8.1 Orbits and stellar evolution

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Build the skills to answer exam questions on **the Universe and stars** : the Solar System, gravity and orbits, orbital speed, the life cycle of stars, and star colour and brightness.

You must be able to:

- describe the Solar System and the role of gravity in orbits
- use orbital speed $v = 2\pi r/T$
- describe the life cycle of stars of different masses
- link the colour of a star to its surface temperature

1 Key knowledge and worked examples

Space

idea	equation or rule
orbits	gravity keeps planets around the Sun and moons around planets; comets have very elliptical orbits
gravitational field strength	g changes from planet to planet; weight $= m \times g$
orbital speed	$v = 2 \times \pi \times r \div T$
star like the Sun	nebula, protostar, main sequence, red giant, white dwarf
massive star	nebula, protostar, main sequence, red supergiant, supernova, neutron star or black hole
colour	hotter stars look blue-white; cooler stars look red

Worked example 1: orbital speed. The Moon orbits Earth with radius 3.8×10^8 m in 2.4×10^6 s. Find its speed.

1. Known: $r = 3.8 \times 10^8$ m; $T = 2.4 \times 10^6$ s.
2. Rule: $v = 2\pi r \div T$.
3. Numbers: $2 \times 3.14 \times 3.8 \times 10^8 \div 2.4 \times 10^6$.
4. Result: **about** 990 **m/s**.

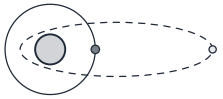
Worked example 2: weight on Mars. On Mars $g = 3.7$ N/kg. Find the weight of a 20 kg rover.

1. Known: $m = 20$ kg; $g = 3.7$ N/kg.
2. Rule: $W = mg$.
3. Numbers: 20×3.7.
4. Result: 74 **N**.

Answer shapes: the mass of an object stays the same everywhere; its weight changes with g.

2 Practice

2.1 Name the force that keeps the planets in orbit around the Sun, and state the shape of a comet's orbit. [2]



2.2 Star A is red and star B is blue-white. Which star is hotter? Explain. [2]

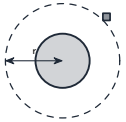


2.3 Name the stage of a star's life when it is stable for billions of years, and explain why it is stable. [2]



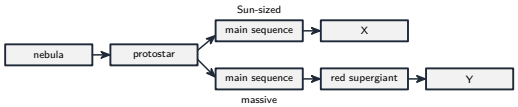
3 Exam-style questions

3.1 A satellite orbits Earth at a radius of 7.0×10^6 m. One orbit takes 5800 s. Calculate its orbital speed. [3]



3.2 The diagram shows the possible life cycles of stars.

(a) Name stage X and stage Y. [2]



(b) Describe how a star forms from a nebula. [3]

(c) Explain why a star becomes a red giant near the end of its main-sequence life. [3]

(d) Compare the life cycle of the Sun with that of a star 20 times more massive. Include what happens at the end of each. [6]