SCIENCE FOUNDATIONS

Weight versus mass

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you explain why astronauts float on the space station even though their bodies have not lost any mass, and why your weight would change on the Moon while your mass stays the same. A bathroom scale measures how hard gravity pulls on you, not how much stuff you are made of. A grocer weighing fruit cares about mass, while an engineer designing a lift cares about the weight it must support. Knowing weight versus mass tells you which one stays the same wherever you go, and which one changes with gravity.



Rule

Weight versus mass: weight is mass times gravity, W = m × g.

Mass is the amount of matter and never changes, while weight is a force that changes with gravity, so your weight on the Moon is less but your mass is the same.

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Worked examples

EXAMPLE 1

Q Find the weight of a 10 kg object on Earth.

SOLUTION

Write the rule:

weight = mass × gravity.

Substitute:

weight = 10 × 9.8 = 98 N

Write the answer in newtons.

The result is weight 98 N.

EXAMPLE 2

Q Find the mass of an object weighing 49 N on Earth.

SOLUTION

Write the rule:

weight = mass × gravity.

Rearrange:

mass = weight ÷ gravity.

Substitute:

mass = 49 ÷ 9.8 = 5 kg

The result is mass 5 kg.

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Practice questions

1 Find the weight of a 25 kg object on Earth. Use $g = 9.8 \frac{m}{s^2}$

- **A** 245 N
- **B** 25 N
- **C** 2,450 N
- **D** 98 N

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2 Find the weight of a 2 kg object on the Moon. Use $g = 1.6 \frac{m}{s^2}$

- **A** 3.2 N
- **B** 19.6 N
- **C** 32 N
- **D** 1.6 N

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3 Find the mass of an object that weighs 196 N on Earth. Use $g = 9.8\ \frac{m}{s^2}$

- **A** 20 kg
- **B** 196 kg
- **C** 2 kg
- **D** 10 kg

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4 An object weighs 98 N on Earth. What is its mass on the Moon?

- **A** 10 kg
- **B** 98 kg
- **C** 1 kg
- **D** 0 kg

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5

What is the unit of mass?

A Kilogram

B Newton

C Joule

D Metre

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6

What is the unit of weight?

A Newton

B Kilogram

C Joule

D Metre

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7 Does mass change on the Moon?

A Yes

B No

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8 Does weight change on the Moon?

A Yes, it is smaller

B Yes, it is bigger

C No, it stays the same

D No, it disappears

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9 What is the weight formula?

A Mass times gravity

B Mass divided by gravity

C Gravity divided by mass

D Mass plus gravity

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10 Which is measured by a balance: mass or weight?

A Mass

B Weight

C Both

D Neither

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ANSWER KEY

1. 245 N

2. 3.2 N

3. 20 kg

4. 10 kg

5. Kilogram

6. Newton

7. No

8. Yes, it is smaller

9. Mass times gravity

10. Mass

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