Name:

Date:

P4 - Test 1
ATOMIC STRUCTURE
Beginner

GCSE

PHYSICS

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

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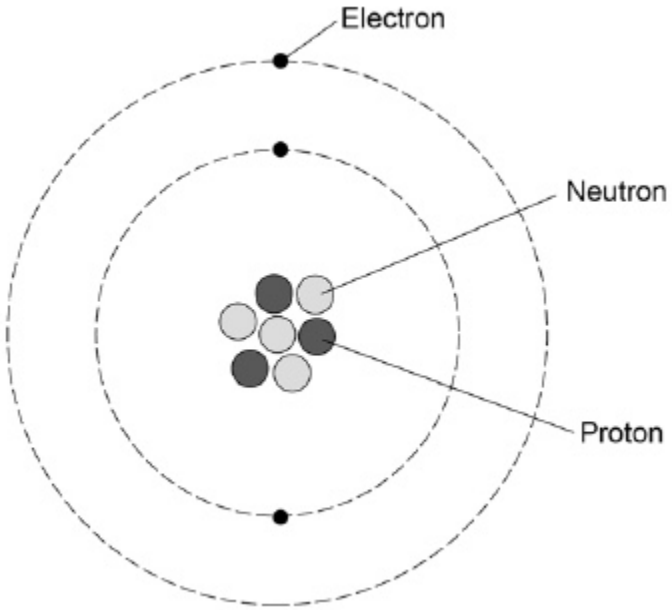
1. The diagram shows a lithium atom.



(a) What is the mass number of this lithium atom?

Tick **one** box.

3 ☐ 4 ☐ 7 ☐ 10 ☐

(1)

(b) What is the atomic number of a lithium atom?

Tick **one** box.

3 ☐ 4 ☐ 7 ☐ 10 ☐

Give a reason for your answer.

_____

_____

(2)

(c) Complete the sentence.

Choose the answer from the box.

circles	levels	rings

The electrons in an atom orbit in different energy _____ .

(1)

(d) Some atomic nuclei are unstable and decay by emitting an alpha particle or a beta particle.

Complete the symbols for an alpha particle and a beta particle.

Use answers from the box.

–1	0	1	2	4

Alpha $\square^{\square}He$

Beta $\square^{0}e$

(3)

(e) Doctors may use nuclear radiation to diagnose certain types of illness.

The table below gives data about three radiation sources used.

Each source emits beta radiation.

Radiation source	Half-life in minutes
Carbon-11	20
Nitrogen-13	10
Oxygen-15	2

Explain why oxygen-15 is likely to pose the least risk to a patient.

_____

_____

_____

_____

(2)

(Total 9 marks)

2. Sources of background radiation are either natural or man-made.

(a) Which **two** of the sources listed in the table are natural sources of background radiation?

Tick **two** boxes.

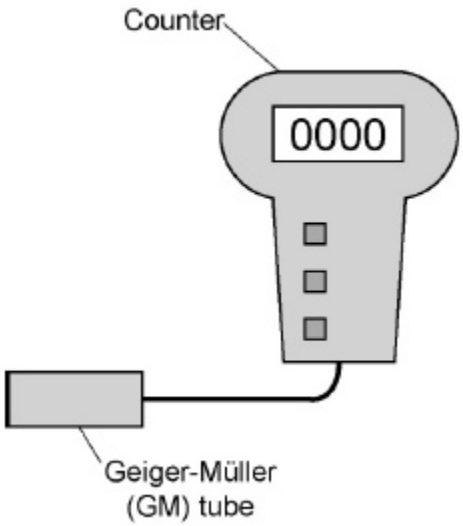
Cosmic rays	☐
Medical X-rays	☐
Nuclear power stations	☐
Nuclear weapons testing	☐
Radon gas	☐

(2)

A teacher used a Geiger-Müller (GM) tube and counter to measure the background radiation in his laboratory.

Figure 1 shows the GM tube and counter.

Figure 1



(b) The table gives three readings taken by the teacher at three different times on the same day.

Counts in 1 minute
16
21
18

What is the most likely reason for the readings being different?

Tick **one** box.

