AQA GCSE Physics | 8463

SPECIFICATION POINT 4.4.4.1

Nuclear fission

Past-paper questions

Tier	**Foundation**
Question groups	**15**
Available paper years	**2009–2024**

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.

4.4.4.1 Nuclear fission

Question 01

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

4.4.4.1 Nuclear fission

Question 02

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

4.4.4.1 Nuclear fission

Question 03

June 2009 | PHY2F | Original Q7 | Legacy

7 The table gives information about the three types of particle that make up an atom.

Particle	Relative mass	Relative charge
Proton		+1
Neutron	1	
Electron	very small	–1

7 (a) Complete the table by adding the **two** missing values. *(2 marks)*

7 (b) Use the information in the table to explain why an atom has no overall electrical charge.

.....

.....

.....

.....

(2 marks)

7 (c) Uranium has two natural isotopes, uranium-235 and uranium-238.
Uranium-235 is used as a fuel inside a nuclear reactor.
Inside the reactor, atoms of uranium-235 are split and energy is released.

7 (c) (i) How is the structure of an atom of uranium-235 different from the structure of an atom of uranium-238?

.....

.....

(1 mark)

7 (c) (ii) The nucleus of a uranium-235 atom must absorb a particle before the atom is able to split.

What type of particle is absorbed?

.....

(1 mark)

7 (c) (iii) The nucleus of an atom splits into smaller parts in a reactor.

What name is given to this process?

.....

(1 mark)

7

4.4.4.1 Nuclear fission

Question 04

March 2010 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

This question is about nuclear power stations.

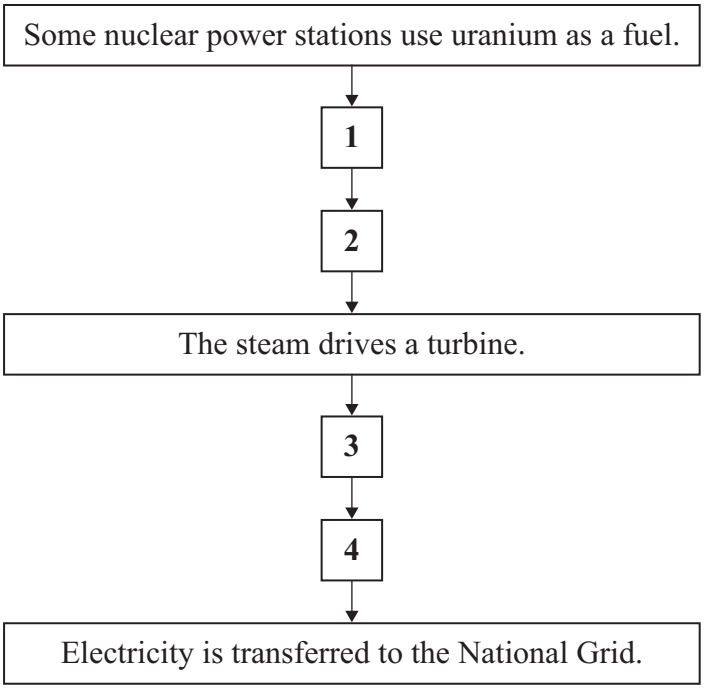
Match statements, **A**, **B**, **C** and **D**, with the boxes **1–4** in the flow chart to describe how nuclear power stations work.

A Electricity is produced.

B Fission of uranium produces heat.

C The heat is used to produce steam.

D The turbine drives a generator.



4.4.4.1 Nuclear fission

Question 05

November 2010 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about generating electricity.

Match energy sources, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A gas

B geothermal

C moving water

D uranium

	Description
1	produces energy from fission
2	is used in hydroelectric schemes
3	energy from underground hot rocks
4	is burnt in some power stations

4.4.4.1 Nuclear fission

Question 06

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
	in a star
fusion	
	in a nuclear reactor
chain reaction	
	in a smoke precipitator
alpha decay	
	in the nucleus of an atom

(3 marks)

3

4.4.4.1 Nuclear fission

Question 07

November 2011 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The energy from various sources can be used to drive turbines in power stations.

