SCIENCE FOUNDATIONS

Gravitational force

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you explain why the Moon stays in orbit, why dropped things fall down, and why you would weigh less on the Moon than on Earth. An engineer planning a satellite launch works out how strong gravity will be at each height to know how fast the satellite must go. A hiker feels the same force as the extra weight of a loaded pack pulling them downhill. Knowing gravity tells you why planets hold their moons, why tides rise and fall, and why your weight depends on where you stand.



Rule

Gravitational force: every mass attracts every other mass.

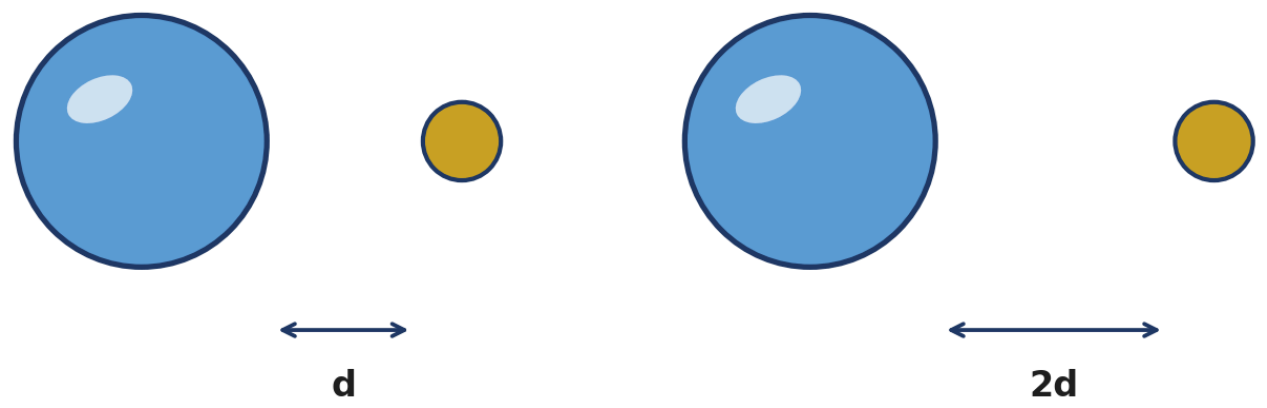
The force grows with the masses and shrinks with the square of the distance between them, so doubling the distance cuts the force to $\frac{1}{4}$. Near Earth, weight is mass times g, $W = m \times g$.

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Worked examples

EXAMPLE 1

Q Compare gravity at twice the distance from a planet.



SOLUTION

Recall the rule: force shrinks with distance squared.

Double the distance: distance squared becomes four times.

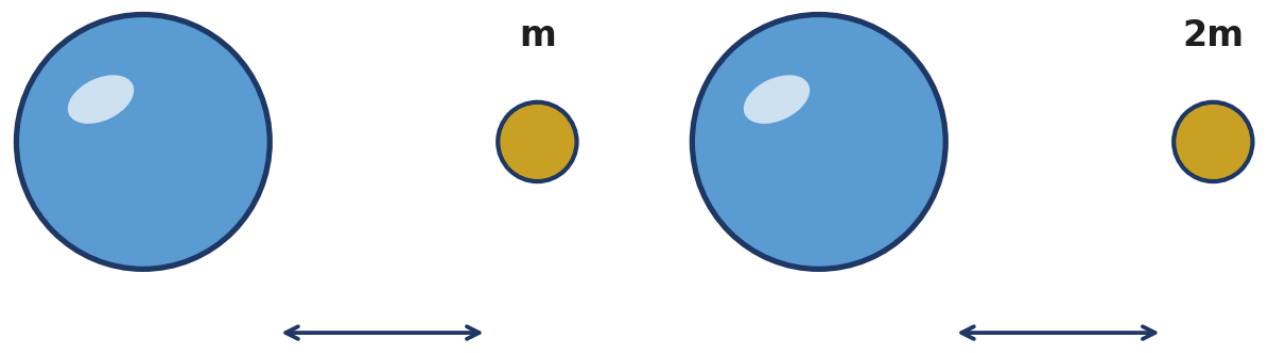
Force becomes one quarter.

The result is one quarter of the original force.

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EXAMPLE 2

Q Compare gravity if one mass doubles.



SOLUTION

Recall the rule: force grows with mass.

Double one mass: force doubles.

State the result.

The result is double the original force.

Practice questions

1 Gravity attracts or repels?

A Attracts

B Repels

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2 Halve the distance: force becomes?

A One half

B One quarter

C Two times

D Four times

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3 Halve one mass: force becomes?

A One quarter

B One half

C Two times

D Four times

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4 Double one mass and halve the distance. What happens to the force?

- A Eight times as strong
- B Two times as strong
- C Four times as strong
- D Half as strong

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5 Weight on Earth formula?

- A Mass divided by 9.8
- B Mass times 9.8
- C 9.8 divided by mass
- D Mass plus 9.8

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6

What provides centripetal force for a planet?

A Friction

B Magnetism

C Gravity

D Air pressure

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7

Does the Moon pull on Earth?

A Yes

B No

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8 **What is the weight of a 10 kg object on Earth? Use g = 9.8 N/kg.**

- **A** 98 N
- **B** 10 N
- **C** 9.8 N
- **D** 1.02 N

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9 **An astronaut on the Moon weighs less than on Earth. Why?**

- **A** The Moon has less mass, so its surface gravity is weaker
- **B** There is no gravity on the Moon
- **C** The astronaut loses mass on the Moon
- **D** The Moon is farther from the Sun

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10

Which falls faster in a vacuum: heavy or light?

A Heavy falls faster

B Light falls faster

C Same rate

D It depends on the shape

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ANSWER KEY

1. Attracts

2. Four times

3. One half

4. Eight times as strong

5. Mass times 9.8

6. Gravity

7. Yes

8. 98 N

9. The Moon has less mass, so its surface gravity is weaker

10. Same rate

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