THE PHYSICS QUESTION BANK · AQA GCSE PHYSICS

Power of the Future – Fission and Fusion

A one-hour lesson (Separate Physics only). Learn how fission and fusion work, then advise the government on the power of the future.

Name: _____ Class: _____ Date: _____

How to use this worksheet: work through the steps in order and write your answers in your exercise book. Copy every blue 📝 box neatly – these are your revision notes. When you have finished a step, check your work against the **Answers** at the end and correct anything in a different colour.

📝 COPY INTO YOUR BOOK

By the end of this lesson I will be able to:

1. describe nuclear fission and a chain reaction

2. explain how a reactor controls the chain reaction

3. describe nuclear fusion

4. evaluate fission and fusion as energy sources.

Step 1: Starter (5 minutes)

"Fission" is like "fissure" (a crack). "Fusion" is like "fuse" (join). **Guess what each one does to a nucleus.** Then check against the box.

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FISSION = SPLITTING a large nucleus into two smaller nuclei.

FUSION = JOINING two light nuclei to make a heavier nucleus.

Both release a lot of energy.

Step 2: Read and write (8 minutes)

Copy these three questions into your book. Then read the text and answer them in full sentences.

1. What usually has to happen to a uranium nucleus before it splits?
2. What is released when it splits?
3. Where does nuclear fusion happen naturally?

📖 READ

Splitting and joining nuclei

Nuclear fission is the splitting of a large, unstable nucleus, such as uranium-235 or plutonium-239. Fission rarely happens on its own – usually the nucleus must first **absorb a neutron**. It then splits into two smaller nuclei of roughly equal size, and releases **two or three neutrons**, **gamma rays** and a large amount of **energy**. The released neutrons can split more nuclei, which release more neutrons – a **chain reaction**. In a reactor the chain reaction is controlled; in a nuclear weapon it is not.

Nuclear fusion is the joining of two light nuclei, such as types of hydrogen, to form a heavier nucleus. Some of the mass is converted into energy. Fusion happens naturally in **stars, including the Sun**. It needs extremely high temperatures and pressures, which is why there is not yet a working fusion power station.

📝 **COPY AND COMPLETE**

For fission to happen, a uranium nucleus usually has to absorb a _____. It splits into two _____ nuclei and releases two or three _____, gamma rays and _____.

Step 3: Key facts (10 minutes)

Your task: draw a chain reaction – one neutron hits a uranium nucleus, which splits and releases three neutrons, each hitting another nucleus. Then copy the steps.

📝 **COPY INTO YOUR BOOK**

Nuclear fission:

1. A uranium-235 nucleus absorbs a neutron.

2. It splits into two smaller nuclei.

3. Two or three neutrons, gamma rays and energy are released.

4. The neutrons split more nuclei → a CHAIN REACTION.

CONTROL RODS absorb some of the neutrons, so the chain reaction happens at a steady rate. In a reactor it is controlled; in a nuclear weapon it is uncontrolled.

In fusion, two light nuclei join together. Some of their mass is converted into energy, released as radiation. Fusion powers the Sun and all other stars. On Earth it needs extremely high temperatures and pressures.

📝 **COPY AND COMPLETE**

In fusion, two _____ nuclei join to form a _____ nucleus. Some of the _____ is converted into energy. Fusion powers the _____. It is hard to do on Earth because it needs extremely high _____ and _____.

Quick check: write one difference and one similarity between fission and fusion.

Step 4: Main task – Power of the Future (15 minutes)

The government needs your advice. Should it build more fission power stations now, or invest in fusion research?

	Fission power stations	Fusion power stations
Available?	Yes – in use today	Not yet – may be decades away
Fuel	Uranium or plutonium – non-renewable, mined	Types of hydrogen – some from seawater, plentiful
CO_2 when generating	None	None
Waste	Radioactive waste stored for thousands of years	Far less long-lasting radioactive waste

	Fission power stations	Fusion power stations
Safety	Small risk of a major accident	Reaction stops if conditions aren't right
Reliability	Reliable	Expected to be reliable

📝 **COPY INTO YOUR BOOK**

How to evaluate:

FOR – at least 2 reasons, using data

AGAINST – at least 2 problems

JUDGEMENT – "Overall, … because …"

Your task: write your advice with these headings: For fission · Against fission · For and against fusion · My advice ("Overall, the government should… because…").

Think about NOW versus THE FUTURE. Can the country wait decades for electricity?

Step 5: Exam practice (14 minutes)

Q1 (2 marks) State two differences between nuclear fission and nuclear fusion.

Q2 (4 marks) Describe how a chain reaction happens in a nuclear reactor, and how it is controlled.

Q3 (6 marks) Evaluate the use of nuclear fission to generate electricity.

✅ Add up your marks out of 12.

Step 6: Exit ticket (8 minutes)

In 3 sentences, explain the difference between fission and fusion to someone in Year 7. Then finish:

- Control rods are important because…
- I think the power of the future is… because…
- One thing I'm still not sure about is…

Answers

Only look at these once you have written your own answer!

Step 1: Starter (5 minutes)

See the box: fission splits, fusion joins.

Step 2: Read and write (8 minutes)

(1) It absorbs a neutron. (2) Two smaller nuclei, two or three neutrons, gamma rays and energy. (3) In stars, such as the Sun.

Gaps: neutron · smaller · neutrons · energy

Step 3: Key facts (10 minutes)

Gaps: light · heavier · mass · stars (the Sun) · temperatures · pressures

Difference: fission splits a large nucleus; fusion joins two small nuclei. Similarity: both release a lot of energy from the nucleus.

Step 4: Main task – Power of the Future (15 minutes)

For fission: available now and reliable; no CO_2 when generating. Against fission: non-renewable; radioactive waste stored for thousands of years; small risk of a major accident. Fusion: for – plentiful fuel, no CO_2, far less long-lasting waste; against – not available for decades, very difficult. Advice: build some fission now for reliable low-carbon electricity AND fund fusion research for the future.

Step 5: Exam practice (14 minutes)

Q1: Fission splits a large nucleus whereas fusion joins small nuclei (1); fission is used in power stations today whereas fusion happens in stars (1).

Q2: U-235 absorbs a neutron and splits into two smaller nuclei (1), releasing two or three neutrons (1); these split other nuclei, releasing more neutrons (1); control rods absorb some neutrons to keep the rate steady (1).

Q3: FOR – no CO_2 when generating; reliable; small amount of fuel gives a lot of energy. AGAINST – non-renewable; long-lasting radioactive waste; small risk of a major accident; very expensive to build and decommission. JUDGEMENT – e.g. a useful low-carbon, reliable source, best used alongside renewables.