PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

PHYSICS



EXAM QUESTION PACK

TOPIC 6: RADIOACTIVITY (PAPER 1)

SCORE	PERCENTAGE
/91	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Carbon-14 is a radioactive isotope that occurs naturally.

Scientists use carbon-14 to help find the age of old pieces of wood.

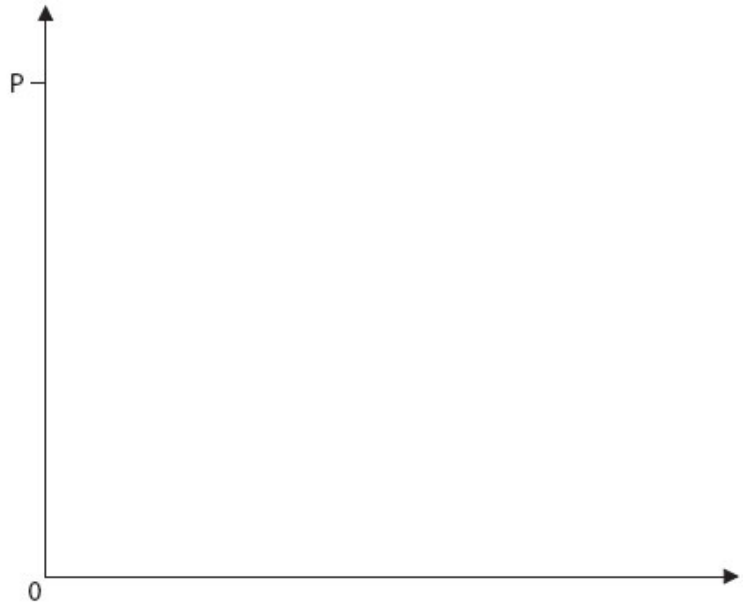
This technique is called carbon dating.

It uses the idea of half-life.

Sketch a graph to show how the activity of a radioactive isotope changes with time.

Use the axes below. Start your line from point P.

(3)



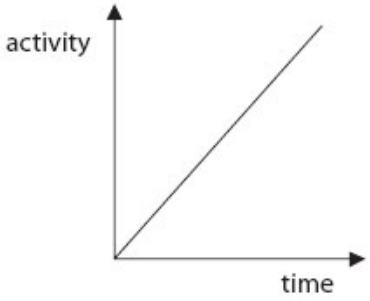
(**Q28 1SC0/1PF, Mar 2013**)

Q2.

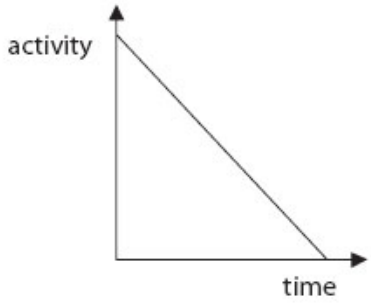
Which graph best shows how the activity of a radioactive isotope changes with time?

Put a cross (☒) in the box next to your answer.

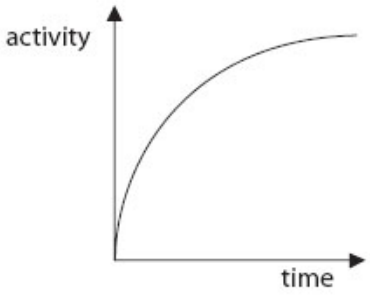
(1)



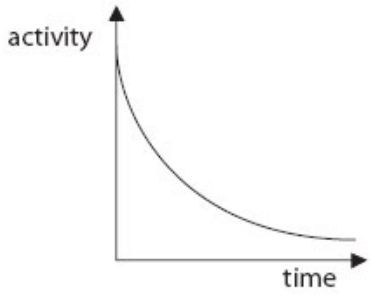
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(**Q14 1SC0/1PF, June 2013**)

Q3.

(a) Which **one** of these statements about alpha radiation is correct?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** Alpha radiation has no charge.

☒ **B** Alpha radiation is very ionising.

☒ **C** Alpha radiation travels very far in air.

☒ **D** Alpha radiation is an electromagnetic wave.

