

# Nuclear fusion

4.4.4.2 · Atomic structure · revision notes

Nuclear fusion is the joining of two light nuclei to form a heavier nucleus, with some of the mass converted into the energy of radiation. You need to describe fusion and compare it with fission. Expect short 'describe' questions and 4 to 6 mark comparisons. GCSE Physics only, not in Combined Science.

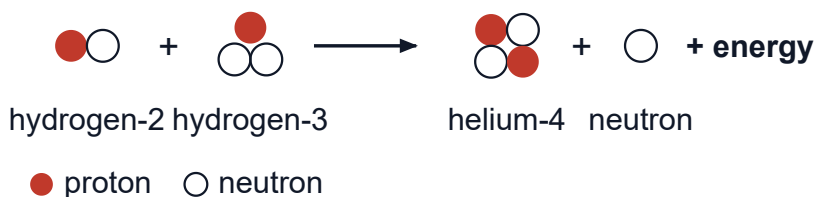
## Key facts

- Fusion: two light nuclei join to form a heavier nucleus
- Stars: hydrogen nuclei fuse to form helium
- Fission is used in power stations now; fusion is not yet used to generate electricity
- Some of the mass is converted into energy of radiation
- Fission splits heavy nuclei; fusion joins light nuclei; both release energy

## Notes

### What fusion is

- **Nuclear fusion** is the joining of two light nuclei to form a heavier nucleus.
- In this process some of the mass may be converted into the energy of radiation. The new nucleus has slightly less mass than the two nuclei that joined.
- Example: two isotopes of hydrogen fuse to form helium:  ${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{n}$



Fusion of two hydrogen isotopes. The products have slightly less mass: that mass became energy.

- Fusion is the energy source of stars. In the core of the Sun, hydrogen nuclei fuse to form helium.

### Fission and fusion compared

- Fission: a large, heavy nucleus splits into two smaller nuclei. Fusion: two light nuclei join to form a heavier nucleus.
- Both release energy.
- Fission usually starts when a nucleus absorbs a neutron. Fusion needs very high temperatures and pressures.
- Fission fuels are uranium and plutonium; fusion fuels are light nuclei such as isotopes of hydrogen.
- Fission is used in nuclear power stations today. Fusion happens naturally in stars.

## How to answer each type of question

### Describe nuclear fusion

2 marks

Grade 4

1. Say that two light nuclei join.
2. Say that a heavier nucleus forms and energy is released (some mass is converted to energy).

**Example.** Describe what happens during nuclear fusion.

**Model answer.** Two light nuclei join together (1) to form a heavier nucleus, and energy is released as some of the mass is converted into energy (1).

## Don't lose marks

- ✗ Mixing up fission and fusion, the most common slip in this topic.
- ✗ Saying fusion joins atoms or molecules. It joins nuclei.
- ✗ Saying energy is 'created'. Some of the mass is converted into energy.
- ✗ Saying today's nuclear power stations use fusion. They use fission.

## More tips

### Memory tricks

- Fusion = fuse = join together. Fission = split.
- Heavy nuclei split (fission); light nuclei join (fusion).
- Stars run on fusion; today's nuclear power stations run on fission.

### Exam technique

- In 'compare' questions, make every point about both processes, using 'whereas'. A list about only one process scores little.
- Say 'nuclei', not 'atoms', in your definitions of fission and fusion.
- Questions sometimes link fusion to stars in space physics, so be ready to use both topics together.

## What each grade needs

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

Grade 4

### Define nuclear fusion

Two light nuclei join to form a heavier nucleus.

Grade 5

### State where fusion happens naturally

In the cores of stars, e.g. hydrogen nuclei fuse to form helium in the Sun.

Grade 5

### State where the energy comes from

Some of the mass is converted into the energy of radiation.

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