

8.2 Orbital motion and satellites

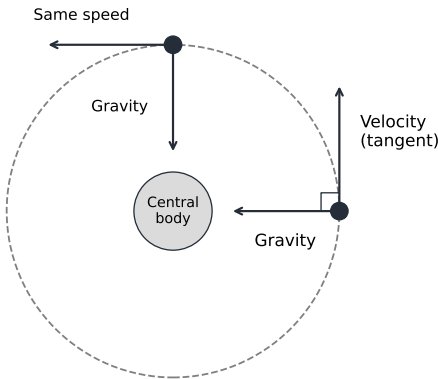
Name: _____ Class: _____ Date: _____ Total: 20 marks

KEY WORDS red-shift

Objective

Explain orbits with gravity as the centripetal force, distinguish planets, moons and artificial satellites, and (HT) explain changing velocity and stable-orbit radius changes. Physics only. Original questions for spec statement 4.8.1.3.

1 Key knowledge and worked examples



HT: velocity direction changes; speed stays constant

Gravity acts at right angles to the motion.

Gravity provides the force that keeps planets and satellites in circular orbits.

Body	Orbits	Made by
planet	the Sun	nature
moon (natural satellite)	a planet	nature
artificial satellite	the Earth (usually)	humans

(HT) Two credited explanations:

1. **Changing velocity, unchanged speed:** velocity is a vector; in a circular orbit the **direction** changes continuously while the speed stays constant. Gravity acts **at right angles** to the motion – it changes direction, not speed.
2. **Compare stable circular orbits around the same central body:** a higher speed corresponds to a **smaller** radius; a lower speed corresponds to a **larger** radius. This compares completed circular orbits, not the immediate result of an engine burn.

2 Practice

2.1 State the force that keeps a satellite in orbit, and its direction relative to the motion.[2]

2.2 Name the natural satellite of the Earth and give one example of an artificial satellite.[2]

2.3 (HT) A planet orbits at constant speed. Explain why its velocity is changing. [2]

3 Exam-style questions

3.1 A satellite orbits the Earth in a circle at constant speed.

- (a) Explain why the satellite accelerates even though its speed is constant. [3]
- (b) State the direction of the force causing this, and name the force. [2]
- (c) Compare this orbit with a second stable circular orbit around the Earth at a higher speed. Explain how the second orbit radius differs. [2]

3.2 Explain the similarities and distinctions between the Moon and a GPS satellite. [3]

3.3 Compare two stable circular orbits of the same space probe around Mars, one lower than the other.

(a) State what happens to the gravitational force strength as the orbit gets closer to the planet. [1]

(b) Explain, in terms of gravity and velocity, why a lower orbit means a faster satellite.[3]