1. Nuclear power today is generated by nuclear fission.

Some scientists believe that in the future, nuclear **fusion** will be a major source of energy.

Use the structure of the atom to explain the process of nuclear fusion.

You may use the blank space to draw a diagram to help your explanation.

The quality of written communication will be assessed in your answer.

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[6]

2. A nuclear reaction takes place in the Sun releasing a lot of energy.

Hydrogen nuclei join together to produce helium.

What is the name of this process?

Put a (ring) around the correct answer.

fission **fusion** **half-life** **radioactivity**

[1]

3. Nina researches how the Sun releases energy. She finds this information in a textbook.

> The Sun releases energy by nuclear fusion. The Sun emits about 4×10^{26} J of energy every second. As a result, its mass falls by about 4 billion kilograms every second.

Explain why nuclear fusion causes the mass of the Sun to decrease.

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[1]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			Level 3 A description of the nucleus that includes at least two features **AND** a description of fusion that includes high temperature or energy release as one of at least two features. Quality of written communication does not impede communication of the science at this level. **(5–6 marks)** Level 2 A description of the nucleus that includes at least two features **OR** a description of fusion that includes at least two features **OR** a simple description of the nucleus AND a simple description of fusion. Quality of written communication partly impedes communication of the science at this level. (**3–4 marks**) Level 1 a simple description of the nucleus or atom **or** a simple description of fusion **or** a simple description of fission Quality of written communication impedes communication of the science at this level. **(1–2 marks)** Level 0 Insufficient or irrelevant science. Answer not worthy of credit. **(0 marks)**	6	This question is targeted at grades up to D Indicative scientific points: Discussion of nuclear fusion: • hydrogen / small nuclei • brought close to each other • fuse (owtte) • to make larger nuclei • lots of energy released. • large energy required to bring nuclei together • (even larger) amounts of energy released • need for magnetic containment • due to high temperatures • ionising radiation. Description of what nuclei are: • the centre of atoms • protons • neutrons • the electrons are round the outside. correct description of fission for level 1 information from diagram **ignore** chemical reaction ideas where atoms join and energy is released. Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This was the first six-mark extended writing question. Candidates were expected to use the model of the atom to explain the phenomenon of nuclear fusion. This question proved to be very challenging to candidates at this level with quite a few candidates making no attempt at an answer. Only the strongest candidates could either recall and label an atom or describe fusion in the simplest terms of hydrogen nuclei joining to make helium. Very few candidates were able to blend both aspects of the explanation. There was

Question			Answer/Indicative content	Marks	Guidance
					general confusion between fusion and fission and also with chemical reactions.
			Total	6	
2			fusion (2nd answer)	1	Examiner's Comments The majority of candidates correctly identified the name of the process generating helium in the Sun.
			Total	1	
3			mass is converted into energy (of radiation) ✓	1 (AO 1.1)	e.g. quoting $E = mc^2$ **ALLOW** mass is lost in the form of energy **ALLOW** mass is transferred/turned into energy Examiner's Comments Most candidates were unable to recall that during fusion reactions mass is converted to energy. This is from a different part of the specification than the previous two parts of this question.
			Total	1	