Radioactivity – 2022 June IGCSE 0625

1. June/2022/Paper_11/No.38

A model of an atom consists of small particles orbiting a central nucleus.

Where is the positive charge in an atom?

A on the orbiting particles

B in the nucleus

C in the space between the nucleus and the orbiting particles

D spread throughout the atom

2. June/2022/Paper_11/No.39

A radioactive source has a half-life of 0.5 hours.

A detector near the source shows a reading of 6000 counts per second.

Background radiation can be ignored.

What is the reading on the detector 1.5 hours later?

A 750 counts per second

B 1500 counts per second

C 2000 counts per second

D 3000 counts per second

3. June/2022/Paper_11/No.40

Which statement about the radioactive decay of a substance is correct?

A It cannot be predicted when a particular nucleus will decay.

B Placing a radioactive substance inside a lead-lined box prevents it from decaying.

C The decay always produces poisonous gases.

D The rate of decay increases if the substance is dissolved in water.

4. June/2022/Paper_12/No.38

Which statement describes two atoms of different isotopes of an element?

A two atoms with the same nucleon number but different proton number

B two atoms with a different nucleon number but the same proton number

C two atoms with the same nucleon number and the same proton number

D two atoms with a different nucleon number and different proton number

5. June/2022/Paper_12/No.39

A radioactive source has a half-life of 0.5 hours.

A detector near the source shows a reading of 6000 counts per second.

Background radiation can be ignored.

What is the reading on the detector 1.5 hours later?

A 750 counts per second

B 1500 counts per second

C 2000 counts per second

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6. June/2022/Paper_12/No.40

Some nuclei are unstable. They emit radiation and change into nuclei of a different element.

What is this process called?

A convection

B electromagnetic induction

C radioactive decay

D the motor effect

7. June/2022/Paper_13/No.38

The atoms of an element can exist as different isotopes.

What is the difference between atoms of different isotopes of the same element?

A They have different numbers of electrons.

B They have different numbers of protons and different numbers of neutrons.

C They have different numbers of protons only.

D They have different numbers of neutrons only.

8. June/2022/Paper_13/No.39

A radioactive source has a half-life of 0.5 hours.

A detector near the source shows a reading of 6000 counts per second.

Background radiation can be ignored.

What is the reading on the detector 1.5 hours later?

A 750 counts per second

B 1500 counts per second

C 2000 counts per second

D 3000 counts per second

9. June/2022/Paper_13/No.40

Which statement explains why radioactive materials need to be handled carefully?

A γ-rays are part of the electromagnetic spectrum.

B Radioactive decay is a random process.

C Radioactive materials have a half-life.

D The radiation given out is ionising.

10. June/2022/Paper_21/No.38

How do the sizes of the two nuclei produced in a nuclear fission reaction compare to the size of the original nucleus?

A both larger than the original nucleus

B one larger and one smaller than the original nucleus

C both smaller than the original nucleus

D one smaller and one the same size as the original nucleus

11. June/2022/Paper_21/No.39

Which statement about the radioactive decay of a substance is correct?

A It cannot be predicted when a particular nucleus will decay.

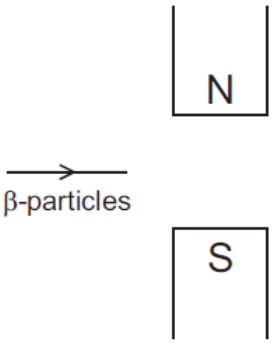
B Placing a radioactive substance inside a lead-lined box prevents it from decaying.

C The decay always produces poisonous gases.

D The rate of decay increases if the substance is dissolved in water.

12. June/2022/Paper_21/No.40

The diagram shows a stream of β-particles travelling in a line that passes between the poles of a magnet.



In which direction will the β-particles be deflected by the magnet?

A towards the N pole

B towards the S pole

C into the page

D out of the page

13. June/2022/Paper_22/No.38

A scientist was asked to separate the following equations into two categories: nuclear fission and nuclear fusion.

1 $^{239}_{94}Pu \rightarrow {}^{112}_{46}Pd + {}^{124}_{48}Cd + 3{}^{1}_{0}n$

2 $^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + {}^{1}_{1}H + {}^{1}_{1}H$

3 $^{14}_{7}N + {}^{1}_{1}H \rightarrow {}^{15}_{8}O$

4 $^{235}_{92}U \rightarrow {}^{90}_{36}Kr + {}^{143}_{56}Ba + 2{}^{1}_{0}n$

Which equations show nuclear fission?