Match power station types, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A coal-fired

B geothermal

C nuclear

D tidal

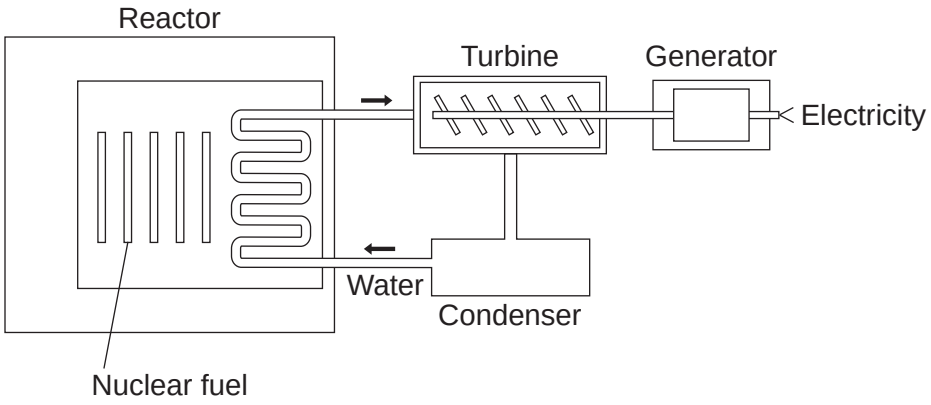
	The turbines are driven by . . .
1	moving water.
2	steam produced from water heated by burning a fuel.
3	steam produced from water heated by hot rocks.
4	steam produced from water heated by the fission of uranium.

4.4.4.1 Nuclear fission

Question 08

June 2013 | PH2FP | Original Q5 | Legacy

5 Nuclear power stations use the energy released from nuclear fuels to generate electricity.



5 (a) Which substance do the majority of nuclear reactors use as fuel?

Draw a ring around your answer.

plutonium-239 **thorium-232** **uranium-235**

(1 mark)

5 (b) Energy is released from nuclear fuels by the process of nuclear fission.

Describe what happens to the nucleus of an atom during nuclear fission.

.....

.....

.....

.....

(2 marks)

5 (c) Use words from the box to complete each sentence.

condenser	**gas**	**generator**	**reactor**	**steam**	**turbine**

The energy released from the nuclear fuel is used to heat water. The water turns into

..... and this is used to drive a ..... .

This turns a ..... to produce electricity.

(3 marks)

6

4.4.4.1 Nuclear fission

Question 09

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

4.4.4.1 Nuclear fission

Question 10

June 2016 | PH1FP | Original Q1 | Legacy

1 Different energy sources are used to generate electricity.

1 (a) Use words from the box to match the correct energy source to each of the descriptions given in **Table 1**.

[3 marks]

biofuel	coal	geothermal	nuclear	waves

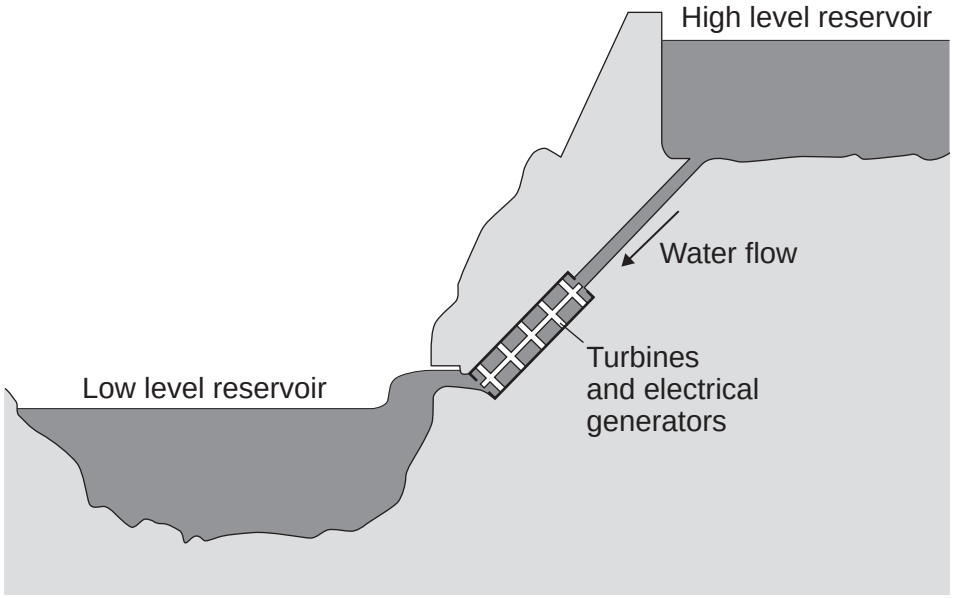
Table 1

Description	Energy source
Energy from the Earth's core is used to heat water.	
Fission of uranium nuclei is used to heat water.	
Gases from rotting plant material are burned to heat water.	

