AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.4.2

Nuclear fusion

Past-paper questions

Tier	**Foundation**
Question groups	**14**
Available paper years	**2006–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.4.4.2 Nuclear fusion

Question 01

November 2006 | PHY1A | Original Q6 | Legacy

QUESTION SIX

Read this extract from a magazine article.

Cold fusion – energy for the future?

On 23rd March 1989, two scientists claimed to have discovered a process which they called cold fusion.

They thought that cold fusion might be a source of cheap energy.

All over the world, other scientists tried to copy the process but none of them had any success.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A conclusion

B evidence

C reliable

D research

Other scientists were not able to reproduce the results, so the evidence for cold fusion was not . . . **1** . . . .

These scientists came to the . . . **2** . . . that cold fusion did not happen.

So far, no one has achieved the dream of cold fusion.

Although further . . . **3** . . . has been carried out, no . . . **4** . . . supporting the existence of cold fusion has been found.

4.4.4.2 Nuclear fusion

Question 02

January 2009 | PHY2F | Original Q1 | Legacy

1 Four different processes are described in **List A**. The names of these processes are given in **List B**.

Draw a line to link each description in **List A** to its correct name in **List B**.
Draw only **four** lines.

List A	List B
the nuclei of two atoms joining together	gamma emission
the nucleus of an atom splitting into several pieces	electric current
an atom losing an electron	ionisation
an electric charge moving through a metal	nuclear fission
	nuclear fusion

(4 marks)

4

4.4.4.2 Nuclear fusion

Question 03

January 2009 | PHY3F | Original Q5 | Legacy

5 (a) Choose the best words from the box to complete the following sentences.

billions	**fission**	**friction**	**fusion**	**gases**
gravity	**liquids**	**millions**	**thousands**	

5 (a) (i) Stars form when enough dust and ..... from space are pulled together by ..... .

(2 marks)

5 (a) (ii) Stars are able to give out energy for millions of years by the process of

..... .

(1 mark)

5 (a) (iii) The Sun is one of many ..... of stars in our galaxy.

(1 mark)

5 (b) What is the name of our galaxy?

.....

(1 mark)

5

4.4.4.2 Nuclear fusion

Question 04

7 (a) The process of nuclear fusion results in the release of energy.

7 (a) (i) Describe the process of nuclear fusion.

.....

.....

.....

.....

(2 marks)

7 (a) (ii) Where does nuclear fusion happen naturally?

.....

(1 mark)

7 (b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

7 (b) (i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

.....

.....

(1 mark)

7 (b) (ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

.....

.....

(1 mark)

4.4.4.2 Nuclear fusion

Question 04 · continued

for mark

7 (c) In 1989, two scientists claimed in a daily newspaper that they had produced nuclear fusion reactions in normal laboratory conditions. The process became known as 'cold fusion'. Other scientists thought that the evidence produced to support 'cold fusion' was unreliable.

7 (c) (i) Suggest **one** reason why other scientists thought that the evidence to support 'cold fusion' was unreliable.

.....

.....

(1 mark)

7 (c) (ii) In 2007, the results of a new 'cold fusion' research project were published in a respected scientific journal. This journal includes scientists such as Albert Einstein amongst its past authors.

Suggest why people may be more likely to believe an article published in a respected scientific journal than one published in a daily newspaper.

.....

.....

.....

(1 mark)

7

4.4.4.2 Nuclear fusion

Question 05

1 The names of three different processes are given in **List A**.
Where these processes happen is given in **List B**.

Draw a line to link each process in **List A** to where the process happens in **List B**.

Draw only **three** lines.

List A Process	List B Where it happens
fusion	in a star
chain reaction	in a nuclear reactor
alpha decay	in a smoke precipitator
	in the nucleus of an atom

(3 marks)

3

4.4.4.2 Nuclear fusion

Question 06

January 2013 | PH2FP | Original Q9 | Legacy

9 Stars go through a life cycle. About 90% of all stars are in the 'main sequence' period of the life cycle.

9 (a) Stars are stable during the 'main sequence' period of the life cycle.

Why?

.....

.....

(1 mark)

9 (b) The table gives an estimated time for the number of years that three stars, **X, Y** and **Z**, will be in the 'main sequence' period of their life cycle.

Star	Relative mass of the star compared to the Sun	Estimated 'main sequence' period in millions of years
X	0.1	4 000 000
Y	1.0	9 000
Z	40.0	200

9 (b) (i) This data suggests that there is a pattern linking the mass of a star and the number of years the star is in the 'main sequence' period of its life cycle.

