

Atomic structure – GCSE Physics Paper 1

1. June/2023/Paper_8463/1F/No.2

0 2

Scientists developed different models of the atom as new discoveries were made.

0 2**. 1**

Which particle in the atom was discovered first?

[1 mark]Tick (✓) **one** box.

Electron

☒

Neutron

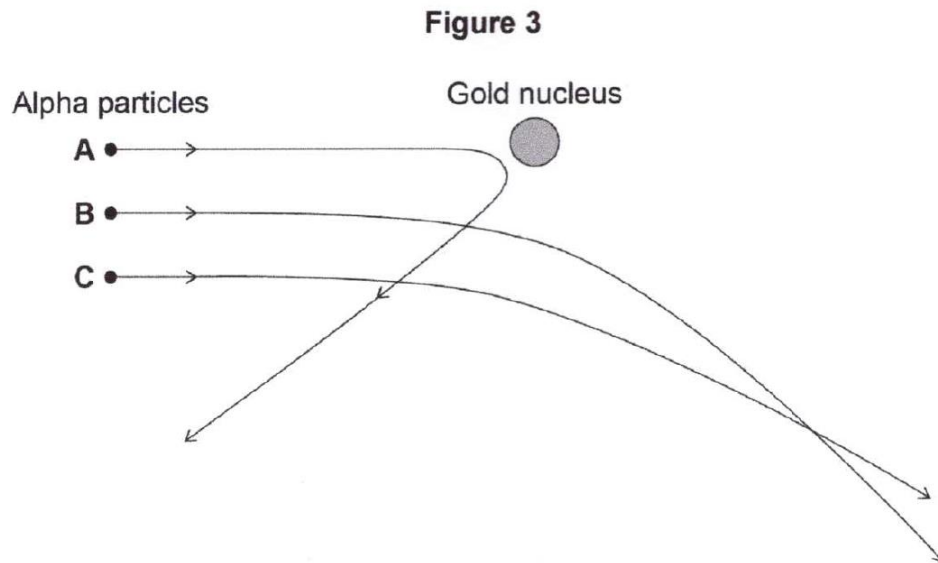
☐

Proton

☐

In an experiment that led to the nuclear model of the atom, alpha particles were directed at a sheet of gold foil.

Figure 3 shows the path of three alpha particles passing close to a gold nucleus.



0 2 . 2

An alpha particle has a radius of 1.7 femtometres.

The radius of a gold nucleus is 4.2 times larger than the radius of an alpha particle.

Calculate the radius of a gold nucleus in femtometres.

[2 marks]

$$\text{radius} = 4.2 \times 1.7 \text{ fm}$$

$$= 7.14 \text{ fm}$$

Radius of a gold nucleus = 7.14 femtometres

0 2 . 3

Alpha particles are deflected by the gold nucleus.

What are the charges on an alpha particle and a gold nucleus?

[1 mark]

Tick (✓) **one** box.An alpha particle and a gold nucleus are both ~~neutral~~.☐

An alpha particle and a gold nucleus are both positively charged.

☒An alpha particle is positively charged and a gold nucleus is ~~neutral~~.☐

0 2 . 4

Which statement describes the force between the alpha particle and the gold nucleus?

[1 mark]

Tick (✓) **one** box.

A contact force

☐

A force of attraction

☐

A force of repulsion

☒*← Since they are like charges.*

There is no force

☐

0 2 . 5

Which alpha particle in **Figure 3** experiences the largest force from the gold nucleus?

[1 mark]

Tick (✓) **one** box.

A

☒

B

☐

C

☐*Closest to the nucleus.*

Table 1 lists different models of the atom in alphabetical order.

Table 1

Model
Bohr
Nuclear
Plum pudding
Tiny spheres that cannot be divided

0 2 . 6

Which model in **Table 1** was developed first?

[1 mark]

Tiny sphere that cannot be divided.

0 2 . 7

Which model in **Table 1** was developed last?

[1 mark]

Bohr's model.