1 (b) Energy can be stored in a pumped storage power station.

Figure 1 shows a pumped storage power station.

Figure 1



4.4.4.1 Nuclear fission

Question 10 · continued

When electricity is needed, the water in the high level reservoir is allowed to flow to the low level reservoir. The flowing water generates electricity.

Use the correct answer from the box to complete each sentence.

[3 marks]

electrical	**gravitational potential**	**kinetic**	**nuclear**	**sound**

The water in the high level reservoir stores _____ energy.

The flowing water has _____ energy.

The water turns the turbine which is connected to the generator.

The generator produces some _____, this is wasted energy.

1 (c) The total power input to a pumped storage power station is 600 MW.

The useful power output is 540 MW.

1 (c) (i) Calculate the efficiency of this pumped storage power station.
Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Efficiency = _____

1 (c) (ii) Calculate how much power is wasted by the pumped storage power station.

[1 mark]

_____

Power = _____ MW

1 (c) (iii) How is the temperature of the surroundings affected by the energy wasted by the pumped storage power station?

[1 mark]

_____

10

4.4.4.1 Nuclear fission

Question 11

June 2016 | PH2FP | Original Q4 | Legacy

4 (a) Uranium has two natural isotopes, uranium-235 and uranium-238.

Use the correct answer from the box to complete the sentence.

[1 mark]

electrons	neutrons	protons

The nucleus of a uranium-238 atom has three more _____ than the nucleus of a uranium-235 atom.

4 (b) Uranium-235 is used as a fuel inside a nuclear reactor.
Energy is released from nuclear fuels by the process of nuclear fission.

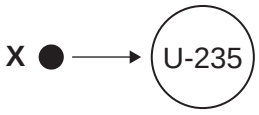
What is the energy released from nuclear fuels inside a nuclear reactor used for?

[1 mark]

_____

4 (c) **Figure 6** shows the nucleus of an atom of uranium-235 (U-235) about to undergo nuclear fission.

Figure 6



4 (c) (i) Before nuclear fission can happen the nucleus of a uranium atom has to absorb the particle labelled **X**.

What is particle **X**?

[1 mark]

Tick (✓) **one** box.

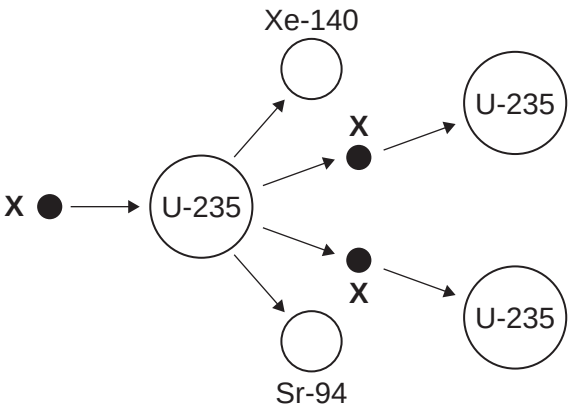
an electron ☐ a neutron ☐ a proton ☐

4.4.4.1 Nuclear fission

Question 11 · continued

4 (c) (ii) The process of nuclear fission, shown in **Figure 7**, causes the nucleus of the uranium-235 (U-235) atom to split apart and release two of the particles **X**.

Figure 7



Complete **Figure 7** to show how the particles **X start** a chain reaction.

[2 marks]

5

4.4.4.1 Nuclear fission

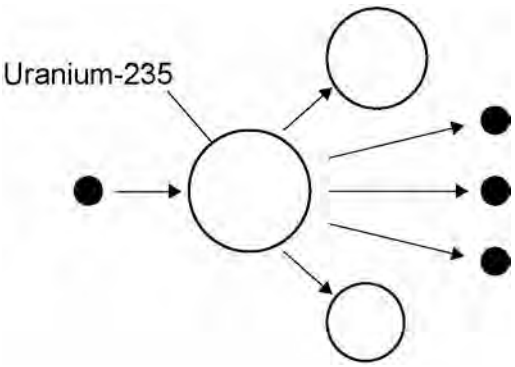
Question 12

June 2018 | 8463/1F | Original Q6

0 6 Nuclear power can be used to generate electricity through nuclear fission.