Radioactive decay is a random process. ☐

The air pressure in the laboratory increased. ☐

The background radiation increased during the day. ☐

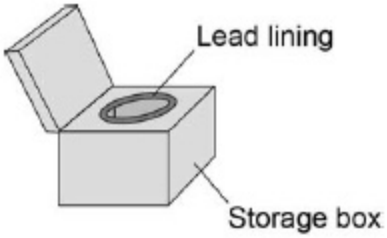
The temperature in the laboratory decreased. ☐

(1)

(c) The teacher takes a radioactive source from a storage box.

Figure 2 shows the box.

Figure 2



Why does storing the radioactive source in the box reduce the risk of radiation exposure to the teacher?

Tick **one** box.

The lead lining absorbs the emitted radiation. ☐

The lead lining reflects the emitted radiation. ☐

The lead lining transmits the emitted radiation. ☐

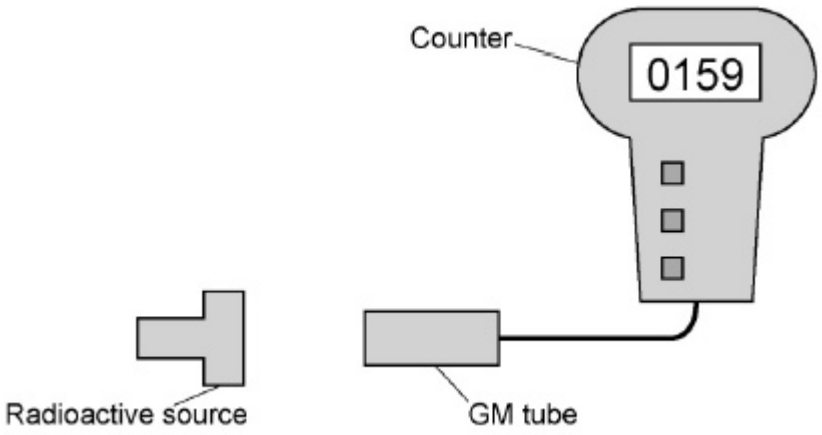
(1)

(d) **Figure 3** shows how the teacher used the GM tube and counter to measure the radiation emitted from the radioactive source.

The counter was reset to zero.

The count after one minute was 159.

Figure 3



How should the teacher calculate the counts from the radioactive source?

Tick **one** box.

Add the background count to 159 ☐

Divide the background count by 159 ☐

Multiply the background count by 159 ☐

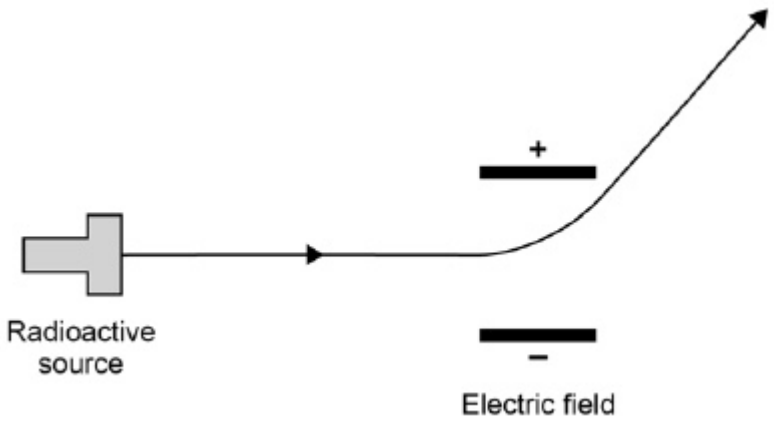
Subtract the background count from 159 ☐

(1)

(e) The teacher passed the radiation through an electric field.

Figure 4 shows the path that the radiation took through the electric field.

Figure 4



What type of radiation was being emitted by the radioactive source?

Tick **one** box.

Alpha ☐ Beta ☐ Gamma ☐ Neutron ☐

Explain the reason for your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

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

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

electrons	**neutrons**	**protons**

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

(1)

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

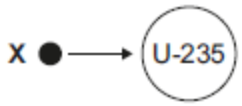
What is the energy released from nuclear fuels inside a nuclear reactor used for?

_____

(1)

(c) **Figure 1** shows the nucleus of an atom of uranium-235 (U-235) about to undergo nuclear fission.

Figure 1



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

What is particle **X**?

