

**Nuclear physics – 2023 June O Level 5054**

**1. June/2023/Paper\_5054/11/No.34**

The results of a scattering experiment show that a very small nucleus contains most of the matter in an atom.

What is scattered in this experiment?

- A alpha-particles
- B beta-particles
- C gamma radiation
- D gold nuclei

**2. June/2023/Paper\_5054/11/No.35**

Atoms P and Q are isotopes of the same element.

How does the composition of an atom of P compare with the composition of an atom of Q?

	number of protons	number of neutrons
<b>A</b>	different	different
<b>B</b>	different	same
<b>C</b>	same	different
<b>D</b>	same	same

**3. June/2023/Paper\_5054/11/No.36**

The nucleus of an atom emits an alpha-particle.

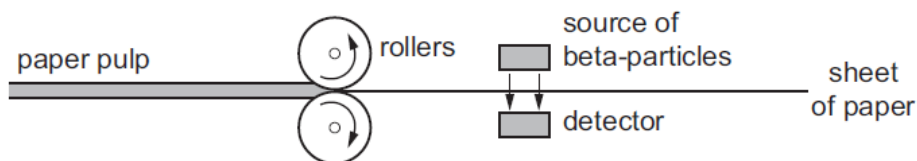
How do the proton number and nucleon number change?

	proton number	nucleon number
<b>A</b>	decreases by 2	decreases by 4
<b>B</b>	decreases by 4	decreases by 2
<b>C</b>	increases by 2	increases by 4
<b>D</b>	increases by 4	increases by 2

4. **June/2023/Paper\_5054/11/No.37**

The diagram shows how the thickness of paper is measured during manufacture.

If the sheet is too thick, fewer beta-particles can reach the detector.



Why are beta-particles used for this purpose?

- A Alpha-particles are all stopped by the paper.
- B Alpha-particles make the paper radioactive.
- C Gamma radiation is all stopped by the paper.
- D Gamma radiation is only produced by sources with a short half-life.

5. **June/2023/Paper\_5054/11/No.38**

A sample of tritium has a mass of 32 mg.

Tritium has a half-life of 12 years.

How much of the sample of tritium decays in 36 years?

- A 4.0 mg      B 8.0 mg      C 24 mg      D 28 mg

6. **June/2023/Paper\_5054/12/No.22**

Which radioactive isotope can be used for measuring cracks or flaws in metal components?

- A americium-241, an alpha emitter with a half-life of 432 years
- B cobalt-60, a gamma emitter with a half-life of 5 years
- C radium-223, an alpha emitter with a half-life of 11 days
- D barium-137, a gamma emitter with a half-life of 3 minutes

7. **June/2023/Paper\_5054/12/No.33**

The results of the alpha-particle scattering experiment give evidence for which of the following?

- A nuclear fusion
- B radioactive decay
- C the existence of isotopes
- D the size of the nucleus

8. June/2023/Paper\_5054/12/No.34

A nucleus of an isotope of cobalt is represented by the symbol  ${}^{59}_{27}\text{Co}$ .

What is the composition of this nucleus?

	number of protons	number of neutrons
<b>A</b>	27	32
<b>B</b>	27	59
<b>C</b>	59	27
<b>D</b>	59	32

9. June/2023/Paper\_5054/12/No.35

The only stable isotope of gold, Au, has 79 protons and 118 neutrons in a nucleus of an atom.

How many electrons are there in a neutral atom of this isotope?

- A** 39                      **B** 79                      **C** 118                      **D** 197

10. June/2023/Paper\_5054/12/No.36

A sample of a radioactive isotope with a very long half-life is placed next to a detector. Sheets of different materials are inserted, one at a time, between the radioactive sample and the detector.

The background count rate is subtracted from the readings on the detector and the corrected count rates are recorded in the table.

type of material	<u>corrected count rate</u> counts/s
no sheet inserted	450
thin aluminium sheet	381
thin lead sheet	285
thin paper sheet	452

Which types of radiation are emitted by the radioactive sample?

- A** alpha-particles and beta-particles only  
**B** alpha-particles only  
**C** beta-particles and gamma radiation only  
**D** gamma radiation only

**11. June/2023/Paper\_5054/12/No.37**

In a fission reactor, which particle causes a uranium-235 nucleus to split?

- A alpha-particle
- B gamma ray
- C neutron
- D proton

**12. June/2023/Paper\_5054/12/No.38**

What is the purpose of moderators in nuclear reactors?

- A to absorb all the neutrons in order to stop the chain reaction
- B to produce more neutrons in order to create a chain reaction
- C to remove thermal energy in order to control the chain reaction
- D to slow down neutrons in order to continue the chain reaction

13. June/2023/Paper\_5054/21/No.10

Carbon-14 is an isotope of carbon. It undergoes radioactive decay with a half-life of 6000 years. The age of a sample of wood is found using the carbon-14 that it contains.

(a) Describe what happens during radioactive decay.

.....  
.....  
..... [2]

(b) The count rate of the carbon-14 in the sample of wood is initially 1600 counts / minute.

On Fig. 10.1 draw a graph to show how the count rate will vary over the next 24 000 years.

The initial count rate is already marked with an x.