2. June/2023/Paper_8463/1F/No.3

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 protons.

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

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.

☐

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

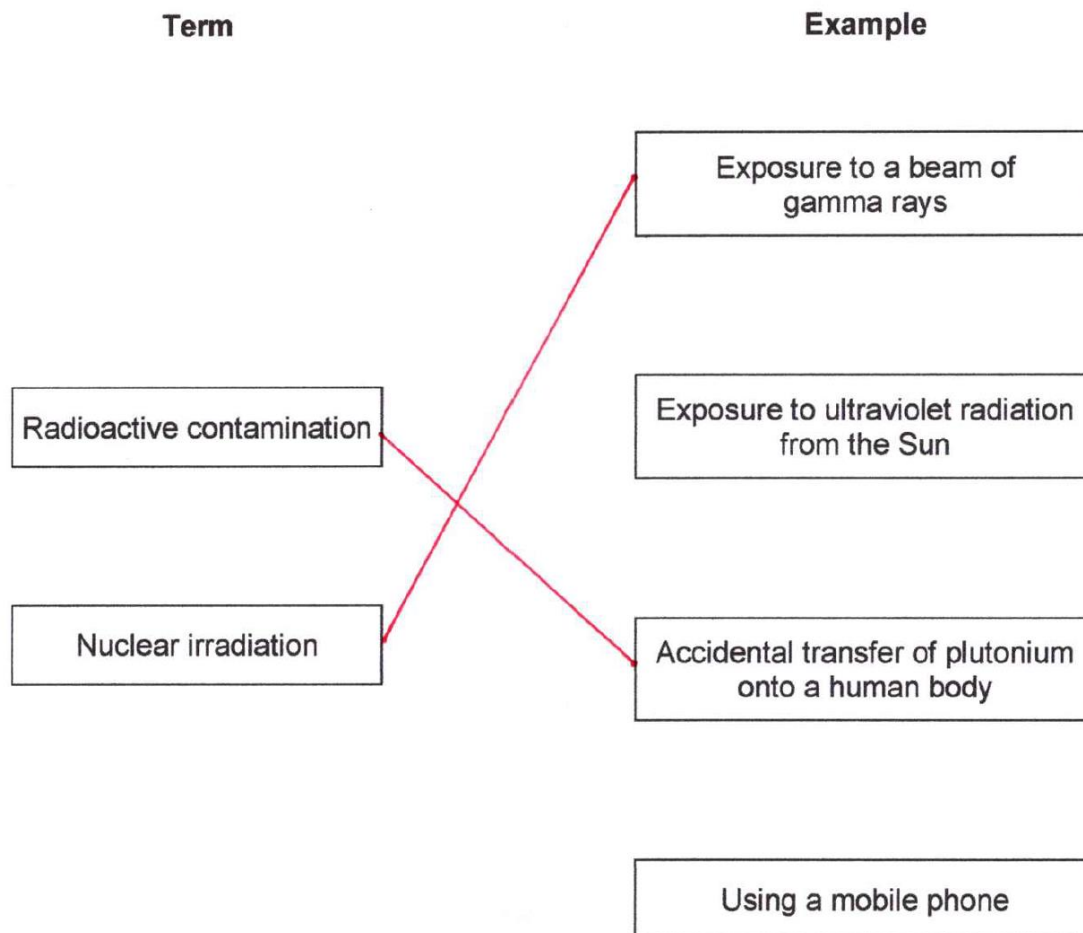
☒*← decays the fastest*

03.4

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]



03.5

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.