(b) When an atom emits an alpha particle its nucleus changes.

Which describes the changes in the nucleus?

Put a cross (☒) in the box next to your answer.

(1)

	proton number	mass number
☒ A	decreases by 2	decreases by 4
☒ B	increases by 2	decreases by 4
☒ C	decreases by 2	increases by 4
☒ D	increases by 2	increases by 4

(**Q15 1SC0/1PF, June 2015**)

Q4.

Alpha, beta and gamma are types of ionising radiation.

State **two** ways in which gamma radiation is different from alpha radiation.

(2)

.....

.....

.....

.....

(**Q30 1SC0/1PF, Mar 2013**)

Q5.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

Carbon-14 is a radioactive substance that emits beta minus (β^-) particles.

(i) Which of these is the unit for the activity of a sample of carbon-14?

(1)

☒ **A** Pa

☒ **B** Nm

☒ **C** Gs

☒ **D** Bq

(ii) Which row of the table gives a correct comparison of the penetrating abilities of alpha, beta and gamma radiation?

(1)

	least penetrating ⟶ most penetrating
☒ **A**	alpha, beta, gamma
☒ **B**	alpha, gamma, beta
☒ **C**	gamma, beta, alpha
☒ **D**	gamma, alpha, beta

(iii) The mass of a beta minus particle is 9.1×10^{-31} kg.

Calculate the kinetic energy of a beta minus particle moving with a speed of 3.8×10^{6}m/s.

(2)

kinetic energy = ... J

(Total for question = 4 marks)

(**QU06a 1SC0/1PH, June 2025**)

Q6.

A teacher sets up an experiment to show some students how far beta particles travel in air.

Figure 5 shows some of the equipment she uses.



(Source: *www.einstein.yu.edu*)

Figure 5

(i) State the scientific name for the radioactivity detector shown in Figure 5.

(1)

.....

The teacher also has:

- a radioactive source that emits only beta particles
- a metre rule.

(ii) State **two** precautions the teacher must take to protect herself from the effects of radioactivity.

(2)

1 .....

.....

2 .....

.....

(iii) Describe how the teacher could show how far beta particles travel in air.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 7 marks)

(**Q03c 1SC0/1PF, Nov 2020**)

Q7.

An isotope of krypton, krypton-89, is produced in a nuclear reactor.
A nucleus of this isotope can be represented as

$$^{89}_{36}Kr$$

Describe the structure of a nucleus of krypton-89.

(4)

.....

.....

.....

.....

.....

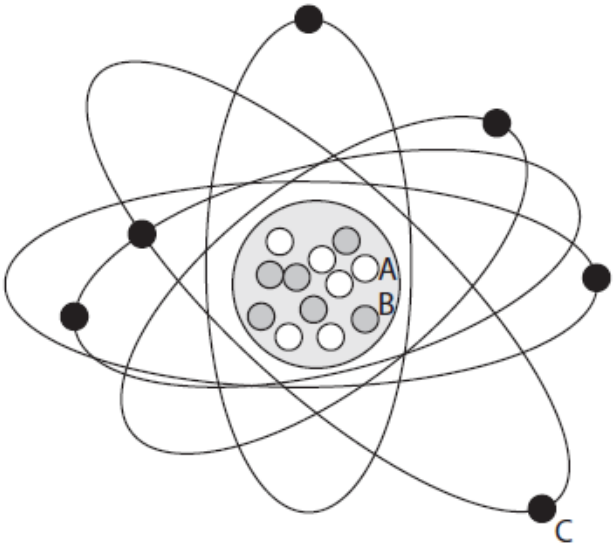
.....

(**Q10 1SC0/1PF, June 2015**)

Q8.

The diagram shows an atom of carbon.

A, B and C are three different particles.



Not to scale

Key

A	○
B	◌
C	●

(i) Name the three different particles shown.

(3)

A = ...

B = ...

C = ...

(ii) What is the mass (nucleon) number of this carbon atom?

(1)

.....

(**Q14 1SC0/1PF, June 2015**)

Q9.

Some rocks contained uranium when they were formed.

Radioactive decay in these rocks produces radon gas.

