Radioactivity – 2020 IGCSE 0625

1. March/2020/Paper_12/No.38

The symbol for a radioactive nuclide of carbon is $^{14}_{6}C$.

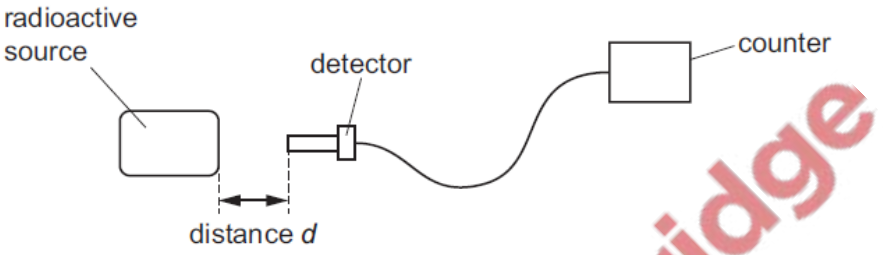
How many neutrons are in its nucleus?

A 6 **B** 8 **C** 14 **D** 20

2. March/2020/Paper_12/No.39

A student measures the rate at which ionising radiation is emitted from a radioactive substance.

He places a detector at different distances from the radioactive source.



The table shows how the reading on the counter varies with distance *d*.

The readings on the counter are corrected for background radiation.

distance *d* / cm	0	2	4	6
counter reading / counts per minute	1250	115	0	0

Which type of ionising radiation is being emitted by the substance?

A α-particles

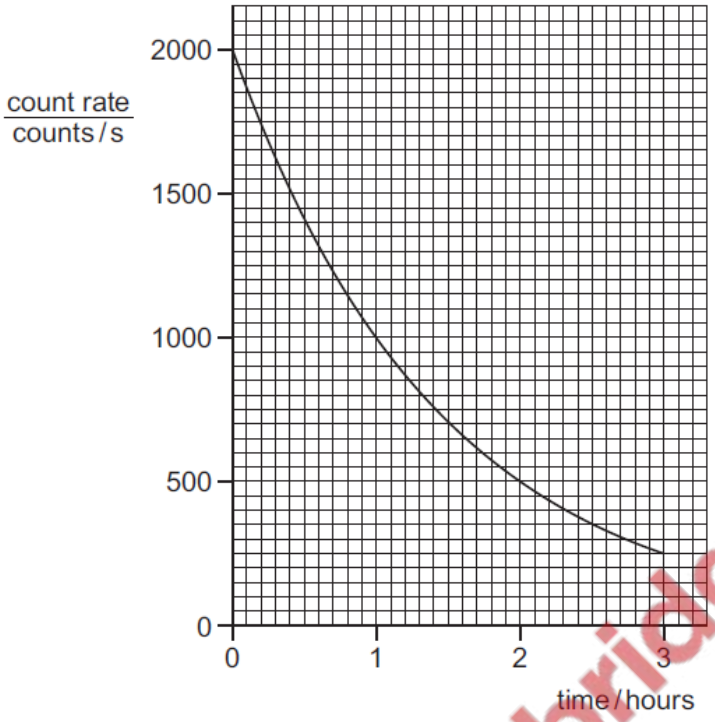
B β-particles

C γ-rays

D X-rays

3. March/2020/Paper_12/No.40

The graph shows the count rate from a radioactive source over a period of time.



What is the half-life of the source?

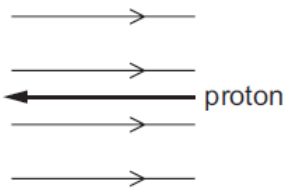
A 0.5 hour **B** 1.0 hour **C** 1.5 hours **D** 3.0 hours

4. March/2020/Paper_22/No.37

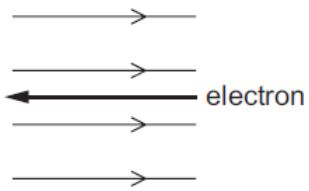
The diagrams show different particles moving through a magnetic field.

Which particle experiences a magnetic force acting up out of the plane of the paper?