☒

03.6

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]

$$\begin{aligned} \text{No. of days} &= \frac{0.072}{0.00050} \\ &= 144 \text{ days.} \end{aligned}$$

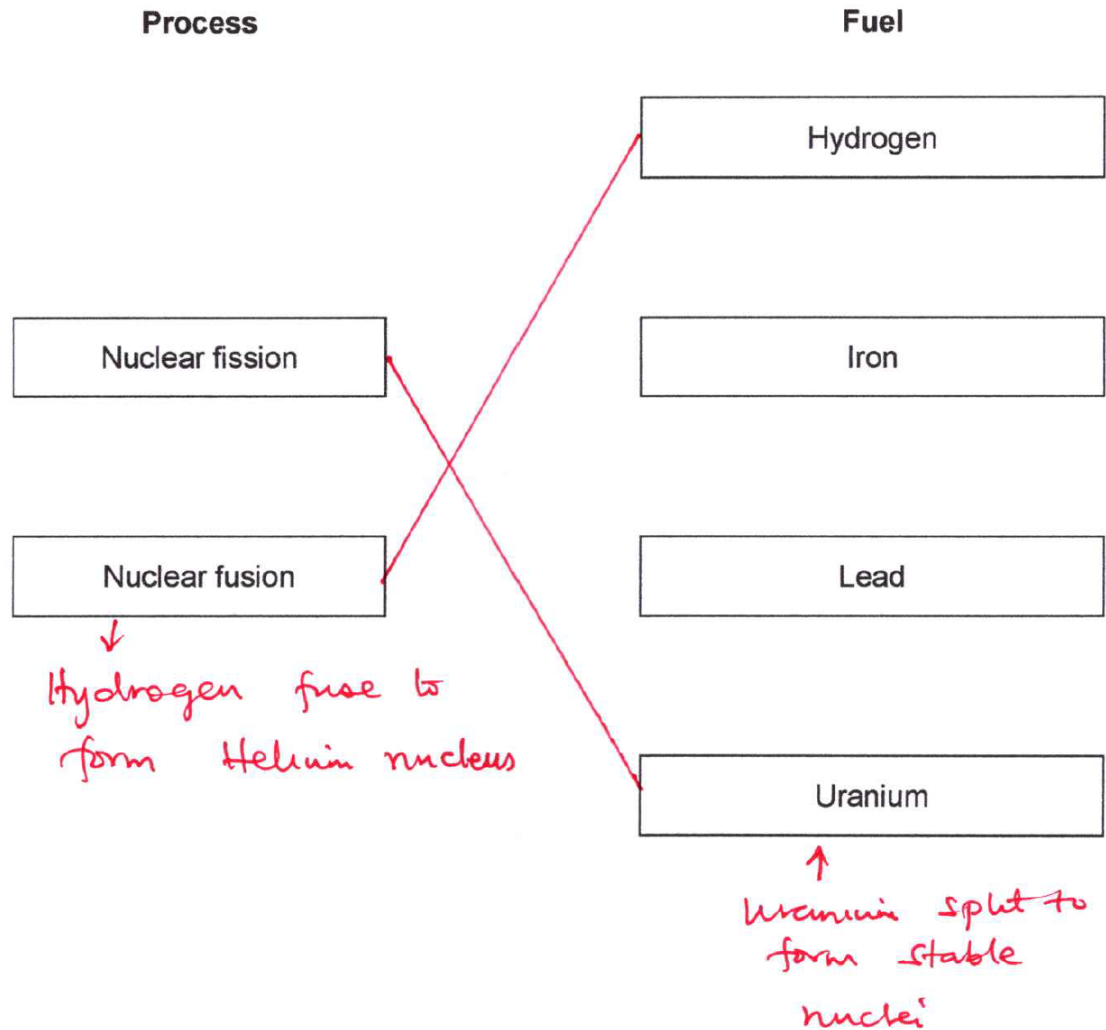
Number of days = _____

03.7 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]



3. June/2023/Paper_8463/1H/No.5

0 5

Some isotopes emit nuclear radiation.

0 5 . 1

Carbon-14 and carbon-12 are isotopes of carbon.

Compare the structure of an atom of carbon-14 with the structure of an atom of carbon-12.

[3 marks]

- Both have the same number of protons
- Carbon-14 has more neutrons than
Carbon-12

0 5 . 2

Carbon-14 is a radioactive isotope.

Carbon-14 has a half-life of 5700 years.

What does 'a half-life of 5700 years' mean?