What is the pattern suggested by the data?

.....

.....

(1 mark)

9 (b) (ii) Scientists cannot give the exact number of years a star will be in the 'main sequence' period.

Suggest why.

.....

.....

(1 mark)

4.4.4.2 Nuclear fusion

Question 06 · continued

9 (b) (iii) Nuclear fusion is the process by which energy is released in stars.

Which **one** of the following can be concluded from the data in the table?

Draw a ring around the correct answer in the box to complete the sentence.

The rate of nuclear fusion in a large star is

faster than
the same as
slower than

in a small star.

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

Question 9 continues on the next page

4.4.4.2 Nuclear fusion

Question 06 · continued

9 (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe what happens to a star **much bigger** than the Sun, once the star reaches the end of the 'main sequence' period of its life cycle.

Your answer should include the names of the stages the star passes through.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

12

4.4.4.2 Nuclear fusion

Question 07

June 2015 | PH2FP | Original Q2 | Legacy

2 The equation below shows the process by which two atomic nuclei join to form a different nucleus.

$$^{1}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He$$

2 (a) Where does the process shown by the equation above happen naturally?

[1 mark]

Tick (✓) **one** box.

Inside the Earth ☐

Inside a nuclear power station ☐

Inside the Sun ☐

2 (b) Use the correct answer from the box to complete the sentence.

[1 mark]

fission	**force**	**fusion**

The process of joining two atomic nuclei to form a different nucleus is called

nuclear ..... .

2 (c) What is released during this process?

[1 mark]

Draw a ring around the correct answer.

charge **energy** **force**

3

4.4.4.2 Nuclear fusion

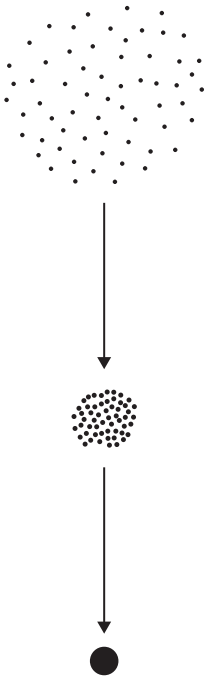
Question 08

1 (a) **Figure 1** shows how a star is formed.

Use **one** answer from each box to complete the sentences in **Figure 1**.

[3 marks]

Figure 1



gas	**rock**	**water**

A star starts as a huge cloud of dust and _____ particles in space.

friction	**fusion**	**gravity**

The force of _____ pulls the particles in the cloud closer together.

protostar	**red giant**	**white dwarf**

The compressed mass of particles

forms a _____ .

4.4.4.2 Nuclear fusion

Question 08 · continued

1 (b) Elements heavier than iron are formed in a supernova.
What is a supernova?

[1 mark]

Tick (✓) **one** box.

the explosion of a massive star ☐

a very bright, hot young star ☐

a very cool super giant star ☐

1 (c) Brown dwarf stars are small stars too cool to give out visible light. They were first discovered in 1995. Scientists think that there are millions of these stars spread throughout the Universe.

Which **one** of the following is the most likely reason why brown dwarf stars were not discovered before 1995?

[1 mark]

Tick (✓) **one** box.

Brown dwarf stars did not exist before 1995. ☐

Scientists were looking in the wrong part of the Universe. ☐

The telescopes and measuring instruments were not sensitive enough. ☐

5

4.4.4.2 Nuclear fusion

Question 09

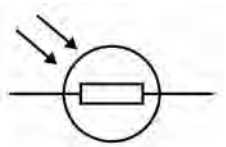
June 2018 | 8463/1F | Original Q7

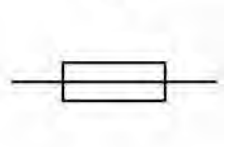
0 7 The plug of an electrical appliance contains a fuse.

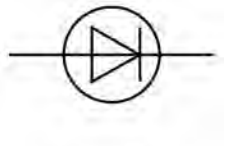
0 7 . 1 What is the correct circuit symbol for a fuse?

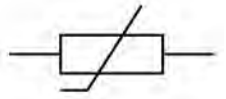
Tick **one** box.

[1 mark]


☐


☐


☐


☐

0 7 . 2 The appliance is connected to the mains electrical supply. The mains potential difference is 230 V.

