

Exercise walk-through

Mass and weight ■ 1.3

eXercise

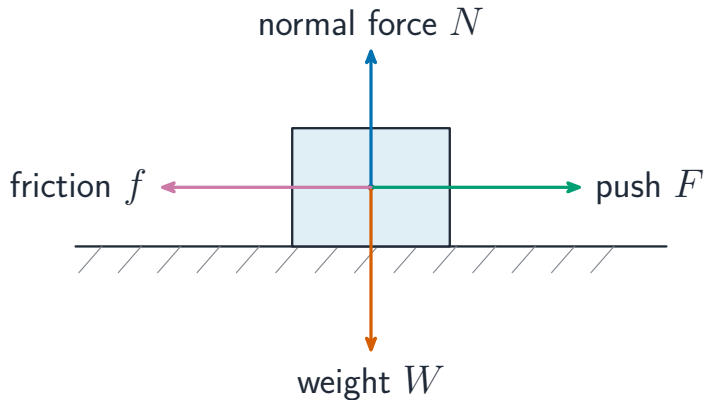
You must be able to

- distinguish mass (kg, constant) from weight (N, depends on gravity)
- use $W = mg$ and $g = \frac{W}{m}$
- explain why weight differs on the Moon

Method — Mass vs weight

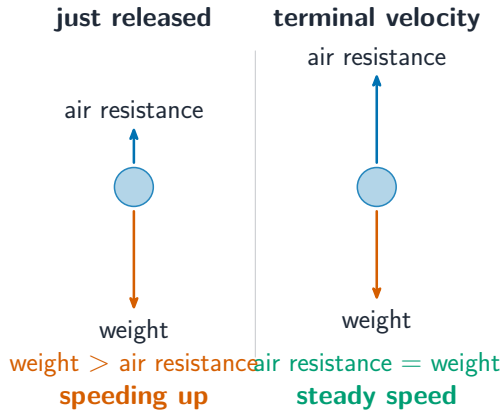
- **mass** = amount of matter (kg), the **same** everywhere.
- **weight** = force of gravity (N); $W = mg$; smaller on the Moon (weaker gravity).
- **gravitational field strength** $g = \frac{W}{m}$ (≈ 10 N/kg on Earth).

Method — Mass vs weight



A free-body diagram of a box with weight acting downward

Method — Mass vs weight



Weight is the downward force, balanced by drag at terminal velocity

Practice 2.1 ■ 2 marks

Find the weight of a 6.0 kg bag on Earth ($g = 10 \text{ N/kg}$).

Solution 2.1

Method: Mass vs weight

Worked steps

$$W = mg = 6.0 \times 10 = 60 \text{ N} \quad \text{M1} \quad \text{A1}.$$

Practice 2.2 ■ 1 mark

State the unit of weight and the unit of mass.

Solution 2.2

Method: Mass vs weight

Worked steps

weight in newtons (N); mass in kilograms (kg) **B1**.

Exam-style 3.1 ■ 1 mark

When an astronaut goes to the Moon, their:

- A** mass and weight both decrease
- B** mass stays the same but weight decreases
- C** mass decreases but weight stays the same
- D** mass and weight both stay the same

Solution 3.1

- A mass and weight both decrease
- B mass stays the same but weight decreases** 
- C mass decreases but weight stays the same
- D mass and weight both stay the same

Worked steps

- B.** Mass is unchanged; weight is less because the Moon's gravity is weaker.

Exam-style 3.2 ■ 2 marks

An object has a weight of 48 N on Earth, where $g = 10 \text{ N/kg}$.

(a) Find its mass.

(b) Find its weight on the Moon, where $g = 1.6 \text{ N/kg}$.

Solution 3.2

Method: Mass vs weight

Worked steps

$$(a) \ m = \frac{W}{g} = \frac{48}{10} = 4.8 \text{ kg} \quad \text{M1} \quad \text{A1}.$$

$$(b) \ W = mg = 4.8 \times 1.6 = 7.7 \text{ N} \quad \text{M1} \quad \text{A1}.$$

Exam-style 3.3 ■ 2 marks

Explain why mass does not change when an object is taken to the Moon, but weight does.

Solution 3.3

Method: Mass vs weight

Worked steps

mass is the amount of matter, which does not change with location **M1**; weight is the force of gravity, which is smaller on the Moon because its gravitational field strength is weaker **A1**.