[1 mark]

It takes about 5700 years for the
activity of carbon-14 to halve its activity.

Table 1 gives the half-life of some other radioactive isotopes.

Table 1

Isotope	Half-life in seconds
Nitrogen-18	0.62
Nitrogen-17	4.17
Fluorine-17	64.37
Fluorine-18	6584.34

0 5 . 3

A sample of fluorine-17 has an activity that is one quarter of its original activity.

Calculate the age of the sample of fluorine-17.

[2 marks]

To get to $\frac{1}{4}$, you need 2 half-lives
 so the age is $64.37 \times 2 = 128.74$ seconds

Age = 128.74 s

0 5 . 4

All of the isotopes in **Table 1** emit beta radiation.

Explain which isotope would cause the biggest risk to a person's health based only on the half-life of each isotope.

[3 marks]

- With a high activity, there is a high dose of radiation absorbed per second. This is harmful to the person's health.

0 5 . 5

People who work in the nuclear power industry need to be aware of irradiation and contamination.

Describe the difference between irradiation and contamination.

[2 marks]

Irradiation - the exposure of an object/person to radiation

Contamination - The presence of radioactive material on an object/person.

0 5 . 6

Give **one** health risk to a person working close to a source of nuclear radiation.

[1 mark]

- Genetic mutation

- cancer

- Radiation poisoning

0 5 . 7

Workers in nuclear power stations are monitored to check the radiation they emit.

A worker stands 1 cm away from a radiation detector.

The amount of radiation the worker emits is recorded.

Explain why the worker needs to stand close to the radiation detector.

[2 marks]

- Some radioactive materials emit alpha particles which have a very short range in air

0 5 . 8

Workers in the nuclear power industry are exposed to nuclear radiation.

Pilots on aircraft are exposed to cosmic radiation from space.

daily dose caused by working in a nuclear power station = 0.00050 mSv**hourly** dose from cosmic rays to a pilot while flying = 0.0030 mSv

Calculate the number of days it takes for a nuclear power station worker to receive the same dose as a pilot flying for 24 hours.

[3 marks]

$$\begin{aligned} \text{Number of} &= \frac{0.072}{0.00050} \\ \text{days} & \\ &= 144 \text{ days} \end{aligned}$$