Calculate the energy transferred when 13 C of charge flows through the appliance.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

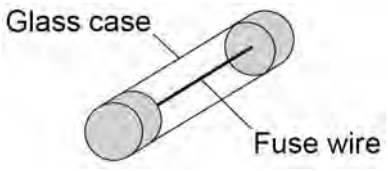
Energy transferred = _____ J

4.4.4.2 Nuclear fusion

Question 09 · continued

Figure 9 shows the structure of a fuse.

Figure 9



0 7 . 3 Write down the equation that links charge flow, current and time.

[1 mark]

0 7 . 4 The fuse wire melts when 1.52 coulombs of charge flows through the fuse in 0.40 seconds.

Calculate the current at which the fuse wire melts.

[3 marks]

Current = _____ A

0 7 . 5 The mass of the fuse wire is 0.00175 kg. The specific latent heat of fusion of the fuse wire is 205 000 J/kg.

Calculate the energy needed to melt the fuse wire.

Use the Physics Equations Sheet.

[2 marks]

Energy = _____ J

9

4.4.4.2 Nuclear fusion

Question 10

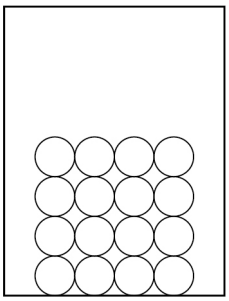
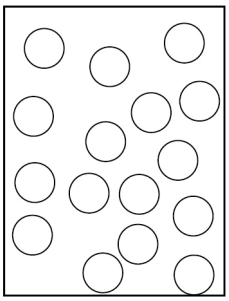
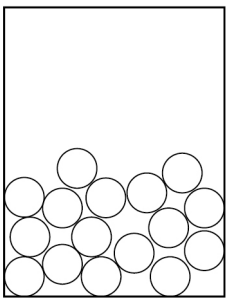
November 2021 | 8463/1F | Original Q1

0 1 . 1 A student investigated the three states of matter.

The arrangement of particles in the three states of matter are different.

Draw **one** line from each particle arrangement to the state of matter.

[2 marks]

Particle arrangement	State of matter
	Solid
	Liquid
	Gas

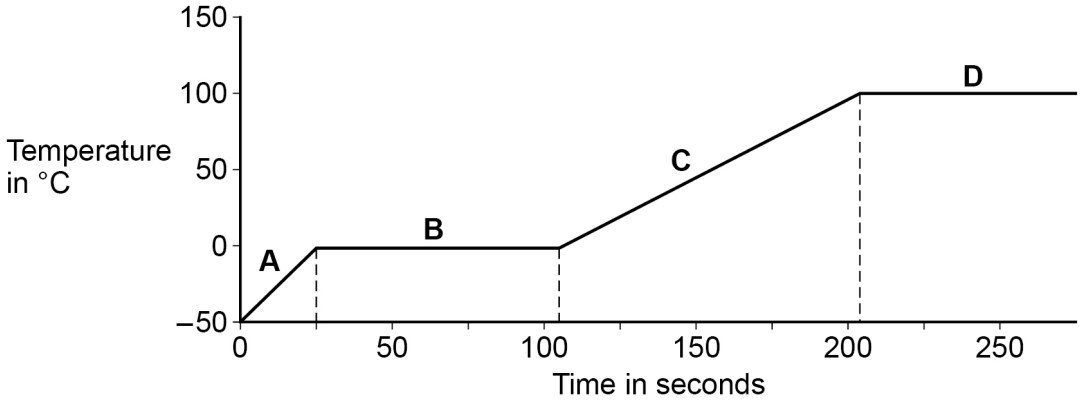
4.4.4.2 Nuclear fusion

Question 10 · continued

A large lump of ice was heated and changed state.

Figure 1 shows how the temperature varied with time.

Figure 1



0 1 . 2 Which part of **Figure 1** shows when the ice was melting?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Which part of **Figure 1** shows when the water was boiling?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 1 continues on the next page

4.4.4.2 Nuclear fusion

Question 10 · continued

0 1 . 4 Which property of the water particles changes as the temperature of the water increases?

[1 mark]

Tick (✓) **one** box.

The kinetic energy of the particles ☐

The mass of each particle ☐

The number of particles ☐

0 1 . 5 Calculate the thermal energy needed to melt 0.250 kg of ice at 0 °C.

specific latent heat of fusion of water = 334 000 J/kg

Use the equation:

thermal energy = mass × specific latent heat

[2 marks]

Thermal energy = _____ J

4.4.4.2 Nuclear fusion

Question 10 · continued

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

condenses	**evaporates**	**ionises**	**sublimates**

A substance is heated and changes directly from a solid to a gas.