A 1 and 2 **B** 1 and 3 **C** 1 and 4 **D** 2 and 4

14. June/2022/Paper_22/No.39

Which radioactive source is used in a smoke alarm system and what is the reason for this?

	source	reason
A	α	causes least ionisation of air
B	α	causes most ionisation of air
C	γ	causes least ionisation of air
D	γ	causes most ionisation of air

15. June/2022/Paper_22/No.40

A beam of α-particles and β-particles is incident at right angles to an electric field.

Which statement about the deflection of the particles in the field is correct?

A α-particles deflect, but β-particles do not deflect.

B α-particles deflect in the opposite direction to β-particles.

C β-particles deflect, but α-particles do not deflect.

D Both α-particles and β-particles deflect in the same direction.

16. June/2022/Paper_23/No.38

Carbon-14 has a proton number (Z) of 6 and a nucleon number (A) of 14.

Nitrogen-14 has a proton number of 7 and a nucleon number of 14.

Carbon-14 emits β-particles to form nitrogen-14.

Which nuclide equation describes this process?

A $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{1}\beta$

B $^{6}_{14}C \rightarrow {}^{7}_{14}N + {}^{1}_{0}\beta$

C $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta$

D $^{6}_{14}C \rightarrow {}^{7}_{14}N + {}^{-1}_{0}\beta$

17. June/2022/Paper_23/No.39

A beam of radiation, containing α-particles, β-particles and γ-rays, passes between two parallel plates. One plate is positively charged and the other is negatively charged.

Which radioactive emissions will be attracted towards the positively charged plate?

A α-particles only

B β-particles only

C γ-rays only

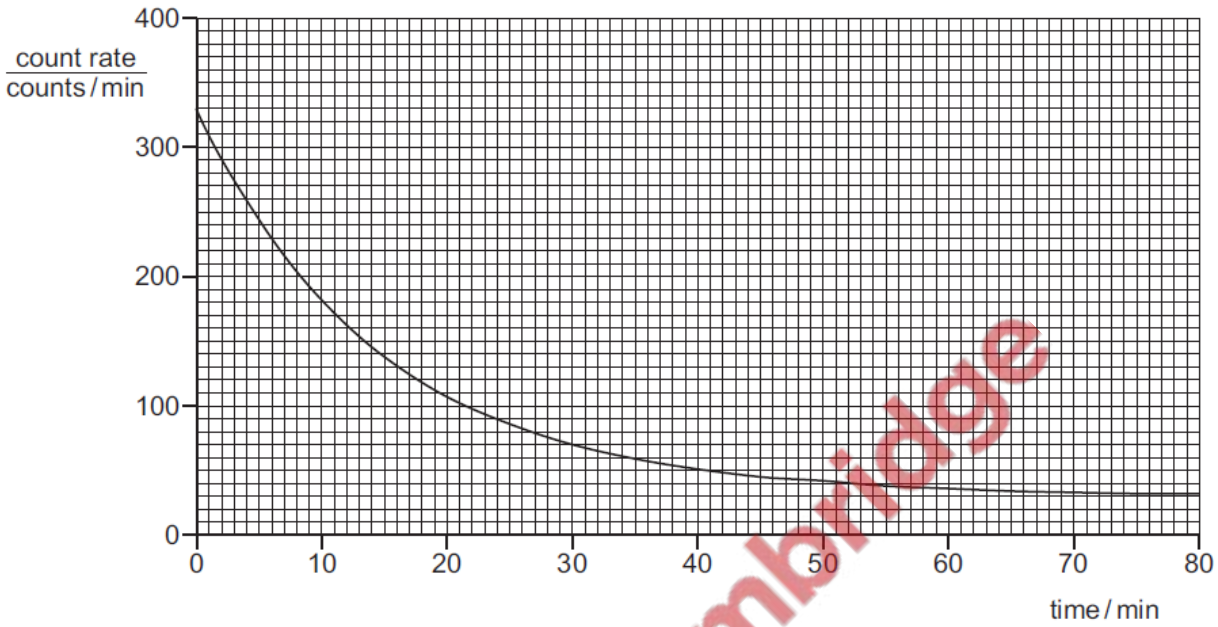
D α-particles, β-particles and γ-rays

18. June/2022/Paper_23/No.40

A scientist uses a counter to measure the radioactivity of a sample of nitrogen-13.