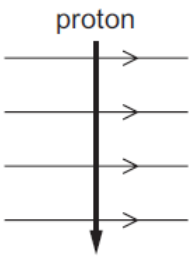
A



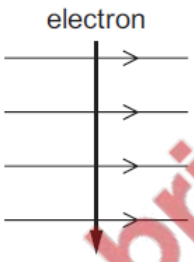
B



C



D



5. March/2020/Paper_22/No.38

When Rutherford bombarded thin gold foil with α-particles, he found that some α-particles were deflected through large angles.

Which statement explains this deflection?

A Most of the atom consists of empty space.

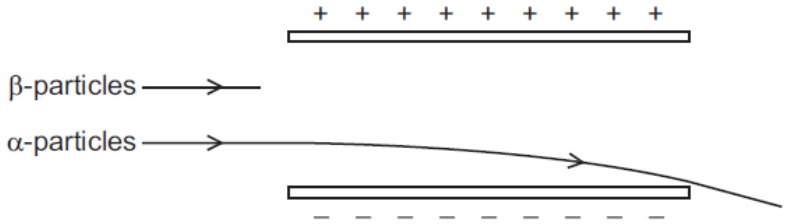
B All of the positive charge and most of the mass of the gold atom are concentrated in a small volume.

C Positive charge in the gold atom is spread evenly throughout the atom.

D All of the negative charge is concentrated at its centre.

6. March/2020/Paper_22/No.39

The diagram shows the path followed by α-particles as they pass between two charged plates. They are deflected downwards.



What happens to β-particles passing through the same electric field?

A They are deflected downwards more than the α-particles.

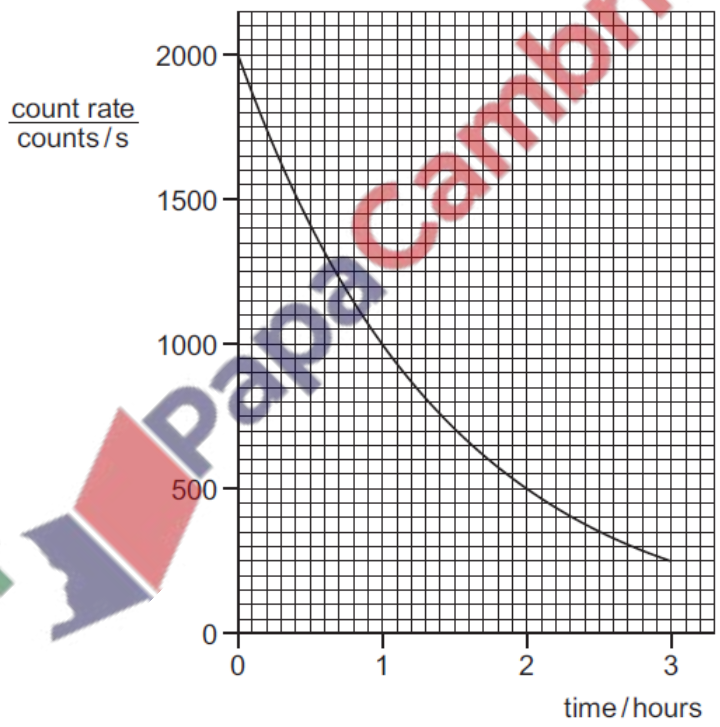
B They are deflected upwards.

C They are not deflected at all.

D They are deflected downwards by the same amount as the α-particles.

7. March/2020/Paper_22/No.40

The graph shows the count rate from a radioactive source over a period of time.



What is the half-life of the source?

A 0.5 hour **B** 1.0 hour **C** 1.5 hours **D** 3.0 hours

8. March/2020/Paper_32/No.12

A nucleus of americium-241 has the nuclide notation shown.

$$^{241}_{95}\text{Am}$$

(a) (i) Determine the number of neutrons in a nucleus of americium-241.

number of neutrons = ... [1]

(ii) Determine the charge on a nucleus of americium-241.

charge = ... [2]

(b) Americium-241 decays by emitting α-particles.

Put a tick in the box next to each correct statement.

α-particles are electromagnetic waves. ☐

α-particles are fast-moving electrons. ☐

α-particles are helium nuclei. ☐

α-particles are stopped by a sheet of paper. ☐

α-particles can pass through 3 cm of aluminium. ☐ [2]

(c) Americium-241 has a half-life of 432 years.
A sample contains 16 mg of americium-241.