The substance _____ .

8

Turn over for the next question

4.4.4.2 Nuclear fusion

Question 11

November 2021 | 8463/1F | Original Q10

1 0 Energy from the Sun is released by nuclear fusion.

1 0 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

1 0 . 2 Nuclear fusion of deuterium is difficult to achieve on Earth because of the high temperature needed.

Electricity is used to increase the temperature of 4.0 g of deuterium by 50 000 000 °C.

specific heat capacity of deuterium = 5200 J/kg °C

Calculate the energy needed to increase the temperature of the deuterium by 50 000 000 °C.

Use the Physics Equations Sheet.

[3 marks]

Energy = _____ J

4.4.4.2 Nuclear fusion

Question 11 · continued

10.3 The idea of obtaining power from nuclear fusion was investigated using models.

The models were tested before starting to build the first commercial nuclear fusion power station.

Suggest **two** reasons why models were tested.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

10.4 Generating electricity using nuclear fusion will have fewer environmental effects than generating electricity using fossil fuels.

Explain **one** environmental effect of generating electricity using fossil fuels.

[2 marks]

_____

_____

_____

_____

_____

9

4.4.4.2 Nuclear fusion

Question 12

June 2023 | 8463/1F | Original Q3

0 3 Some isotopes emit nuclear radiation.

0 3 . 1 Carbon-12 and carbon-14 are both isotopes of carbon.

Complete the sentences.

Choose answers from the box.

[2 marks]

alpha particles	**electrons**	**neutrons**	**protons**

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have the **same** number of _____ .

The nucleus of a carbon-12 atom and the nucleus of a carbon-14 atom have a **different** number of _____ .

0 3 . 2 Different radioactive isotopes have different half-lives.

What does 'half-life' mean?

[1 mark]

Tick (✓) **one** box.

- Half the time taken for all of the nuclei in a sample to decay. ☐
- The time taken for half the nuclei in a sample to decay. ☐
- The time taken for one nucleus to split in half. ☐

Question 3 continues on the next page

4.4.4.2 Nuclear fusion

Question 12 · continued

0 3 . 3 **Table 2** shows the half-life of some different isotopes of carbon.

Table 2

Isotope	Half-life in seconds
Carbon-15	2.45
Carbon-16	0.75
Carbon-17	0.19
Carbon-18	0.09

Which isotope is the least stable?

[1 mark]

Tick (✓) **one** box.

Carbon-15 ☐

Carbon-16 ☐

Carbon-17 ☐

Carbon-18 ☐

4.4.4.2 Nuclear fusion

Question 12 · continued

0 3 . 4 Workers in nuclear power stations must be aware of nuclear irradiation and radioactive contamination.

Draw **one** line from each term to an example of the term.

[2 marks]

Term	Example
	Exposure to a beam of gamma rays
Radioactive contamination	Exposure to ultraviolet radiation from the Sun
Nuclear irradiation	Accidental transfer of plutonium onto a human body
	Using a mobile phone

Question 3 continues on the next page

4.4.4.2 Nuclear fusion

Question 12 · continued

0 3 . 5 Why are workers required to walk across a sticky floor before leaving the nuclear power station?

[1 mark]

Tick (✓) **one** box.

To remove alpha particles from their shoes. ☐

To remove gamma radiation from their shoes. ☐

To remove radioactive dust from their shoes. ☐

0 3 . 6 The places where people work and live contribute to the nuclear radiation they are exposed to.

Table 3 shows the mean daily dose of radiation caused by two different jobs.

Table 3

Job	Mean daily dose in mSv
Aeroplane pilot	0.072
Nuclear power station worker	0.00050

Calculate the number of days a nuclear power station worker must work before receiving the same dose that an aeroplane pilot receives in one day.

[2 marks]

Number of days = _____

4.4.4.2 Nuclear fusion

Question 12 · continued

0 3 . 7 The process of nuclear fission takes place in nuclear power stations.

The process of nuclear fusion takes place in the Sun.

Draw **one** line from each process to its fuel.

