Our solar system

4.8.1.1 · Space physics · revision notes

What makes up our solar system, how the Sun formed from a cloud of dust and gas, and why a star like the Sun stays the same size for billions of years. Expect short recall questions and 2 to 4 mark 'describe' and 'explain' questions on Paper 2. Space physics is in GCSE Physics only, not in Combined Science.

Key facts

- Solar system: 1 star (the Sun), 8 planets, dwarf planets and moons
- Our solar system is a small part of the Milky Way galaxy
- A star forms when gravity pulls the dust and gas of a nebula together
- Main sequence star: hydrogen fuses into helium in the core
- Moon = natural satellite that orbits a planet
- Nebula = cloud of dust and gas
- Nuclear fusion: light nuclei join to form a heavier nucleus, releasing energy
- Stable star: inward gravitational collapse balanced by outward expansion due to fusion energy

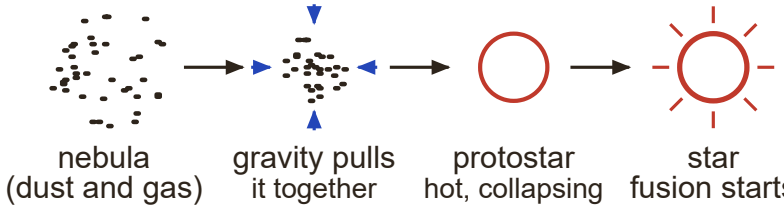
Notes

What is in our solar system

- Our solar system has **one star**: the Sun.
- **Eight planets** orbit the Sun. **Dwarf planets**, such as Pluto, also orbit the Sun.
- **Moons** are natural satellites that orbit planets. They are part of the solar system too.
- Our solar system is a small part of the **Milky Way** galaxy, which contains billions of stars.

How the Sun formed

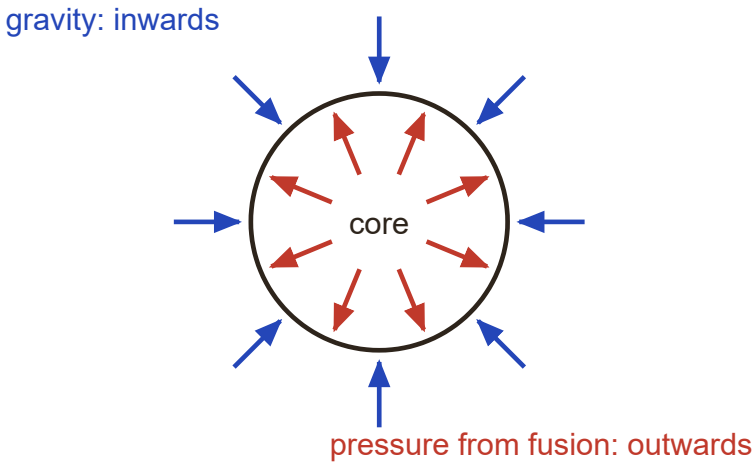
- The Sun formed from a **nebula**: a cloud of dust and gas (mainly hydrogen).
- Gravitational attraction pulled the dust and gas together, so the cloud collapsed and became denser.
- As it collapsed, energy was transferred from gravitational potential energy to the kinetic energy of the particles, so the temperature rose. This hot, collapsing ball is called a **protostar**.
- When the core was hot and dense enough, hydrogen nuclei were moving fast enough to overcome their repulsion (they are all positive) and join together. This is **nuclear fusion**: hydrogen nuclei fuse to form helium and energy is released.
- Once fusion starts in its core, the protostar has become a star.



Nebula → protostar → star. Gravity does the pulling; fusion starts when the core is hot and dense enough.

Why a star stays the same size

- Gravity pulls all the material of the star inwards (gravitational collapse).
- The energy released by fusion causes an outward pressure that tends to make the star expand.
- In a **main sequence star** these two effects are balanced (in **equilibrium**), so the star stays the same size.



Balanced forces (equilibrium): the star neither collapses nor expands.

- The Sun is in this stable main sequence stage now, and a star like the Sun stays in it for billions of years.

How to answer each type of question

Recall: name objects in the solar system

1 mark each | Grade 3

1. Read exactly what is asked for, e.g. the natural satellites of planets are 'moons'.
2. Give one clear answer. If you write two answers and one is wrong, you can lose the mark.