Explain why people living near these rocks have an increased health risk from background radiation.

(3)

.....

.....

.....

.....

.....

.....

(**Q07 1SC0/1PH, June 2015**)

Q10.

Everyone is exposed to background radiation. Some of this radiation comes from natural sources.

(i) One example of a source of background radiation that does not occur naturally is radiotherapy.

State **one** other source of background radiation that does not occur naturally.

(1)

.....

.....

(ii) Radon gas is a natural source of background radiation.

In some parts of the country, a lot of the background radiation comes from radon gas.

Explain why there is no radon gas in some other parts of the country.

(2)

.....

.....

.....

.....

(**Q10 1SC0/1PF, Mar 2013**)

Q11.

Beryllium-9 is a stable isotope of beryllium.

(i) State the meaning of the term **stable.**

(1)

.....

.....

(ii) Beryllium-9 has an atomic number of 4 and a mass number of 9.
A nucleus of this isotope can be described using this symbol.

$$^{9}_{4}\mathrm{Be}$$

Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of neutrons in this nucleus is

(1)

☒ **A** 4

☒ **B** 5

☒ **C** 9

☒ **D** 13

(iii) Which one of these symbols describes the nucleus of a different isotope of beryllium?

Put a cross (☒) in the box next to your answer.

(1)

$^{8}_{4}\mathrm{Be}$ ☐ **A**

$^{8}_{5}\mathrm{Be}$ ☐ **B**

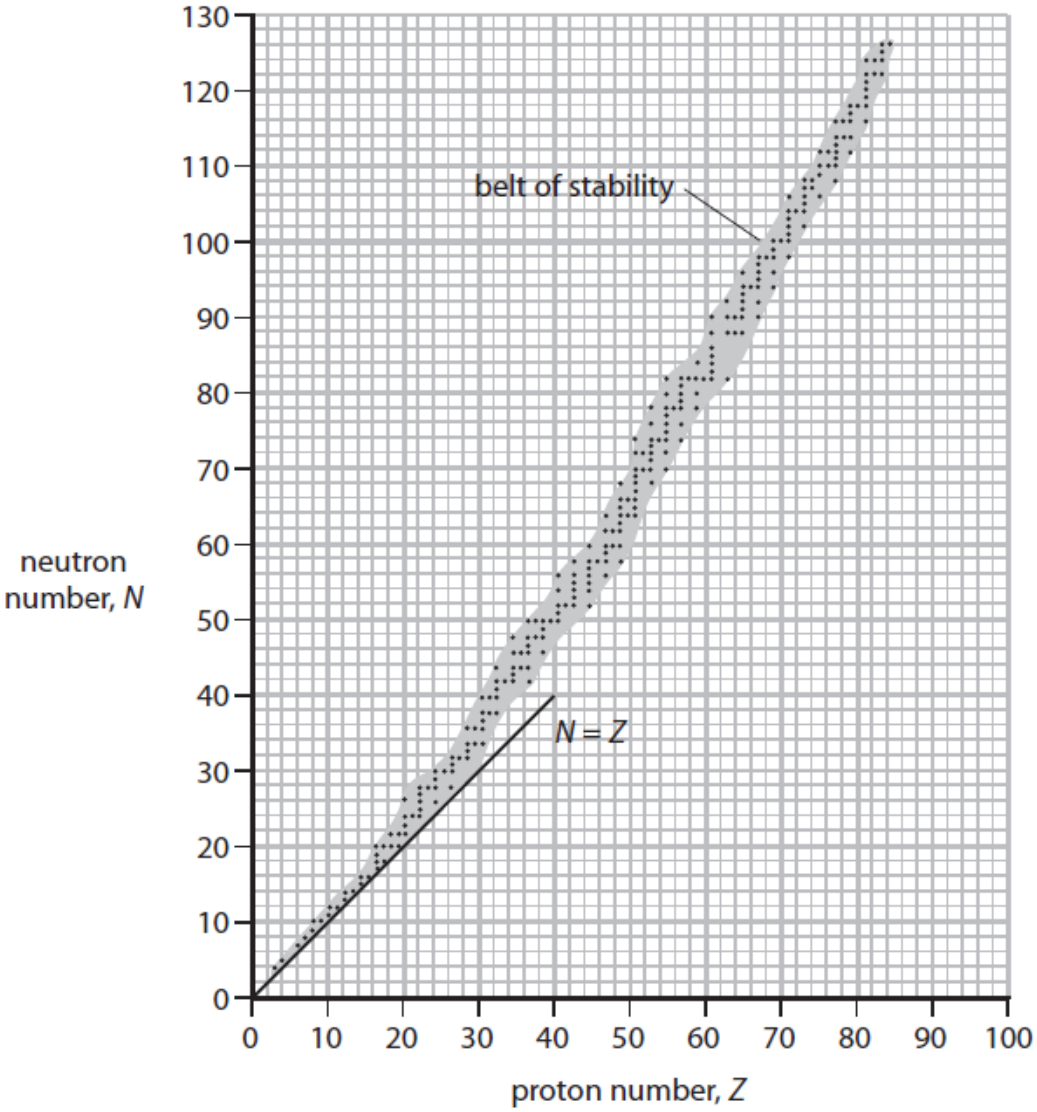
$^{9}_{4}\mathrm{B}$ ☐ **C**

$^{9}_{5}\mathrm{Be}$ ☐ **D**

(**Q17 1SC0/1PF, June 2013**)

Q12.

(a) The diagram shows the stability curve for nuclear isotopes.



Complete the sentence by putting a cross (☒) in the box next to your answer.

An isotope above the curve will undergo β^- decay because it has

(1)

☒ **A** too few protons

☒ **B** too many protons

☒ **C** too few neutrons

☒ **D** too many neutrons

