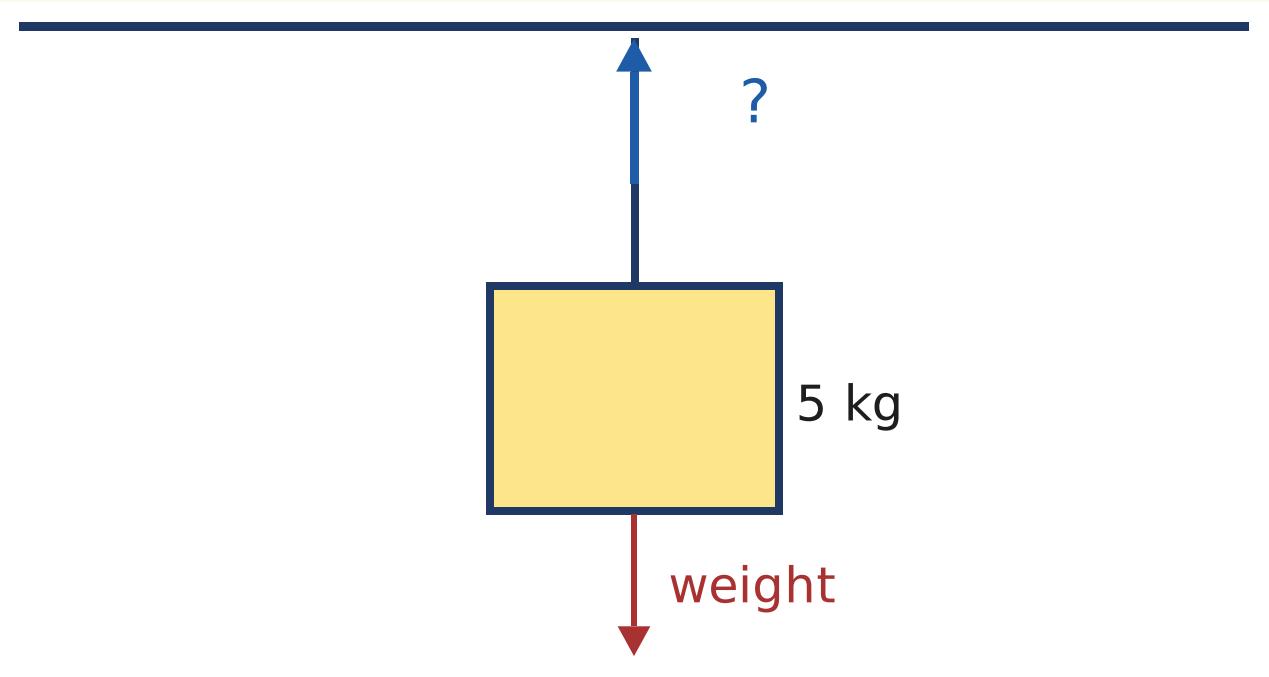
EXAMPLE 2

## Q Find the tension in a rope holding a 5 kg mass at rest.




### SOLUTION

Find the weight:

5 × 9.8 = 49 N downward

At rest, tension balances the weight.

State the tension: 49 N upward along the rope

The result is tension 49 N.

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## Practice questions

### 1 Normal force direction?

- A At right angles to the surface
- B Along the surface
- C Into the surface
- D Downward, with gravity

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### 2 Book 4 kg on a flat table: normal force?

- A 19.6 N upward
- B 39.2 N upward
- C 49 N upward
- D 98 N upward

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## 3 Tension direction?

- A Along the rope
- B At right angles to the rope
- C Into the rope
- D Downward, with gravity

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## 4 Rope holding 8 kg at rest: tension?

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## 5 What is tension?

A Pulling force along a rope or cable

B Pushing force through a surface

C The weight of a hanging object

D Friction between two surfaces

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## 6 On flat ground at rest, normal equals what?

A Weight

B The applied force

C Friction

D The tension

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**7** A book rests on a table. The table pushes up on the book with 20 N. What is the weight of the book?

- A 10 N
- B 20 N
- C 40 N
- D 0 N

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**8** A hanging mass at rest: tension equals what?

- A Weight
- B The normal force
- C Friction
- D The mass

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**9** A book of mass 2 kg rests on a table. What force does the book exert on the table?

- **A** 19.6 N upward
- **B** 19.6 N downward
- **C** 9.8 N upward
- **D** 9.8 N downward

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**10** A rope holds a 10 kg mass at rest. The mass is doubled to 20 kg. What is the new tension?

- **A** 49 N
- **B** 98 N
- **C** 196 N
- **D** 980 N

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## ANSWER KEY

**1.** At right angles to the surface

**2.** 39.2 N upward

**3.** Along the rope

**4.** 78.4 N

**5.** Pulling force along a rope or cable

**6.** Weight

**7.** 20 N

**8.** Weight

**9.** 19.6 N downward

**10.** 196 N

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