Example. (a) Name the only star in our solar system.
(b) How many planets orbit this star?
(c) Name the galaxy that our solar system is part of.

Model answer.

(a) The Sun (1)
(b) Eight (1)
(c) The Milky Way (1)

Describe how the Sun formed

2 to 3 marks | Grade 5

1. Start with the nebula: a cloud of dust and gas.
2. Say that gravity (gravitational attraction) pulled the dust and gas together.
3. Say that it became hot and dense enough for fusion to start in the core.

Example. Describe how the Sun formed.

Model answer. The Sun formed from a nebula, a cloud of dust and gas (1). Gravitational attraction pulled the dust and gas together (1). The collapsing cloud became hot and dense enough for hydrogen nuclei to fuse, releasing energy (1).

Explain why a main sequence star is stable

2 marks | Grade 5

1. Name the inward effect: gravity pulling the star's material in.
2. Name the outward effect: expansion (outward pressure) caused by the energy released by fusion.
3. Say that the two are balanced (in equilibrium).

Example. The Sun has stayed about the same size for billions of years.
Explain why.

Model answer. Gravity pulls the material of the Sun inwards (1). This is balanced by the outward expansion caused by the energy released by fusion, so the Sun is in equilibrium (1).

Explain how a collapsing cloud becomes a star 3 to 4 marks **Grade 7**

1. Gravity pulls the dust and gas together, so it collapses and becomes denser.
2. Energy is transferred from gravitational potential energy to the kinetic energy of the particles, so the temperature rises.
3. When the core is hot enough, nuclei move fast enough to overcome their repulsion.
4. Finish with fusion: hydrogen nuclei fuse to form helium, releasing energy.

Example. A protostar is a collapsing ball of gas that is getting hotter.
Explain how a protostar becomes a star in which nuclear fusion takes place.

Model answer. Gravity pulls the gas inwards, so the protostar keeps collapsing and becomes denser (1). Energy is transferred from gravitational potential energy to the kinetic energy of the particles, so the temperature of the core increases (1). Eventually the hydrogen nuclei are moving fast enough to overcome their repulsion (1), so they fuse to form helium, releasing energy (1).

Don’t lose marks

- Writing 'fission' instead of 'fusion'. Stars release energy by joining light nuclei, not by splitting heavy ones.
- Calling Pluto a planet (it is a dwarf planet) or saying that moons orbit the Sun (they orbit planets).
- Writing 'the dust and gas came together' without saying that gravity pulled them together.
- Just writing 'fusion balances gravity'. Say what fusion causes: an outward expansion (pressure) from the energy released, which balances the inward pull of gravity.
- Mixing up the solar system and the galaxy: the solar system is one star and the objects orbiting it; the Milky Way is a galaxy of billions of stars.

More tips

Memory tricks

- Who orbits whom: moons orbit planets, and planets and dwarf planets orbit the Sun.
- Star formation chain: nebula → gravity pulls it together → hotter and denser → fusion → star. Each link is usually a mark.
- Picture a tug of war that ends in a draw: gravity pulls in, fusion energy pushes out, so the star stays the same size.
- Fusion joins (think 'fuse' = 'join'); fission splits. Stars use fusion.

Exam technique

- Use the key words examiners look for: nebula, gravitational attraction, fusion, equilibrium.
- In 'describe how the Sun formed' questions, give the steps in order. Each correct step is usually worth a mark.
- For stability questions, always name both effects (inward and outward) and say that they are balanced.
- In 'explain' questions about fusion starting, link each step with 'so' or 'because': gravity → collapse → temperature rises → fusion.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

List the objects in our solar system

One star (the Sun), eight planets, dwarf planets such as Pluto, and moons that orbit planets.

Grade 3

Name the galaxy our solar system is in

Our solar system is a small part of the Milky Way galaxy.

Grade 4

Describe how the Sun formed

A nebula (a cloud of dust and gas) was pulled together by gravity until fusion started.

Grade 5

State how a star releases energy

In the core of a main sequence star, hydrogen nuclei fuse to form helium, releasing energy.

Grade 5

Explain why a main sequence star is stable

The inward pull of gravity is balanced by the outward expansion caused by the energy released by fusion.

Grade 7

Explain how gravitational collapse starts fusion

As the cloud collapses its particles gain kinetic energy, so the core heats up until nuclei move fast enough to fuse.

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