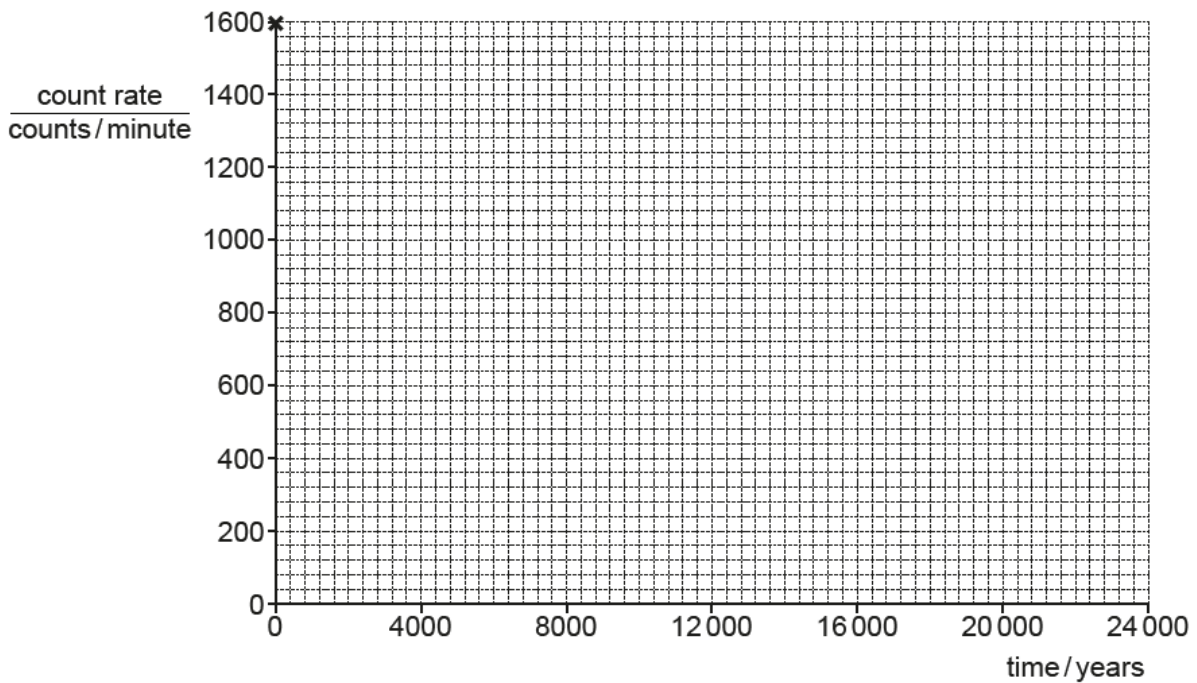


Fig. 10.1

[2]

- (c) Name the apparatus used to measure the radiation from the sample of wood and describe how it is used to measure the count rate.

apparatus used .....

how the apparatus is used .....

.....

..... [2]

- (d) Describe how the count rate from a sample of wood is used to find its age.

.....

.....

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.....

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..... [2]

[Total: 8]

14. June/2023/Paper\_5054/22/No.9

A radioactive source emits  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -radiation.

(a) (i) State which type of radiation produces the strongest ionising effect.

..... [1]

(ii) State which type of radiation is deflected most by a magnetic field.

..... [1]

(b) Fig. 9.1 shows a Geiger-Müller (G.M.) tube and counter. A radioactive source is placed 10 cm from the G.M. tube.

In Fig. 9.2 a piece of metal 5 mm thick is placed between the source and the G.M. tube. The readings on the counter have been corrected for background radiation and show the count rate due to the source.

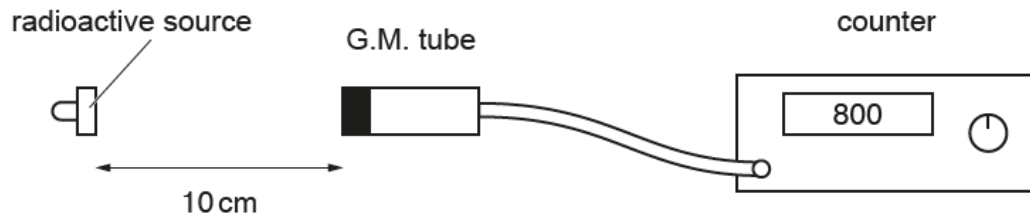


Fig. 9.1

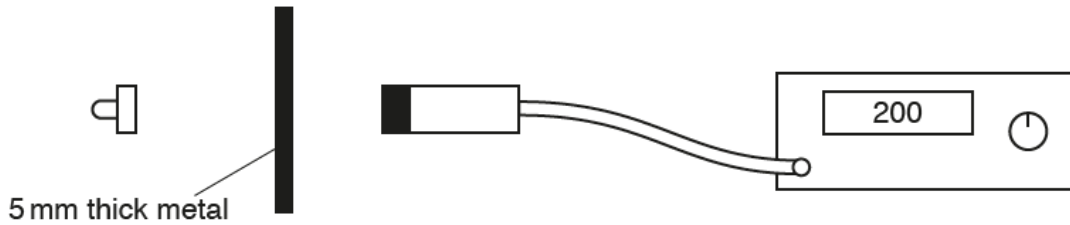


Fig. 9.2

(i) Explain how the readings show that the source emits  $\beta$ -particles and  $\gamma$ -radiation.

.....  
.....  
.....  
..... [3]

(ii) State why the readings **cannot** be used to show that the source emits  $\alpha$ -particles.

.....  
..... [1]

(c) Describe **one** way that a radioactive source is moved safely in a school laboratory.

.....  
..... [1]

[Total: 7]