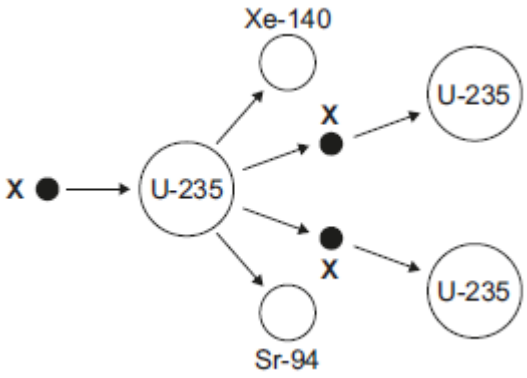
Tick (✓) **one** box.

an electron ☐ a neutron ☐ a proton ☐

(1)

(ii) The process of nuclear fission, shown in **Figure 2**, causes the nucleus of the uranium-235 (U-235) atom to split apart and release two of the particles X.

Figure 2

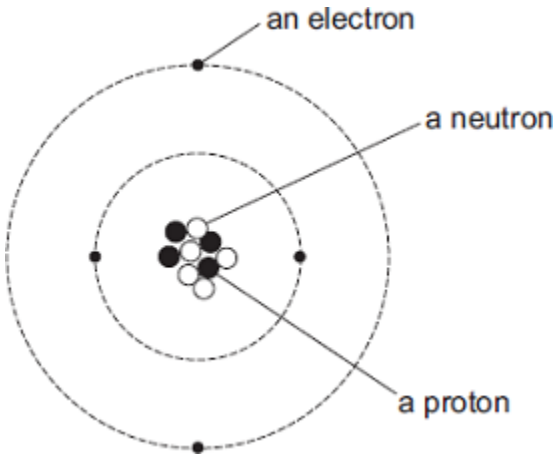


Complete **Figure 2** to show how the particles **X start** a chain reaction.

(2)

(Total 5 marks)

4. The diagram represents an atom of beryllium. The three types of particle that make up the atom have been labelled.



(a) Use the labels from the diagram to complete the following statements.

Each label should be used once.

The particle with a positive charge is _____ .

The particle with the smallest mass is _____ .

The particle with no charge is _____ .

(2)

(b) What is the mass number of a beryllium atom?

Draw a ring around your answer.

4	**5**	**9**	**13**

Give a reason for your answer.

_____

_____

(2)

(Total 4 marks)

5. Atoms contain three types of particle.

(a) Draw a ring around the correct answer to complete the sentence.

The particles in the nucleus of the atom are

electrons and neutrons.

electrons and protons.

neutrons and protons.

(1)

(b) Complete the table to show the relative charges of the atomic particles.

Particle	Relative charge
Electron	–1
Neutron	
Proton	

(2)

(c) (i) A neutral atom has no overall charge.

Explain this in terms of its particles.

_____

_____

_____

_____

(2)

(ii) Complete the sentence.

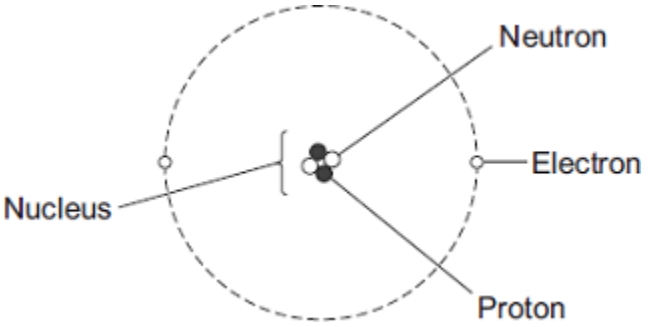
An atom that loses an electron is called an _____

and has an overall _____ charge.

(2)

(Total 7 marks)

6. The diagram shows the structure of an atom.



Not drawn to scale

(a) In 1931 scientists thought that atoms contained **only** protons and electrons.

Suggest what happened in 1932 to change the idea that atoms contained only protons and electrons.

_____

_____

(1)

(b) The table gives information about the particles in an atom.

Complete the table by adding the names of the particles.

Particle	Relative Mass	Relative Charge
	1	0
	very small	–1
	1	+1

(2)

(Total 3 marks)

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

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

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

Tick (✓) **one** box.

Inside the Earth ☐

Inside a nuclear power station ☐

Inside the Sun ☐

(1)

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

fission	**force**	**fusion**

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

nuclear _____ .

(1)

(c) What is released during this process?