Calculate the time it takes until only 4.0 mg of americium-241 are left in the sample.

time = ... years [2]

[Total: 7]

9. March/2020/Paper_42/No.11

(a) The isotope hydrogen-1 has a proton number of 1 and a nucleon number of 1.

Two isotopes of helium are helium-3 and helium-4.

Helium-3 has a proton number of 2 and a nucleon number of 3.

Helium-4 has a nucleon number of 4.

Complete Table 11.1 for neutral atoms of these isotopes of helium.

Table 11.1

	helium-3	helium-4
number of neutrons		
number of electrons		
mass compared to a neutral atom of hydrogen-1		

[3]

(b) An experiment takes place in a laboratory shielded from all background radiation. A sample of radioactive material is wrapped in aluminium foil of thickness 0.1 mm. A detector of ionising radiation placed 1 cm from the foil records a reading.

A piece of aluminium of thickness 5 mm is placed between the detector and the foil. The detector reading drops to zero.

State and explain any type of radiation passing through the aluminium foil.

.....

.....

.....

..... [3]

[Total: 6]

10. June/2020/Paper_11/No.37

A nuclide of the element iron has the symbol shown.

$$^{56}_{26}Fe$$

What does a neutral atom of this nuclide contain?

	protons	neutrons	electrons
A	26	30	26
B	26	56	30
C	30	26	56
D	56	26	30

11. June/2020/Paper_11/No.38

What is the nucleon number of a nuclide?

A the number of neutrons in the nucleus

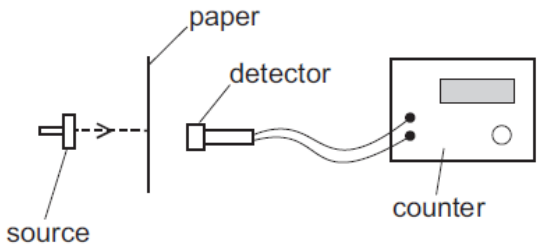
B the number of protons in the nucleus

C the number of protons minus the number of neutrons in the nucleus

D the number of protons plus the number of neutrons in the nucleus

12. June/2020/Paper_11/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

13. June/2020/Paper_11/No.40

In 1986 the Chernobyl nuclear power station in Ukraine suffered a meltdown.

This caused background radiation in many countries, thousands of kilometres from Chernobyl, to increase.

What was transported in the atmosphere to these countries to cause this rise in background radiation?

A α-particles

B β-particles

C γ-rays

D radioactive isotopes

14. June/2020/Paper_12/No.37

A nuclide of the element iron has the symbol shown.

$^{56}_{26}Fe$

What does a neutral atom of this nuclide contain?

	protons	neutrons	electrons
A	26	30	26
B	26	56	30
C	30	26	56
D	56	26	30

15. June/2020/Paper_12/No.38

Which statement about the nuclei of all atoms is correct?

A They all contain electrons.

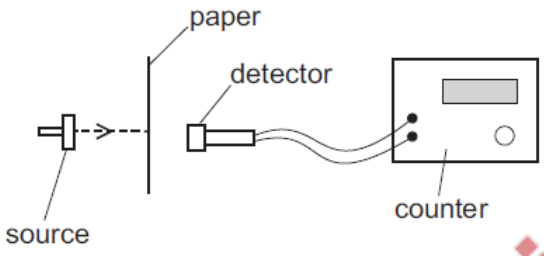
B They are all always stable.

C They all contain protons and electrons.

D They all have a positive charge.

16. June/2020/Paper_12/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

17. June/2020/Paper_12/No.40

A radioactive isotope has a half-life of 120 minutes.

It emits radiation at a rate of 100 particles per second.

How long does it take for the rate of emission to fall to 25 particles per second?

A 30 minutes **B** 45 minutes **C** 90 minutes **D** 240 minutes

18. June/2020/Paper_13/No.37

A nuclide of the element iron has the symbol shown.