The counter and sample of nitrogen-13 are on a table in a laboratory.

The reading on the counter is recorded for a period of 80 min and a graph is drawn using the measurements.



What is the best estimate for the half-life of the sample of nitrogen-13?

A 10 min **B** 12 min **C** 14 min **D** 40 min

19. June/2022/Paper_31/No.11

A teacher determines the types of emission from a radioactive source. He uses different materials to absorb the emissions. Fig. 11.1 shows the equipment.

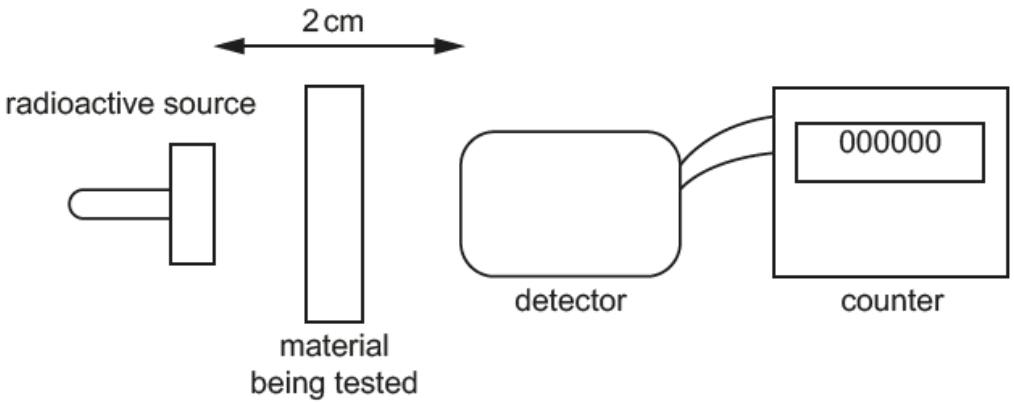


Fig. 11.1 (not to scale)

The teacher places a material between the radioactive source and the detector. The counter shows the count rate for the emission that reaches the detector. The teacher records the count rate. He repeats the experiment for different materials.

Table 11.1 shows the results.

Table 11.1

material being tested	count rate / counts/s
air (no object in gap)	480
thin sheet of paper	481
2 mm sheet of aluminium	479
10 mm block of lead	120

(a) State whether the source emits α (alpha)-particles.
Use information from Table 11.1 to give a reason for your answer.

.....

.....

..... [2]

(b) State whether the source emits γ (gamma)-rays.
Use information from Table 11.1 to give a reason for your answer.

.....

.....

..... [2]

[Total: 4]

20. June/2022/Paper_32/No.11

(a) An isotope of americium has 95 protons and 146 neutrons in its nucleus.

Write the nuclide notation for the nucleus of this isotope. The chemical symbol for americium is Am.

[2]

(b) Fig. 11.1 shows how the count rate of a sample of americium changes with time.