Draw a ring around the correct answer.

charge **energy** **force**

(1)

(Total 3 marks)

8. Alpha, beta and gamma are types of nuclear radiation.

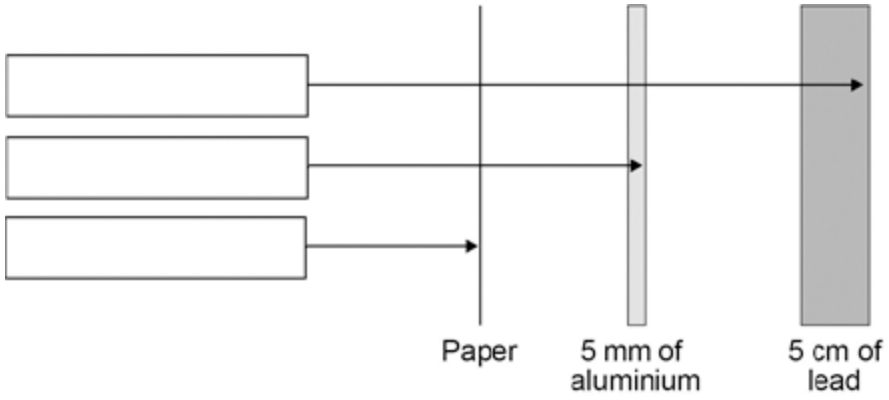
(a) Draw **one** line from each type of radiation to what the radiation consists of.

Type of radiation	What radiation consists of
	Electron from the nucleus
Alpha	
	Two protons and two neutrons
Beta	
	Electromagnetic radiation
Gamma	
	Neutron from the nucleus

(3)

(b) A teacher demonstrates the penetration of alpha, beta and gamma radiation through different materials.

The demonstration is shown in the figure below.



Complete the figure above by writing the name of the correct radiation in each box.

(2)

(c) Give **two** safety precautions the teacher should have taken in the demonstration.

1. _____

_____

2. _____

_____

(2)

(d) The table below shows how the count rate from a radioactive source changes with time.

Time in seconds	0	40	80	120	160
Count rate in counts/second	400	283	200	141	100

Use the table to calculate the count rate after 200 seconds.

_____

_____

(2)

(e) The half-life of the radioactive source used was very short.

Give **one** reason why this radioactive source would be much less hazardous after 800 seconds.

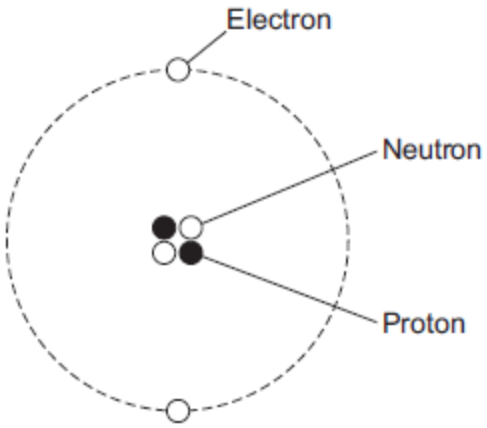
_____

_____

(1)

(Total 10 marks)

9. (a) The figure below shows a helium atom.



(i) Which **one** of the particles in the atom is **not** charged?

Draw a ring around the correct answer.

electron **neutron** **proton**

(1)

(ii) Which **two** types of particle in the atom have the same mass?

_____ and _____

(1)

(iii) What is the atomic number of a helium atom?

Draw a ring around the correct answer.

2 **4** **6**

Give a reason for your answer.

_____

_____

(2)

(b) Alpha particles are one type of nuclear radiation.

(i) Name **one** other type of nuclear radiation.

_____

(1)

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

electrons	**neutrons**	**protons**

The difference between an alpha particle and a helium atom is that the alpha particle does **not** have any _____ .

(1)

(iii) Which **one** of the following is a property of alpha particles?

Tick (✓) **one** box.

Have a long range in air ☐

Are highly ionising ☐

Will pass through metals ☐

(1)

(c) Doctors may use nuclear radiation to treat certain types of illness.

Treating an illness with radiation may also harm a patient.

(i) Complete the following sentence.

The risk from treating a patient with radiation is that the radiation may

_____ healthy body cells.

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Radiation may be used to treat a patient if the risk from the

radiation is | much bigger than / about the same as / much smaller than | the possible benefit of having

the treatment.

(1)

(Total 9 marks)