(b) Which statement is correct for β^+ and β^- particles?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** a β^+ is positively charged and a β^- is negatively charged

☒ **B** the mass of a β^+ is 1800 times the mass of a β^-

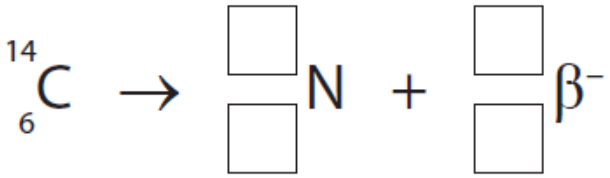
☒ **C** the charge on a β^+ is twice the charge on a β^-

☒ **D** a β^+ is a proton and a β^- is an electron

(c) Carbon-14 decays by emitting a β^- particle to form an isotope of nitrogen.

Complete the nuclear equation for this decay by filling in the boxes.

(2)



(d) Protons and neutrons both contain quarks.

Describe the arrangement of quarks in a proton.

(2)

.....

.....

.....

.....

(e) Explain what happens to a nucleus during β^+ decay.

(2)

.....

.....

.....

.....

.....

(**Q10 1SC0/1PH, June 2015**)

Q13.

Ionising radiations are emitted by unstable nuclei.

(i) Which particle has the same mass as but opposite charge to a β^+ particle?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** electron

☒ **B** positron

☒ **C** proton

☒ **D** neutron

(ii) Suggest why a beta particle will travel further in air than an alpha particle.

(2)

.....

.....

.....

.....

(**Q38 1SC0/1PH, June 2013**)

Q14.

Alpha, beta and gamma are types of ionising radiation.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A beta particle is emitted by

(1)

☒ **A** an alpha particle

☒ **B** a fusion particle

☒ **C** a gamma ray

☒ **D** an unstable nucleus

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A beta particle has an identical charge to

(1)

☒ **A** an alpha particle

☒ **B** an electron

☒ **C** a neutron

☒ **D** a nucleus

(**Q31 1SC0/1PF, Mar 2013**)

Q15.

The mass of a proton is 1.6726×10^{-27} kg.
The mass of an electron is 9.1094×10^{-31} kg.

Calculate how many times the mass of a proton is greater than the mass of an electron.

Give your answer to two significant figures.

(3)

..... times

(Total for question = 3 marks)

(**Q03d 1SC0/1PF, June 2019**)

Q16.