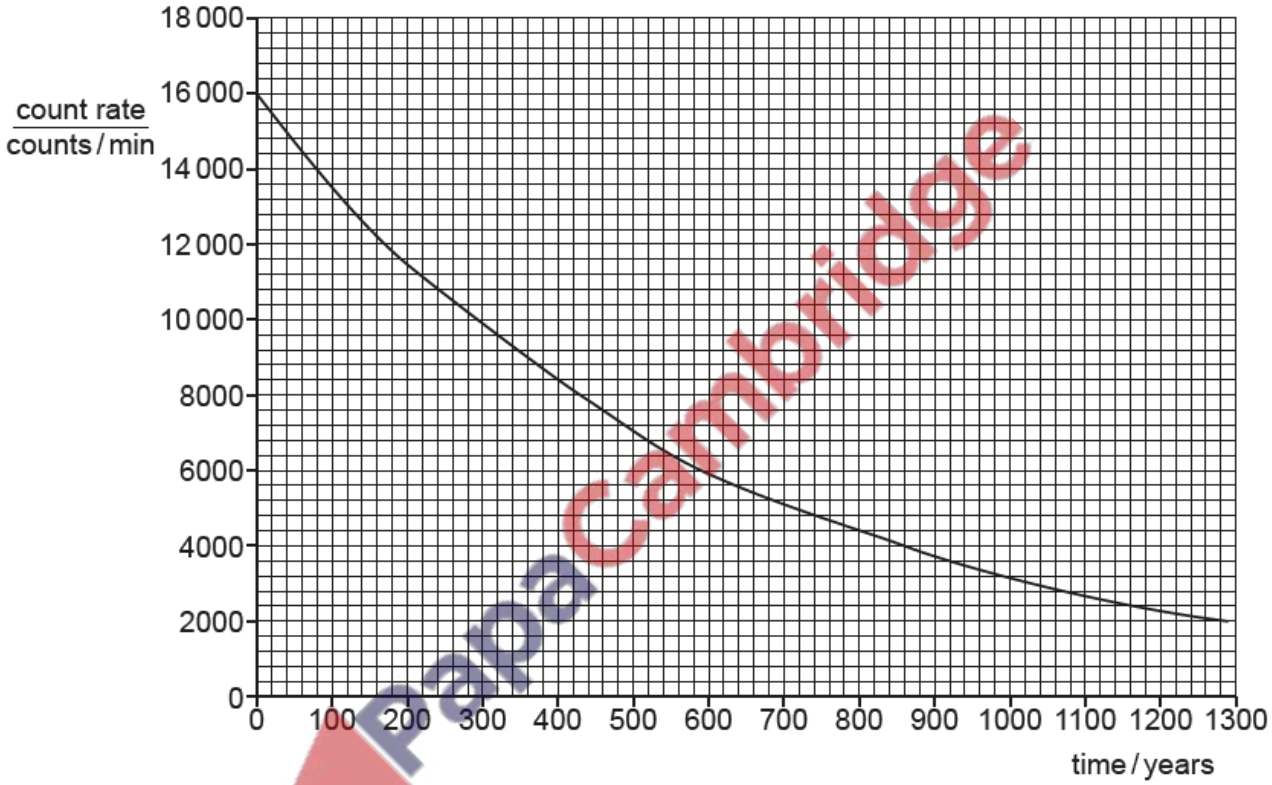


Fig. 11.1

Determine the half-life of the americium in the sample. Use information from Fig. 11.1.

half-life = ... years [2]

[Total: 4]

21. June/2022/Paper_33/No.10

(a) State the names of **three** types of radioactive emission.

1. .....

2. .....

3. .....

[3]

(b) In nuclide notation, $^{35}_{17}Cl$ represents one nuclide of chlorine.

For one neutral atom of $^{35}_{17}Cl$, state:

(i) the nucleon number ..... [1]

(ii) the proton number ..... [1]

(iii) the number of neutrons. ..... [1]

(c) Complete the sentence:

In a neutral atom, the number of protons is equal to the number of ..... . [1]

[Total: 7]

22. June/2022/Paper_41/No.10

Two of the isotopes of hydrogen are hydrogen-2 ($^{2}_{1}H$) and hydrogen-3 ($^{3}_{1}H$).

(a) **(i)** State **one** similarity in the composition of their nuclei.

.....

[1]

(ii) Describe how a nucleus of hydrogen-3 differs from a nucleus of hydrogen-2.

.....

.....

[2]

(b) In a nuclear fusion reactor, a nucleus of hydrogen-2 fuses with a nucleus of hydrogen-3 at an extremely high temperature. This fusion reaction produces an isotope of element X and releases a neutron.

(i) Explain why an extremely high temperature is needed when forcing these two nuclei together.

.....

.....

.....

.....

[3]

(ii) Using nuclide notation, complete the equation for this reaction.

$$^{2}_{1}H + {}^{3}_{1}H \longrightarrow$$

[2]

[Total: 8]

23. June/2022/Paper_42/No.11

(a) Fig. 11.1 shows the paths of three α-particles moving towards a thin gold foil. Four gold nuclei are shown.