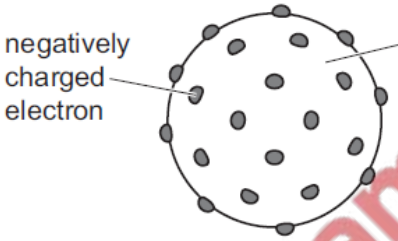
$$^{56}_{26}Fe$$

What does a neutral atom of this nuclide contain?

	protons	neutrons	electrons
A	26	30	26
B	26	56	30
C	30	26	56
D	56	26	30

19. June/2020/Paper_13/No.38

The diagram shows an early model of the structure of an atom.



This early model is different from the atomic model accepted today.

Which statement about the early model is **not** included in the model accepted today?

A The atom is mainly filled with a ball of positive charge.

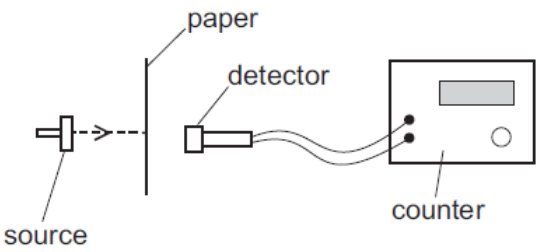
B The electrons are negatively charged.

C There are positive and negative charges.

D There are small particles called electrons.

20. June/2020/Paper_13/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

21. June/2020/Paper_13/No.40

Why should all radioactive materials be handled carefully?

A They all make anything they touch radioactive.

B They all catch fire very easily.

C They all emit ionising radiation.

D They all have long half-lives.

22. June/2020/Paper_21/No.37

Uranium-235 is a radioactive isotope. It undergoes a chain of decays and eventually forms the stable isotope lead-207. These two isotopes are represented as shown.

$^{235}_{92}U$ $^{207}_{82}Pb$

During this chain of decay, how many protons and how many neutrons are lost from a single nucleus of uranium-235 to form a single nucleus of lead-207?

	protons	neutrons
A	10	18
B	10	28
C	18	10
D	28	10

23. June/2020/Paper_21/No.38

A radioactive material has a half-life of 20 days.

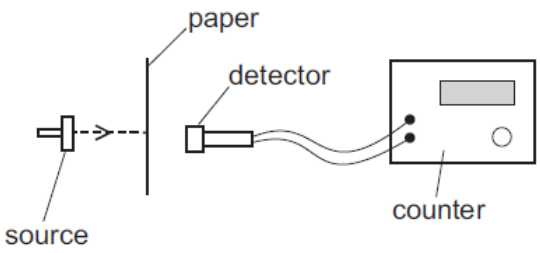
A sample of the material contains 8.0×10^{10} atoms.

How many atomic nuclei have decayed after 60 days?

A 1.0×10^{10} **B** 4.0×10^{10} **C** 6.0×10^{10} **D** 7.0×10^{10}

24. June/2020/Paper_21/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

25. June/2020/Paper_21/No.40

α-particles, β-particles and γ-rays are emitted by radioactive nuclei when they decay.

Which emissions can be deflected by an electric field?

A α-particles and β-particles only

B β-particles and γ-rays only

C γ-rays and α-particles only

D α-particles, β-particles and γ-rays

26. June/2020/Paper_22/No.37

Uranium-235 can undergo nuclear fission in many ways.

Which equation correctly shows a possible fission reaction for uranium-235?

A $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$

B $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{91}_{38}Sr + {}^{144}_{54}Xe + 2{}^{1}_{0}n$

C $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{95}_{37}Rb + {}^{136}_{55}Cs + 3{}^{1}_{0}n$

D $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{87}_{35}Br + {}^{146}_{57}La + 4{}^{1}_{0}n$

27. June/2020/Paper_22/No.38

A radioactive material has a half-life of 20 days.

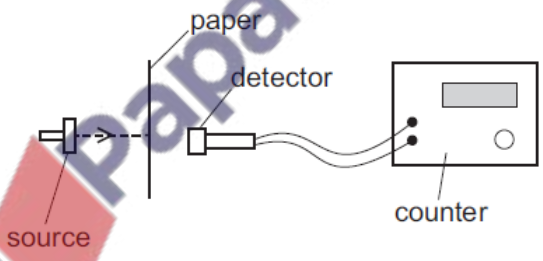
A sample of the material contains 8.0×10^{10} atoms.