A G-M tube is connected to a counter.
A teacher places the G-M tube near to a radioactive source.
A student starts the counter and clock at the same time and writes down the readings shown on the counter every 15 s.

The student plots the readings with a line of best fit, as shown in Figure 8.

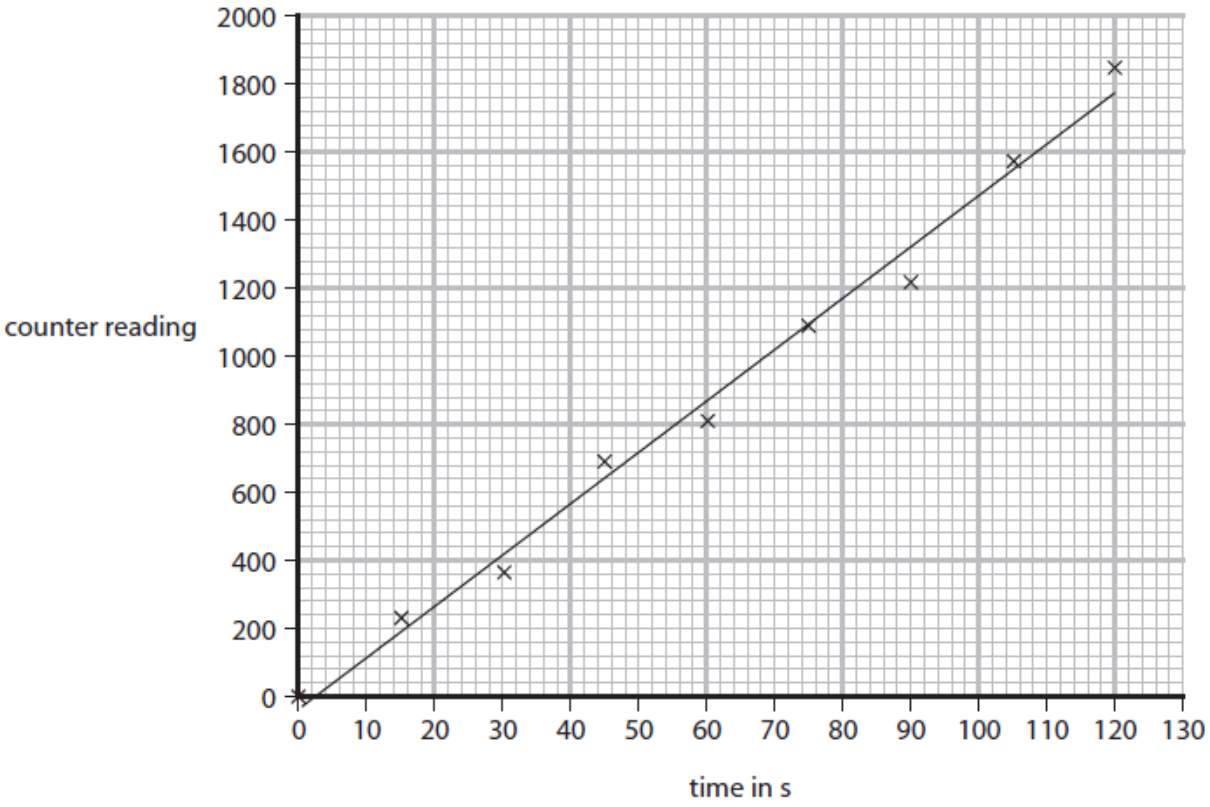


Figure 8

(i) Calculate the average count rate, in counts / s, from the graph.

Show your working on the graph.

(2)

average count rate = ... count / s

(ii) The student says that the experiment must have been done carelessly because the data seemed quite scattered away from the best fit line.

The teacher claims such results should be expected in radioactivity experiments.

Justify the teacher's claim.

(2)

.....

.....

.....

.....

(Total for question = 4 marks)

(**Q05e 1SC0/1PH, Nov 2020**)

STEMUP.CO.UK

Q17.

A sample of a radioactive isotope has a mass of 520 g.

The half-life of the radioactive isotope is 18 days.

(i) Calculate the mass of the original radioactive isotope remaining after 18 days.