Figure 6 shows the process of nuclear fission.

Figure 6



0 6 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

gamma rays	**light rays**	**proton**	**neutron**	**nucleus**	**X-rays**

During the process of nuclear fission a uranium _____

absorbs a _____ .

Electromagnetic radiation is released in the form of _____ .

0 6 . 2 The UK needs at least 25 000 000 kW of electrical power at any time.

A nuclear power station has an electrical power output of 2 400 000 kW

Calculate how many nuclear power stations are needed to provide 25 000 000 kW of electrical power.

[2 marks]

_____

_____

_____

_____

Number of nuclear power stations = _____

4.4.4.1 Nuclear fission

Question 12 · continued

0 6 . 3 State **two** environmental issues caused by generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

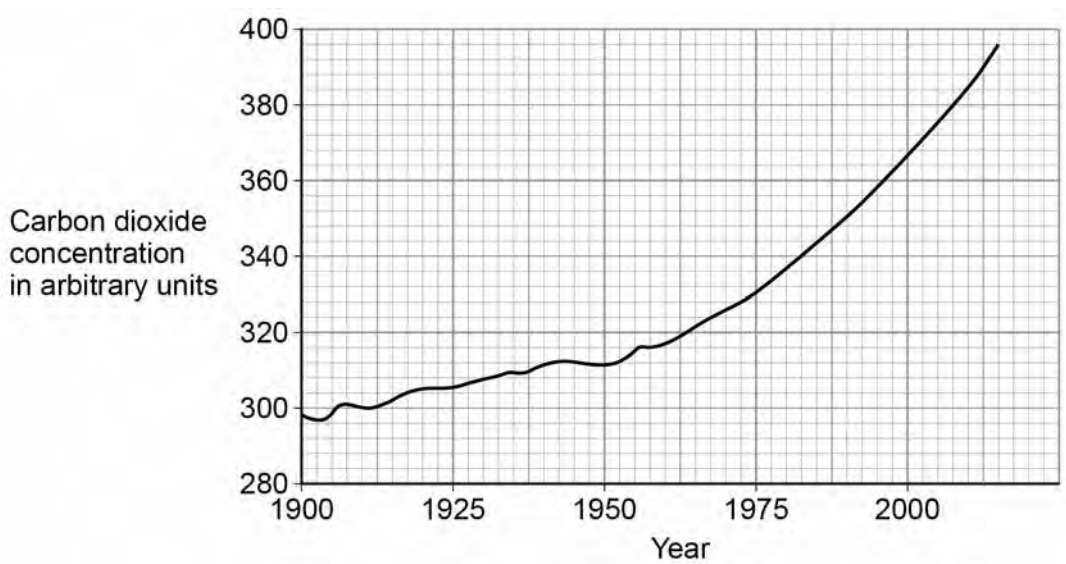
2 _____

_____

0 6 . 4 The UK currently generates a lot of electricity by burning natural gas. This process releases carbon dioxide into the atmosphere.

Figure 7 shows how the concentration of carbon dioxide in the atmosphere has changed over the past 115 years.

