

# 8.1 Our solar system and the life cycle of stars

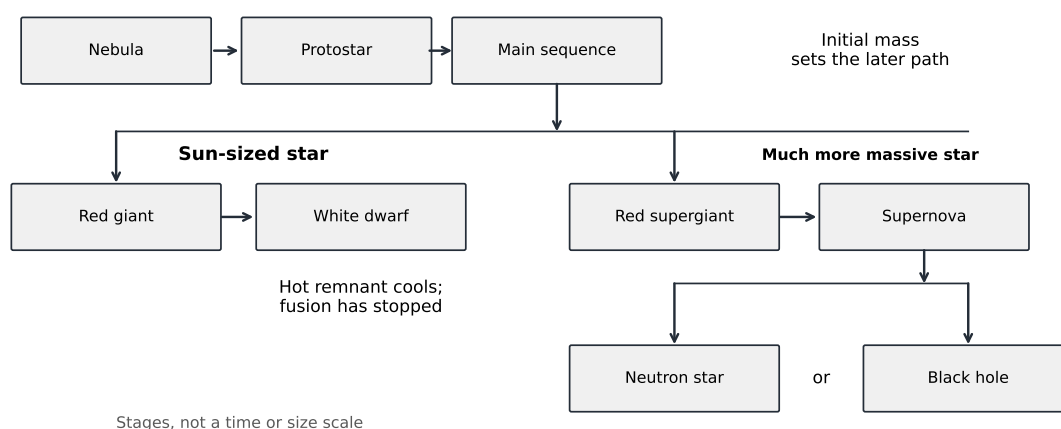
Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**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



*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  $3.6 \times 10^{14}$  km away at  $3.0 \times 10^8$  m/s. Find the travel time.

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

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**2.2** Explain what keeps a main-sequence star stable.

[2]

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**2.3** Where do elements heavier than iron form, and how do they reach us?

[2]

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### 3 Exam-style questions

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

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**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]