(1)

mass after 18 days ..... g

(ii) Calculate the mass of the original radioactive isotope remaining after 54 days.

(2)

mass after 54 days ..... g

(Total for question = 3 marks)

(**QU04c 1SC0/1PF, June 2022**)

Q18.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

(i) Which of these is the unit for the activity of a radioactive isotope?

(1)

☒ **A** second (s)

☒ **B** kilogram (kg)

☒ **C** kelvin (K)

☒ **D** becquerel (Bq)

(ii) The isotope nitrogen-13 (N-13) has a half-life of 10 minutes.

A sample of N-13 has an initial mass of 120 g.

Calculate the mass of N-13 that remains after 30 minutes.

(2)

mass remaining = ... g

(Total for question = 3 marks)

(**QU03c 1SC0/1PF, June 2025**)

Q19.

A teacher uses a Geiger-Müller tube and a counter to measure background radiation.

The reading on the counter tube is 34 counts per minute.

(i) The teacher puts a source of beta radiation 15 cm in front of the same Geiger-Müller tube.

The reading on the counter tube is now 468 counts per minute.

Calculate how much radiation detected by the Geiger-Müller tube comes from the source of beta radiation.

(1)

..... counts per minute

(ii) The teacher puts a thick sheet of aluminium between the source of beta radiation and the Geiger-Müller tube.

Estimate the reading on the counter tube.

(1)

..... counts per minute

(iii) Give a reason why the answer to (ii) is only an estimate.

(1)

.....

.....

(Total for question = 3 marks)

(**Q03b 1SC0/1PF, SAM 2016**)

Q20.

Carbon-14 is a radioactive isotope that occurs naturally.

Scientists use carbon-14 to help find the age of old pieces of wood.

This technique is called carbon dating.

It uses the idea of half-life.

(a) Which of these describes half-life?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** the time it takes for half of the undecayed nuclei to decay

☒ **B** the time it takes for all of the undecayed nuclei to decay

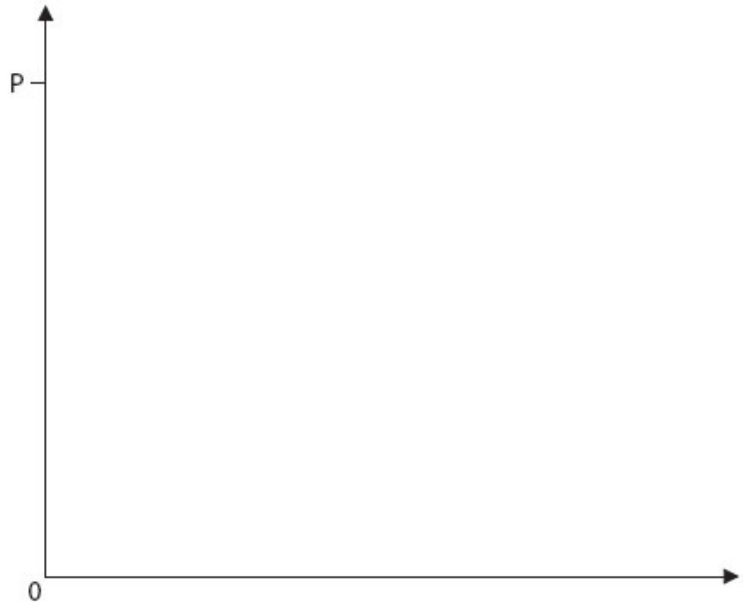
☒ **C** half the time it takes for all of the undecayed nuclei to decay

☒ **D** half the time it takes for half of the undecayed nuclei to decay

(b) Sketch a graph to show how the activity of a radioactive isotope changes with time.

Use the axes below. Start your line from point P.

(3)



(c) A scientist investigates an old wooden comb.



The activity of the carbon-14 in it is 0.55 Bq.

The estimated age of the comb is 11 400 years.

The half-life of carbon-14 is 5700 years.

(i) Calculate the activity of the carbon-14 in the comb when it was new.

(3)

activity = ...Bq

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

.....

.....

.....

.....

.....

(iii) Old objects like the comb emit a very small amount of radiation.