$$\text{Number of days} = 144$$

4. June/2023/Paper_8463/1H/No.8

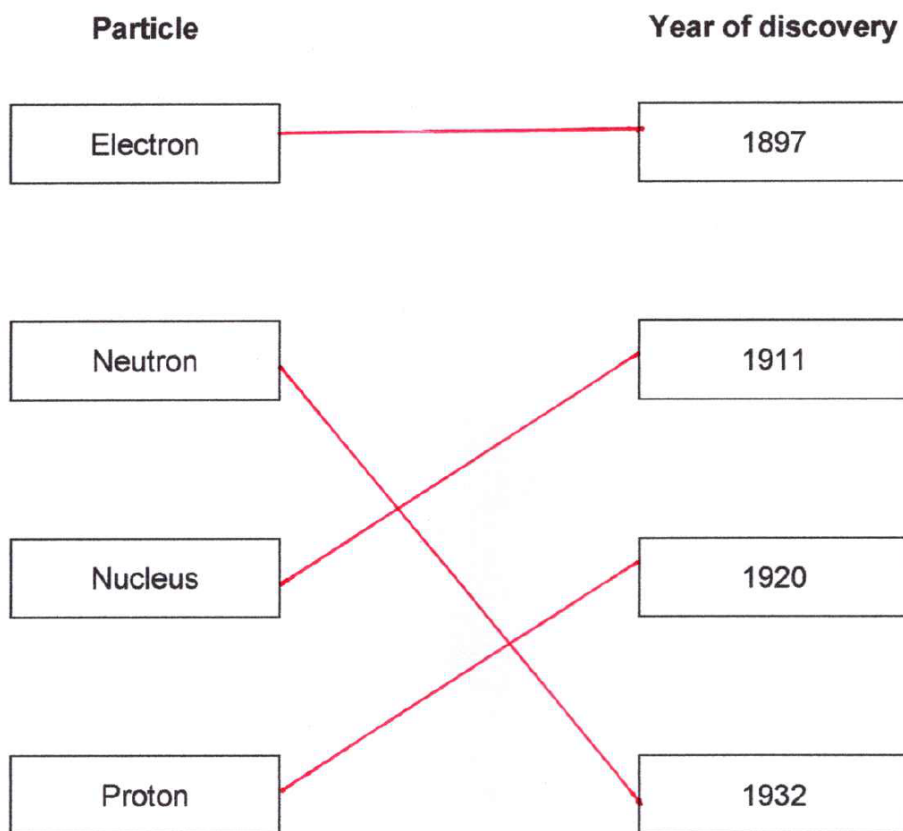
0 8

Scientists developed new models of the atom as new particles were discovered.

0 8 . 1

Draw **one** line from each particle to the year it was discovered.

[2 marks]

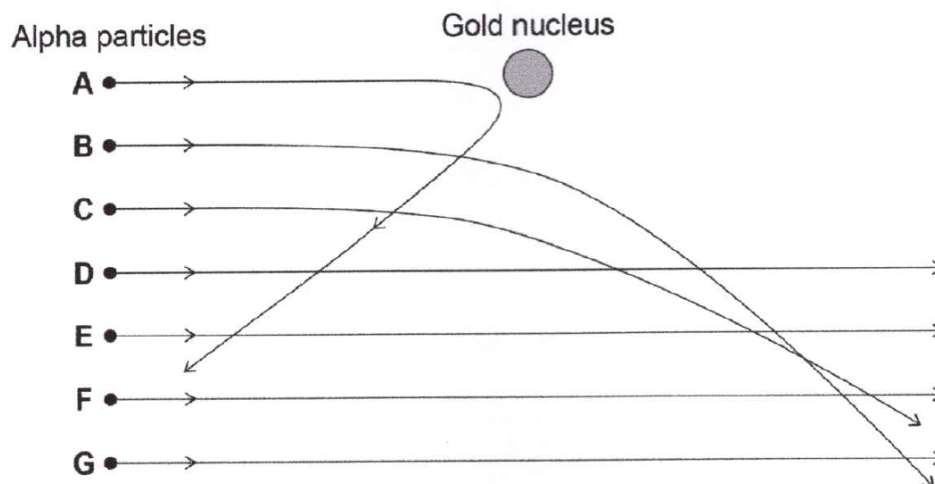


The nucleus was discovered using an alpha particle scattering experiment.

Alpha particles were directed at a sheet of gold foil.

Figure 8 shows the paths taken by seven alpha particles, **A**, **B**, **C**, **D**, **E**, **F** and **G**.

Figure 8



0 8 . 2 Explain why alpha particle **A** takes the path shown in **Figure 8**.

[2 marks]

The alpha particles and the nucleus both are positively charged. So they repel.

0 8 . 3 Explain why the path of alpha particle **B** is more tightly curved than the path of alpha particle **C**.

[2 marks]

- B is closer to the nucleus, so experiences a greater force of repulsion than C.

0 8 . 4

What can be deduced about the atom from the paths taken by alpha particles **D, E, F** and **G** in **Figure 8**?

[1 mark]

Tick (✓) **one** box.

The atom contains a nucleus.

☐

The atom contains protons, neutrons and electrons.

☐

The atom is mostly empty space.

☒

0 8 . 5

How is the Bohr model of the atom different from the nuclear model of the atom?

[1 mark]

-In the Bohr's model, the electrons orbit the nucleus at a specific distance unlike the nuclear model where the electrons orbit at a continuous range of distances

0 8 . 6

Explain how an electron can move up and down between energy levels in an atom.

[2 marks]

-Electrons can move higher if it absorbs energy from electromagnetic radiation
-They could move down if they emit energy in form of electromagnetic radiation