[2 marks]

Process	Fuel
	Hydrogen
Nuclear fission	Iron
Nuclear fusion	Lead
	Uranium

11

4.4.4.2 Nuclear fusion

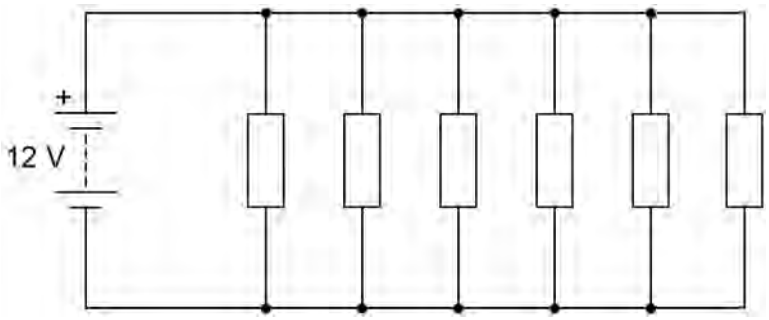
Question 13

June 2023 | 8463/1F | Original Q10

1 0 **Figure 14** shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

Figure 14



1 0 . 1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

Use the Physics Equations Sheet to answer questions **10.2** and **10.3**.

1 0 . 2 Which equation links charge flow (Q), energy (E) and potential difference (V)?

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

4.4.4.2 Nuclear fusion

Question 13 · continued

1 0 . 3 Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

[3 marks]

Charge flow = _____ C

1 0 . 4 Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of water = _____ J/kg

4.4.4.2 Nuclear fusion

Question 13 · continued

10.5 The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

Explain the changes in the arrangement **and** movement of the particles as the ice melted and the temperature increased to 5 °C.

[6 marks]

14

4.4.4.2 Nuclear fusion

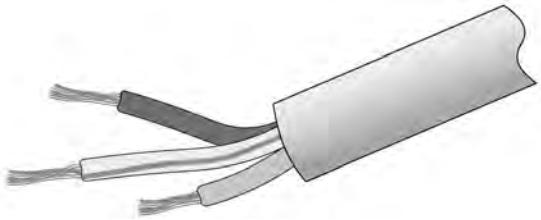
Question 14

June 2024 | 8463/1F | Original Q7

0 7 An electrical appliance is connected to the mains electricity supply using a three-core cable.

Figure 13 shows a three-core cable.

Figure 13



0 7 . 1 What colour is the insulation covering the live wire inside the cable?

[1 mark]

Tick (✓) **one** box.

- Blue ☐
- Brown ☐
- Green and yellow ☐
- Orange ☐

0 7 . 2 What colour is the insulation covering the neutral wire inside the cable?

[1 mark]

Tick (✓) **one** box.

- Blue ☐
- Brown ☐
- Green and yellow ☐
- Orange ☐

4.4.4.2 Nuclear fusion

Question 14 · continued

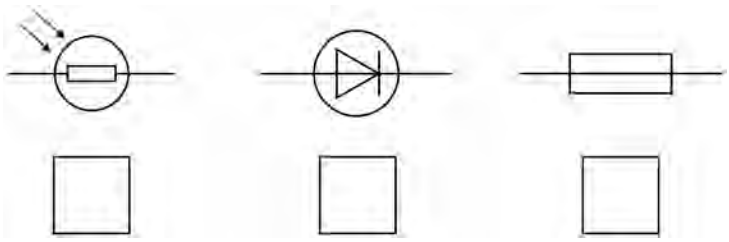
The plug connected to the cable contains a fuse.

A fuse contains a wire that is designed to melt when the current is too great.

0 7 . 3 What is the circuit symbol for a fuse?

[1 mark]

Tick (✓) **one** box.



0 7 . 4 The wire in the fuse melts when there is a charge flow of 2.0 C in a time of 0.40 s.

Calculate the current in the wire when it melts.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

[2 marks]

Current = _____ A

Question 7 continues on the next page

4.4.4.2 Nuclear fusion

Question 14 · continued

0 7 . 5 The mass of the wire is 0.016 g.

specific latent heat of fusion of the wire = 60 000 J/kg

Calculate the change in thermal energy needed to melt the wire.

Use the Physics Equations Sheet.

[3 marks]

Change in thermal energy = _____ J

0 7 . 6 The fuse transfers some energy to the surroundings as it melts.

How does transferring energy to the surroundings affect the total energy needed to melt the fuse?

[1 mark]

Tick (✓) **one** box.

- The total energy will be smaller. ☐
- The total energy will be the same. ☐
- The total energy will be greater. ☐

9