How many atomic nuclei have decayed after 60 days?

A 1.0×10^{10} **B** 4.0×10^{10} **C** 6.0×10^{10} **D** 7.0×10^{10}

28. June/2020/Paper_22/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

29. June/2020/Paper_22/No.40

α-particles, β-particles and γ-rays are emitted by radioactive nuclei when they decay.

Which emissions can be deflected by an electric field?

A α-particles and β-particles only

B β-particles and γ-rays only

C γ-rays and α-particles only

D α-particles, β-particles and γ-rays

30. June/2020/Paper_23/No.37

What occurs during nuclear fusion?

A Two light atomic nuclei join together and emit energy.

B Two light atomic nuclei join together and absorb energy.

C A heavy atomic nucleus splits and emits energy.

D A heavy atomic nucleus splits and absorbs energy.

31. June/2020/Paper_23/No.38

A radioactive material has a half-life of 20 days.

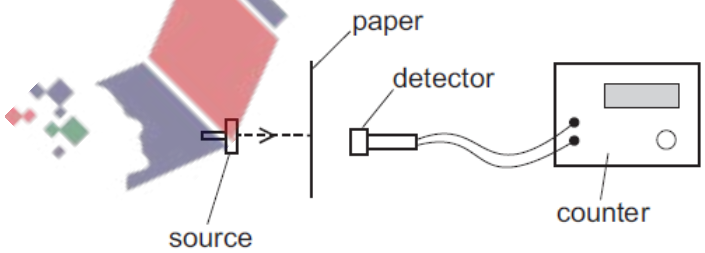
A sample of the material contains 8.0×10^{10} atoms.

How many atomic nuclei have decayed after 60 days?

A 1.0×10^{10} **B** 4.0×10^{10} **C** 6.0×10^{10} **D** 7.0×10^{10}

32. June/2020/Paper_23/No.39

A thin sheet of paper is placed between a radioactive source and a radiation detector. The count rate falls to a very low reading.



From this result, which type of radiation is the source emitting?

A α-particles

B β-particles

C γ-rays

D X-rays

33. June/2020/Paper_23/No.40

α-particles, β-particles and γ-rays are emitted by radioactive nuclei when they decay.

Which emissions can be deflected by an electric field?

A α-particles and β-particles only

B β-particles and γ-rays only

C γ-rays and α-particles only

D α-particles, β-particles and γ-rays

34. June/2020/Paper_31/No.12

Radioactive sources emit α-(alpha), β-(beta) and γ-(gamma) radiations.

(a) State which of these types of radiation can pass through paper.

..... [1]

(b) Barium-137 is a radioactive isotope. The nuclide notation for barium-137 is

$$^{137}_{56}Ba$$

Determine the number of neutrons in a nucleus of barium-137.

number of neutrons = ... [1]

(c) An isotope of barium-137 has a half-life of 3 minutes.

A radioactive source contains 36 mg of this isotope.

Calculate the mass of the isotope that remains in the source after 9 minutes.

mass of the isotope remaining = ... mg [3]

[Total: 5]

35. June/2020/Paper_32/No.12

(a) Carbon-14 is a radioactive isotope of carbon. An atom of carbon-14 has 6 protons in its nucleus.

Another isotope of carbon is carbon-12.

(i) Determine the number of protons in a carbon-12 nucleus.

..... [1]

(ii) Determine the number of neutrons in a carbon-14 nucleus.

..... [1]

(iii) Determine the number of electrons orbiting the nucleus of a single carbon-14 atom.

..... [1]

(b) Carbon-14 decays by emitting a β-particle.

State what happens to a nucleus of carbon-14 when it emits a β-particle.

..... [1]

(c) People working with radioactive sources need to take safety precautions.

(i) A shielding material can absorb ionising radiation and reduce the damage to living tissue.

State a suitable material that will absorb all types of naturally occurring nuclear radiation.

..... [1]

(ii) Apart from using shielding, state how a person can reduce the amount of ionising radiation they absorb when they handle samples of radioactive substances.

..... [1]

[Total: 6]

36. June/2020/Paper_41/No.10

Fig. 10.1 represents a neutral atom of an isotope of element X.

