Exercise walk-through

8.1
Our solar system and the life cycle of a star (4.8.1.1–4.8.1.2)

AQA · GCSE · Physics

The solar system

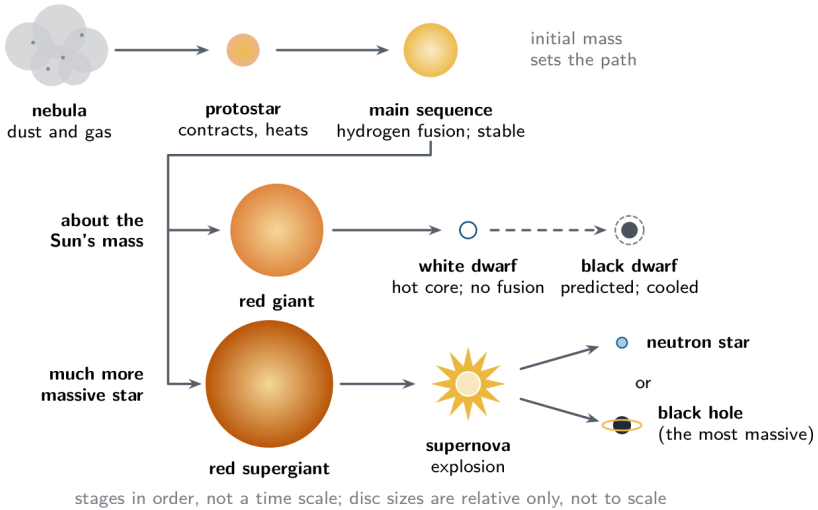
- Our solar system has one star, the Sun, with eight planets and the dwarf planets that orbit it, and the natural satellites, called moons, that orbit the planets.
- The solar system is a very small part of the Milky Way galaxy, which contains hundreds of billions of stars.
- **How the Sun formed.** The Sun formed from a **nebula** , a cloud of dust and gas.
- Gravity pulled the dust and gas together.

The life cycle of a star

- **A star about the size of the Sun**: **nebula** → protostar → main sequence star → red giant → white dwarf → black dwarf. When the hydrogen in its core runs low, the star swells into a red giant and fuses helium into heavier elements. Its outer layers drift away, leaving a hot, small core: a white dwarf. Fusion has stopped, so the white dwarf slowly cools and fades; after a very long time, it would become a cold black dwarf.
- **A star much more massive than the Sun**: nebula → protostar → main sequence star → red supergiant → **supernova** → neutron star or black hole. The red supergiant fuses heavier and heavier elements until its core is iron, then collapses and explodes as a **supernova**. The core that remains becomes a very dense neutron star or, for the most massive stars, a black hole, from which not even light can escape.

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

Figure: The life cycle of a star



- The life cycles of a star like the Sun and of a much more massive star.
- Match each part of the diagram to the text.

Exercises 2.1·2.2

2.1 Name the force that pulls a cloud of dust and gas together to form a star, and give the name of this cloud. [2]



2.2 Name the stages X and Y in the life cycle of a star like the Sun. [2]



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2.1

- gravity; a nebula

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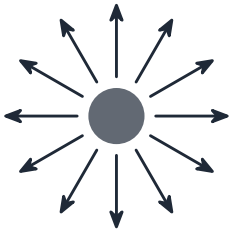


2.2

- X: red giant; Y: black dwarf

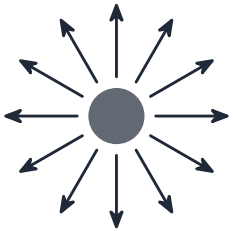
Exercise 3.1

3.1 Gold atoms on Earth were made in stars. Explain where and how elements heavier than iron are made, and how they reached the Earth. [3]



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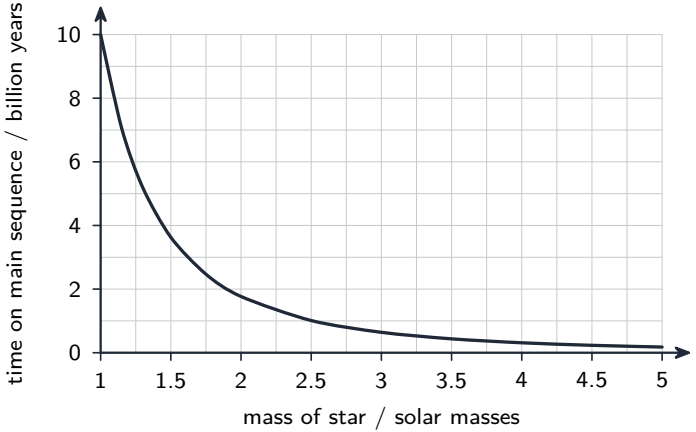
3.1

- elements heavier than iron are made in a supernova
- the explosion of a massive star gives enough energy to fuse nuclei into heavier elements
- the explosion spreads them through space, and they became part of the nebula that formed the solar system

Exercise 3.2 (a)

3.2 The graph shows how long stars of different masses stay on the main sequence. Mass is given compared with the Sun.

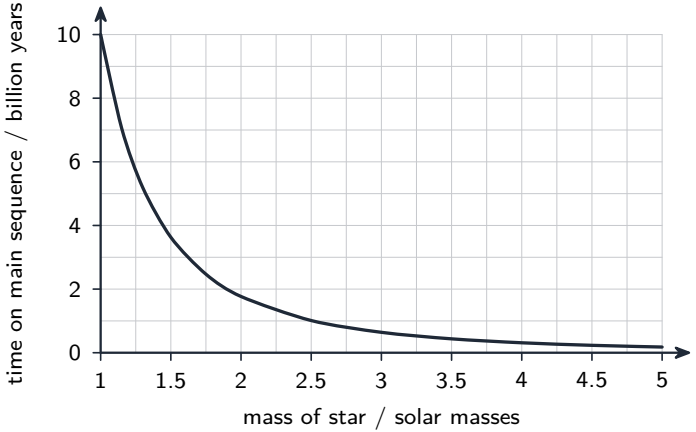
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(a) read at 2.0; about **1.8** billion years

Exercise 3.2 (b)

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(b) Describe the pattern shown by the graph, and suggest a reason for it. [3]

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(b) the more massive the star, the shorter its time on the main sequence; it falls very quickly from 1 to 2 solar masses; massive stars are hotter in the core and fuse their hydrogen much faster

Exercise 3.2 (c)

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(c) Describe what happens to a star of 10 solar masses at the end of its life. [2]

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(c) it becomes a red supergiant, then explodes as a supernova; it leaves a neutron star or a black hole

Exercise 3.2 (d)

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(d) Describe the life cycle of a star like the Sun, from its formation to its end. Explain why it is stable for most of its life. [6]

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(d) points to include:

- a nebula of dust and gas is pulled together by gravity
- it forms a protostar, which heats up as it gets denser
- when it is hot enough, hydrogen nuclei fuse into helium: it is now a main-sequence star
- it is stable because the outward pressure from fusion balances the inward pull of gravity
- when the hydrogen runs low it swells into a red giant
- it then collapses into a white dwarf, which cools to a black dwarf

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.