

8.1 Our solar system and the life cycle of stars

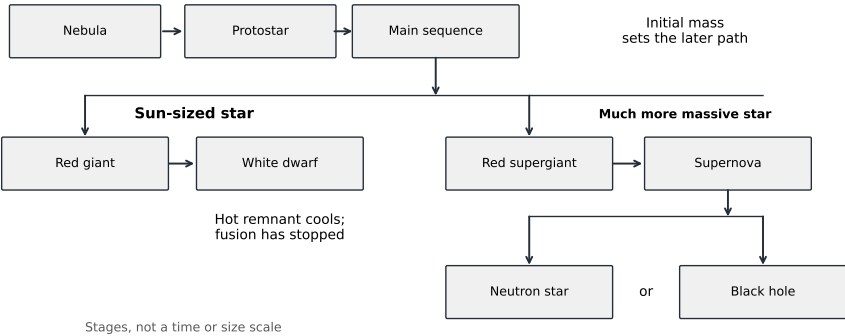
Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS nebula • supernova

Objective

Describe the solar system, the Sun’s formation, and both stellar life cycles, including where the elements form. Physics only. Original questions for spec statements 4.8.1.1–4.8.1.2.

1 Key knowledge and worked examples



Stages, not a time or size scale

The mass at birth picks the path.

Solar system: one star (the Sun); eight planets; dwarf planets; natural satellites (moons) orbiting planets. Part of the **Milky Way** galaxy.

Sun’s birth: nebula (dust + gas) pulled together by **gravity**; the core heats until **fusion** starts; then **equilibrium** – energy released by fusion maintains the outward pressure that balances gravity.

Stage	Sun-sized	Massive
start	nebula → protostar → main sequence	same
after hydrogen runs out	red giant	red supergiant
end	white dwarf (cooling)	supernova → neutron star / black hole

Elements: fusion joins light nuclei into heavier nuclei. Sufficiently massive stars build elements **up to iron**; in the AQA GCSE model, **heavier-than-iron** elements form in a **supernova**, which scatters them through the universe. Do not claim the Sun will fuse up to iron.

Worked data example (AQA June 2024 Q03.5, official numerical answer): light travels from a star 3.6×10^{14} km away at 3.0×10^8 m/s. Find the travel time.

Known distance: $s = 3.6 \times 10^{14}$ km = 3.6×10^{17} m.

Choose the speed equation and rearrange for time:

$$v = \frac{s}{t} \quad t = \frac{s}{v}$$
$$t = \frac{s}{v} = \frac{3.6 \times 10^{17}}{3.0 \times 10^8} = 1.2 \times 10^9 \text{ s}$$

2 Practice

2.1 List the contents of the solar system. [4]

2.2 Explain what keeps a main-sequence star stable. [2]

2.3 Where do elements heavier than iron form, and how do they reach us? [2]

3 Exam-style questions

3.1 Describe the life cycle of a star much more massive than the Sun. [5]

3.2 The table lists three stars.

Star	Relative mass
X	$0.9 \times \text{Sun}$
Y	$1.0 \times \text{Sun}$
Z	$20 \times \text{Sun}$

(a) State the final stage of each star. [3]

(b) Explain how star Z creates and distributes new elements. [3]

3.3 “The Sun was formed from a nebula.” Describe the sequence from nebula to main sequence, naming the force involved and the event that begins the main sequence. [4]