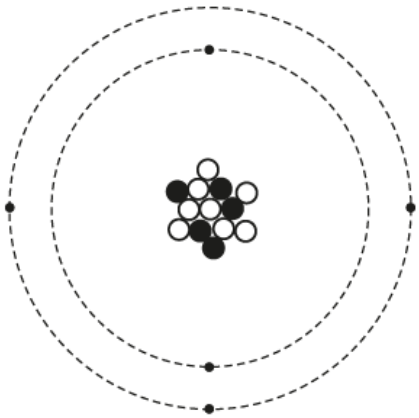


Fig. 10.1

(a) State **one** similarity between this atom and a neutral atom of a different isotope of element X.

.....

..... [1]

(b) The isotope of element X is radioactive. It decays to form an isotope of element Y by emitting a β-particle.

(i) Using Fig. 10.1 deduce the nuclide notation for the isotope of Y produced by this decay.

nuclide notation: $^{\cdots\cdots}_{\cdots\cdots}Y$ [3]

(ii) β-particles ionise the air they pass through less strongly than the same number of α-particles.

Suggest why this is so.

.....

.....

..... [3]

[Total: 7]

37. June/2020/Paper_42/No.10

Fig. 10.1 shows a vacuum tube with a radioactive source. The radioactive source emits α-particles, β-particles and γ-rays. There is a very strong magnetic field between the N pole and the S pole of the magnet.

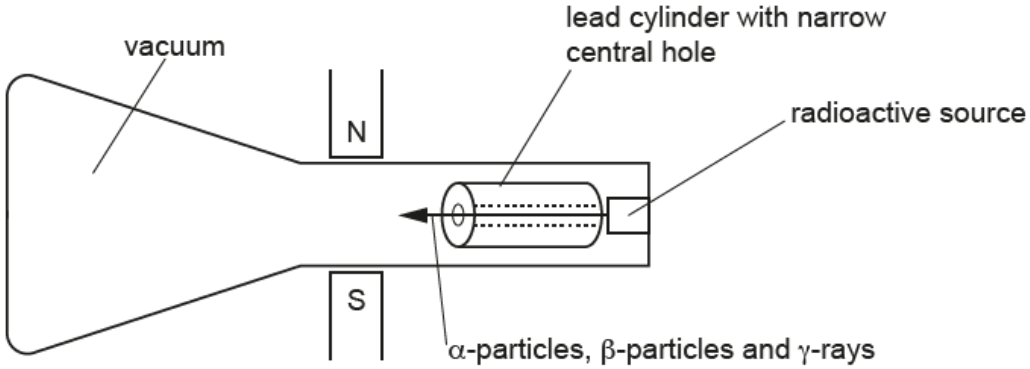


Fig. 10.1

(a) The lead cylinder has a narrow central hole. State and explain the effect of the lead cylinder.

.....

..... [2]

(b) Describe the paths of the α-particles, β-particles and γ-rays as they pass through the magnetic field. Explain your answers.

(i) α-particles

.....

.....

..... [2]

(ii) β-particles

.....

.....

.....

..... [2]

(iii) γ-rays

.....

.....

..... [2]

[Total: 8]

38. June/2020/Paper_43/No.10

(a) A radioactive nucleus of carbon decays to a nucleus of nitrogen by emitting a particle.

Complete the nuclide equation and state the name of the particle.

$$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{\cdots\cdots}_{\cdots\cdots}X$$

name of particle X ..... [3]

(b) A radiation detector in a laboratory records a reading of 10 counts/min. There are no radioactive samples in the laboratory.

(i) Explain why the radiation detector records a reading and suggest a possible source.

explanation .....

source .....

..... [2]

(ii) Carbon-14 has a half-life of 5700 years. There are atoms of carbon-14 in all living organisms.

An archaeologist digs up some ancient wood. In the same laboratory as in **(b)(i)**, a sample of this ancient wood gives a reading of 20 counts/min. An equivalent sample of living wood gives a reading of 80 counts/min. It is suggested that the age of the ancient sample is 11400 years.

Do a calculation to check whether this suggestion is correct.

[4]

[Total: 9]