Figure 7

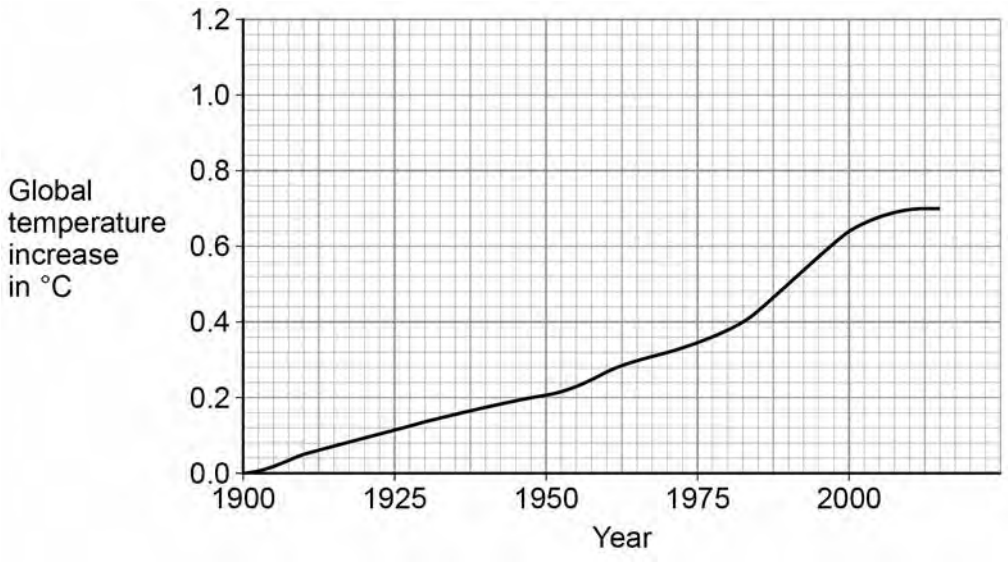


4.4.4.1 Nuclear fission

Question 12 · continued

Figure 8 shows how the global temperature has changed over the past 115 years.

Figure 8



Give **one** similarity and **one** difference between the data in **Figure 7** and **Figure 8**.

[2 marks]

Similarity _____

_____

_____

Difference _____

_____

_____

9

4.4.4.1 Nuclear fission

Question 13

November 2020 | 8463/1F | Original Q5

0 5 Radioactive waste from nuclear power stations is a man-made source of background radiation.

0 5 . 1 Which of the following is also a man-made source of background radiation?

[1 mark]

Tick (✓) **one** box.

- cosmic rays ☐
- radiotherapy ☐
- rocks ☐
- stars ☐

0 5 . 2 Nuclear power stations use the process of nuclear fission.

Complete the sentences to describe the process of nuclear fission.

Choose answers from the box.

[3 marks]

a neutron	**a proton**		**an electron**
cosmic rays	**energy**	**gamma rays**	**x-rays**

An unstable nucleus absorbs _____ and splits into two parts.

Two or three neutrons are released, as well as _____

and _____ .

4.4.4.1 Nuclear fission

Question 13 · continued

0 5 . 3 Plutonium-239 is one type of radioactive waste from nuclear power stations.

The following nuclear equation represents the decay of plutonium-239 (Pu-239).

$$^{239}_{94}Pu \rightarrow {}^{235}_{92}U + {}^{4}_{2}He$$

How does the nuclear equation show that alpha radiation is emitted when plutonium-239 decays?

[1 mark]

Tick (✓) **one** box.