The activity from the comb is about the same as comes from background radiation.

Scientists have stopped measuring the activity of carbon-14 for carbon dating.

Instead, they can measure the mass of undecayed carbon-14 left in the sample.

Suggest a reason for this change.

(1)

.....

.....

.....

(Total for Question is 10 marks)

(**Q23 1SC0/1PF, Mar 2013**)

Q21.

Carbon-14 is a radioactive isotope that occurs naturally.

Scientists use carbon-14 to help find the age of old pieces of wood.

This technique is called carbon dating.

It uses the idea of half-life.

A scientist investigates an old wooden comb.



The activity of the carbon-14 in it is 0.55 Bq.

The estimated age of the comb is 11 400 years.

The half-life of carbon-14 is 5700 years.

(i) Calculate the activity of the carbon-14 in the comb when it was new.

(3)

activity = ...Bq

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

.....

.....

.....

.....

.....

(iii) Old objects like the comb emit a very small amount of radiation.

The activity from the comb is about the same as comes from background radiation.

Scientists have stopped measuring the activity of carbon-14 for carbon dating.

Instead, they can measure the mass of undecayed carbon-14 left in the sample.

Suggest a reason for this change.

(1)

.....

.....

.....

(**Q29 1SC0/1PF, Mar 2013**)

Q22.

Figure 3 shows the structure of an oxygen-14 atom.

(i) Complete the four labels on Figure 3.

(4)

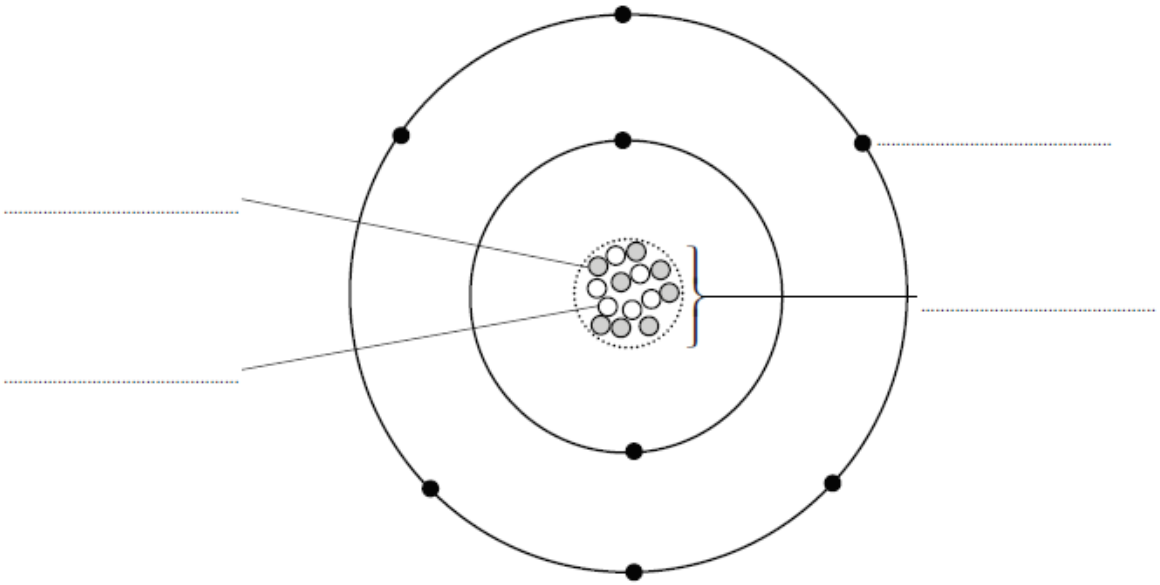


Figure 3

(ii) Which of these particles has a negative charge?

(1)

- ☒ **A** alpha particle
- ☒ **B** electron
- ☒ **C** neutron
- ☒ **D** nucleus

(iii) State the overall charge of the oxygen-14 atom.

(1)

.....

.....

(Total for question = 6 marks)

(**Q03a 1SC0/1PF, SAM 2016**)

Q23.

Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

(**Q06d 1SC0/1PH, June 2019**)

Q24.