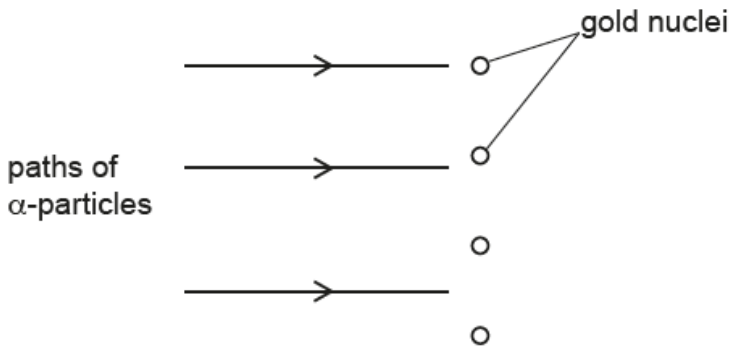


Fig. 11.1 (not to scale)

(i) On Fig. 11.1, complete the paths of the **three** α-particles. [3]

(ii) State the sign of the charge on the α-particles.

..... [1]

(b) The nuclide notation for a nucleus of gold-198 is $^{198}_{79}Au$.

State the numbers of electrons, neutrons and protons in a neutral atom of gold-198.

number of electrons = ...

number of neutrons = ...

number of protons = ...

[3]

[Total: 7]

24. June/2022/Paper_43/No.10

A student places a sample of an isotope of protactinium (Pa-234) near a radiation detector. The readings on the detector, taken every 20 s, are recorded in Table 10.1.

Table 10.1

time / s	count rate / counts / min
0	101
20	88
40	76
60	66
80	58
100	51
120	46
140	42
160	38
180	35

Fig. 10.1 shows a graph of the count rate **due to this sample** against time.

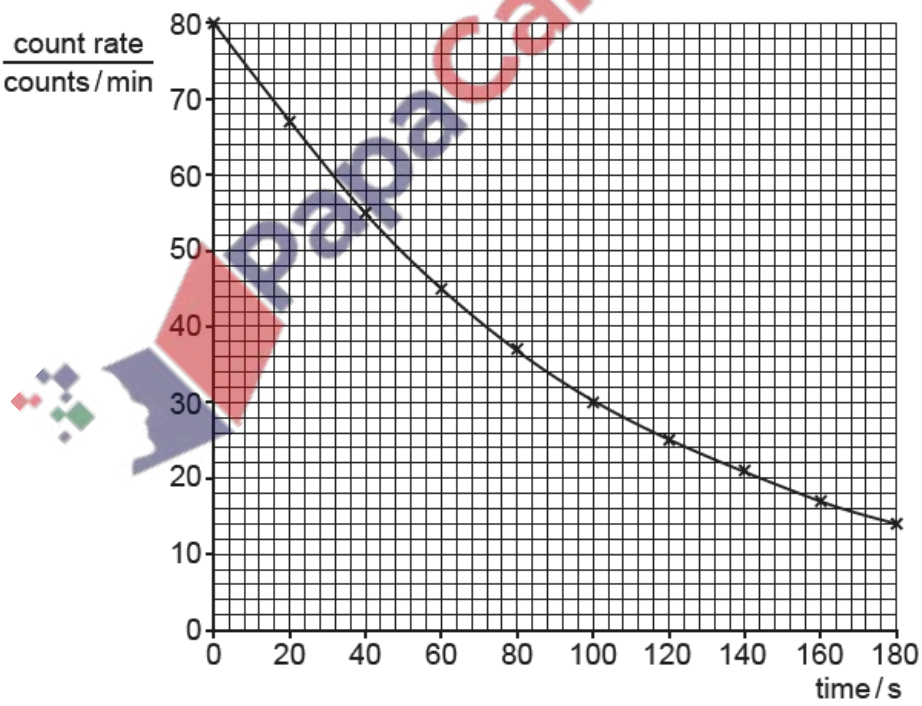


Fig. 10.1

(a) Explain why the readings in Table 10.1 are **not** the same as those plotted on the graph.

.....

..... [2]

(b) Using the graph in Fig. 10.1, determine the half-life of this isotope of protactinium.

half-life = ... s [2]

(c) The nuclide notation for this isotope of protactinium is $^{234}_{91}Pa$.

Protactinium-234 decays to an isotope of uranium (U) by β-emission.

Write down the nuclide equation for this decay of protactinium-234.

[3]

[Total: 7]