

Exercise walk-through

6.1

The Earth and the Solar System

IGCSE Physics

Try it: what orbits what?

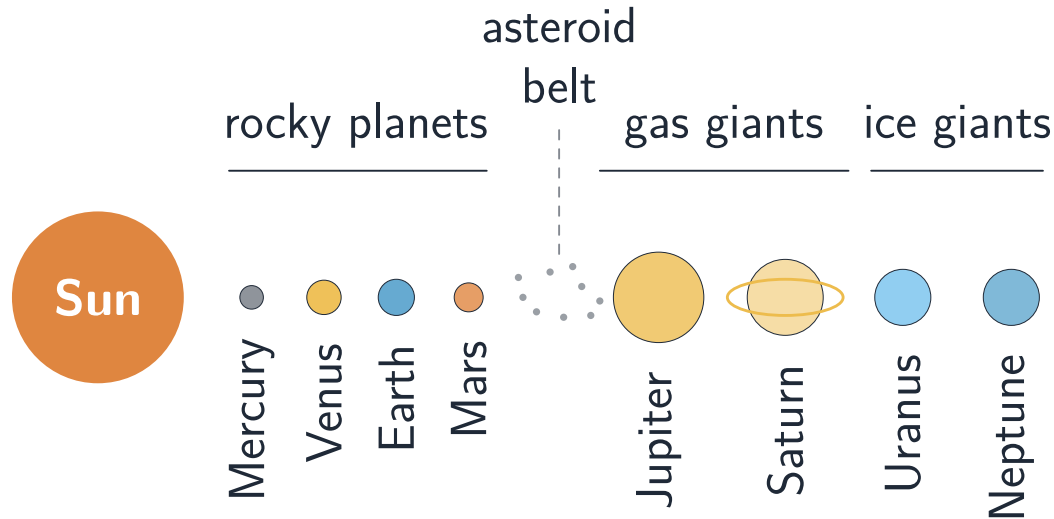
Sort these objects: the Sun, Mars, Jupiter, Pluto, the Moon, an asteroid and a **comet** .

Which is a star? Which are among the eight planets? Which orbit a planet rather than the Sun directly?

Write the eight planets in order from the Sun. Mark the boundary between the four inner **rocky** planets and the four large outer planets.

Explain why counting the Moon and Pluto as two of the eight planets would be wrong.

The eight planets in order



The asteroid belt lies between Mars and Jupiter. The diagram shows order and groups, not true sizes or distances.

Use the orbit and the type of object

The Sun is the star. Mars and Jupiter are planets; Pluto is a dwarf planet.

Asteroids and comets also orbit the Sun. The Moon is a natural satellite of Earth.

The four inner planets are small and rocky. The outer four are large and **gaseous** in the syllabus comparison: Jupiter and Saturn are **gas giants**; Uranus and Neptune are **ice giants**.

The Sun holds most of the Solar System's mass; its **gravity** keeps the planets in orbit. A moon orbits a planet, while that planet orbits the Sun.

Try it: test a pattern against the data

Selected rounded values from the handout:

Planet	Distance / million km	Density / g/cm ³	Temperature / °C
Mercury	58	5.4	170
Venus	108	5.2	460
Jupiter	779	1.3	−110
Saturn	1430	0.7	−140

Which pair supports the inner/outer density comparison? Quote both values.

A student says: “Every planet farther from the Sun is colder.” Find a counterexample.
Does distance alone explain temperature?

Give evidence, then qualify the conclusion

Mercury's density is 5.4 g/cm^3 ; Jupiter's is 1.3 g/cm^3 . This supports the comparison between a dense rocky inner planet and a less dense outer giant.

Venus is farther from the Sun than Mercury (108 versus 58 million km), yet its listed temperature is higher (460°C versus 170°C). It disproves the word "every".

Venus has a thick atmosphere that traps heat. Temperature depends on the atmosphere as well as distance. The listed outer planets are colder, but this is not a universal rule for every pair.

Describe the pattern supported by the table. Test a universal claim against every relevant row, and report exceptions.

Exercises 2.1·3.1

2.1 State what causes day and night.

[1]

2.2 Name the force that keeps a planet in orbit around the Sun.

[1]

3.1 Compared with the inner planets, the outer planets orbit the Sun:

[1]

☐

A faster

B more slowly

C at the same speed

D in the opposite direction

Exercises 2.1·3.1

2.1 State what causes day and night. [1]

2.1

- the Earth spinning (rotating) on its axis

2.2 Name the force that keeps a planet in orbit around the Sun. [1]

2.2

- gravity / the Sun's gravitational attraction

3.1 Compared with the inner planets, the outer planets orbit the Sun: [1]

☐

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B more slowly

C at the same speed

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3.1 B

- the Sun's gravity is weaker further out, so outer planets move more slowly

Exercise 3.2 (a)

3.2 A moon orbits a planet at a radius of 4.0×10^8 m with a period of 2.0×10^6 s.

(a) Find its orbital speed.

[3]

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[3]

(a) $v = 2\pi r/T$

$$v = \frac{2\pi(4.0 \times 10^8 \text{ m})}{2.0 \times 10^6 \text{ s}} = \mathbf{1.3 \times 10^3 \frac{m}{s}}$$

Exercise 3.2 (b)

3.2 A moon orbits a planet at a radius of 4.0×10^8 m with a period of 2.0×10^6 s.

(b) State what happens to the gravitational field strength of the planet as you move further from it. [1]

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(b) State what happens to the gravitational field strength of the planet as you move further from it. [1]

(b) it decreases (gets weaker)

Exercise 3.3

3.3 A comet moves in a very stretched elliptical orbit. Explain why it moves fastest when closest to the Sun. [2]

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3.3

- as the comet comes closer, its gravitational potential energy falls
- by conservation of energy this becomes kinetic energy, so it speeds up