An alpha particle contains 92 protons. ☐

An alpha particle has a mass number of 235. ☐

An alpha particle is the same as a helium nucleus. ☐

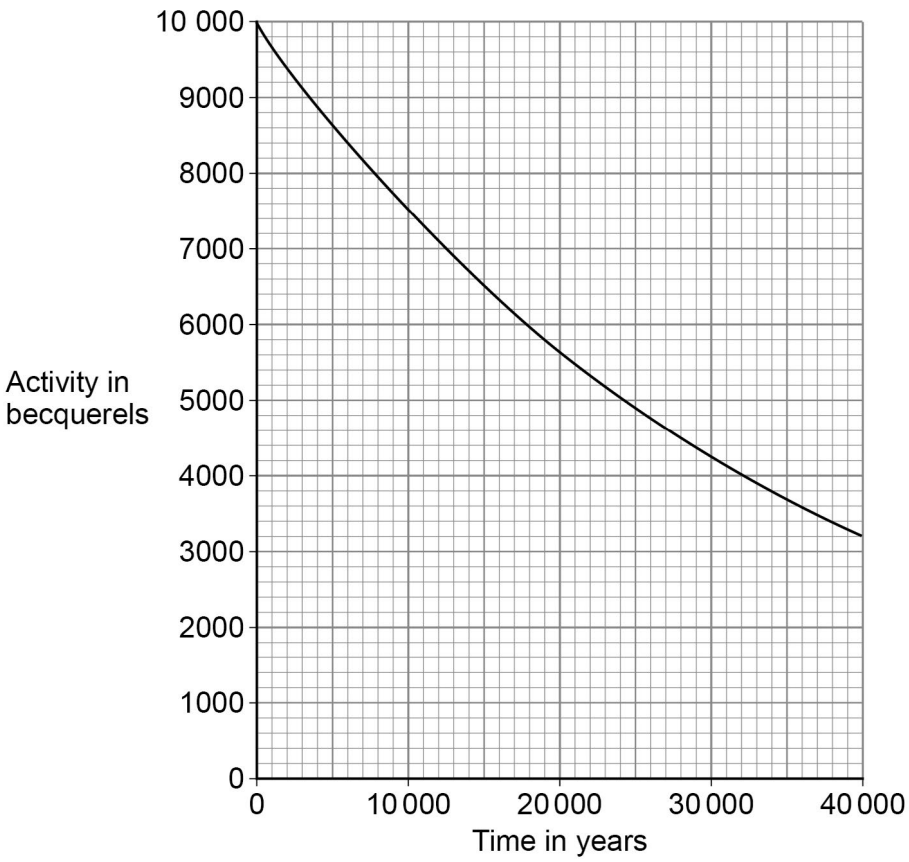
Question 5 continues on the next page

4.4.4.1 Nuclear fission

Question 13 · continued

Figure 8 shows how the activity of a sample of plutonium-239 varies with time.

Figure 8



0 5 . 4 How much time will it take for the activity of the sample of plutonium-239 to fall to half of its initial activity?

[1 mark]

Time = _____ years

0 5 . 5 What is the half-life of plutonium-239?

[1 mark]

Half-life = _____ years

4.4.4.1 Nuclear fission

Question 13 · continued

0 5 . 6 The radioactive waste from a nuclear power station is buried underground.

People are warned to stay away from places where radioactive waste is buried.

Suggest **one** risk of going near the place where radioactive waste is buried.

[1 mark]

8

Turn over for the next question

4.4.4.1 Nuclear fission

Question 14

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

4.4.4.1 Nuclear fission

Question 14 · 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 ☐

4.4.4.1 Nuclear fission

Question 14 · 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
Radioactive contamination	Exposure to a beam of gamma rays
Nuclear irradiation	Exposure to ultraviolet radiation from the Sun
	Accidental transfer of plutonium onto a human body
	Using a mobile phone

Question 3 continues on the next page

4.4.4.1 Nuclear fission

Question 14 · 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 = _____

4.4.4.1 Nuclear fission

Question 14 · 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

4.4.4.1 Nuclear fission

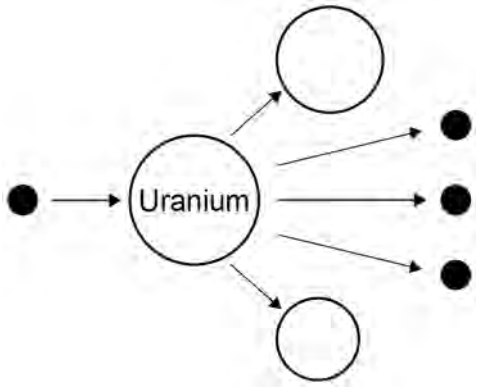
Question 15

June 2024 | 8463/1F | Original Q10

1 0 The process of nuclear fission is used in nuclear power stations.

Figure 17 shows the process of nuclear fission.

Figure 17



1 0 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

electrons	**gamma rays**	**neutrons**	**nuclei**	**protons**

In nuclear power stations, energy is released from

uranium _____.

The uranium in **Figure 17** splits into two parts and

releases three _____.

The process of nuclear fission releases electromagnetic radiation in the

form of _____.

4.4.4.1 Nuclear fission

Question 15 · continued

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

10.2 Write down the equation which links energy (*E*), power (*P*) and time (*t*).

[1 mark]

10.3 A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J.

[3 marks]

Energy output = _____ J

10.4 Radioactive waste produced by nuclear power stations has a long half-life.

Suggest **one** precaution taken to reduce the hazard caused by radioactive waste from power stations.

[1 mark]

4.4.4.1 Nuclear fission

Question 15 · continued

1 0 . 5 Nuclear power stations do **not** generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity.

[2 marks]

Number of days = _____

10

Turn over for the next question