Fluorine-19 is a stable isotope of the element fluorine.

The element fluorine also has several radioactive isotopes.

Describe **one** similarity and **one** difference between the numbers of particles in one nucleus of fluorine-19 and one nucleus of a radioactive isotope of fluorine.

(2)

similarity .....

.....

difference .....

.....

(Total for question = 2 marks)

(**Q06b 1SC0/1PF, Nov 2021**)

Q25.

Fluorine-19 is a stable isotope of the element fluorine.

The element fluorine also has several radioactive isotopes.

Describe **one** similarity and **one** difference between the numbers of particles in one nucleus of fluorine-19 and one nucleus of a radioactive isotope of fluorine.

(2)

similarity .....

.....

difference .....

.....

(Total for question = 2 marks)

(**Q02b 1SC0/1PH, Nov 2021**)

Q26.

* Gamma radiation is produced by radioactive decay.

Alpha radiation and beta radiation are also produced by radioactive decay.

Compare the processes of alpha decay and beta decay.

Your answer should include what each radiation is and what effect each decay has on the original nucleus.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

(**Q06d 1SC0/1PH, Nov 2021**)

Q27.

* Radioactive decay can produce gamma radiation and alpha radiation.

Compare the processes of gamma decay and alpha decay.

Your answer should include

- a description of both gamma radiation and alpha radiation
- the effect of each type of decay on the original nucleus.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

(**QU06c 1SC0/1PH, June 2025**)

Q28.

The teacher now investigates the absorption of beta radiation by different thicknesses of aluminium.

The apparatus available is

- a source of beta radiation
- a Geiger-Müller (G-M) tube and counter
- 10 pieces of aluminium, each 0.5 mm thick
- a metre rule.

(i) Sketch a labelled diagram showing the positions of the apparatus when the measurements are being taken.

(2)

(ii) Give the independent variable in this investigation.

(1)

.....

(iii) Name a quantity that must be kept constant during the investigation.

(1)

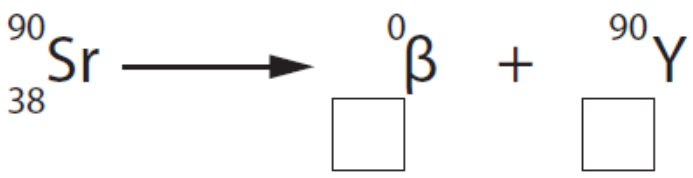
.....

.....

(iv) Strontium-90 is the source of beta minus radiation in this investigation.

Complete the nuclear equation for this emission of beta minus radiation.

(2)



(Total for question = 6 marks)

(**QU05d 1SC0/1PH, June 2024**)

Q29.

The half-life of strontium-90 is 29 years.

The table in Figure 4 gives some information about how the mass of a sample of strontium-90 changes with time.

mass of strontium-90 in g	time in years
1600	0
.....	29
400	.....

Figure 4

Complete the table in Figure 4.

(Total for question = 2 marks)

(**Q03b 1SC0/1PF, Nov 2020**)

Q30.

Carbon-13 and carbon-14 are isotopes of carbon.

Nuclei of carbon-13 and carbon-14 can be represented by these symbols

$$^{13}_{6}C \quad \text{and} \quad ^{14}_{6}C$$

Complete the table for an atom of carbon-13 and an atom of carbon-14.

(2)

	number of neutrons in the nucleus	number of electrons in orbit around the nucleus
carbon-13		
carbon-14		

(Total for question = 2 marks)

(**Q06a 1SC0/1PF, June 2019**)

Q31.

Carbon-13 and carbon-14 are isotopes of carbon.

Nuclei of carbon-13 and carbon-14 can be represented by these symbols

$$^{13}_{6}C \quad \text{and} \quad ^{14}_{6}C$$

Complete the table for an atom of carbon-13 and an atom of carbon-14.

(2)

	number of neutrons in the nucleus	number of electrons in orbit around the nucleus
carbon-13		
carbon-14		

(Total for question = 2 marks)

(**Q02a 1SC0/1PH, June 2019**)

Q32.

Figure 5 shows a diagram of a helium atom.

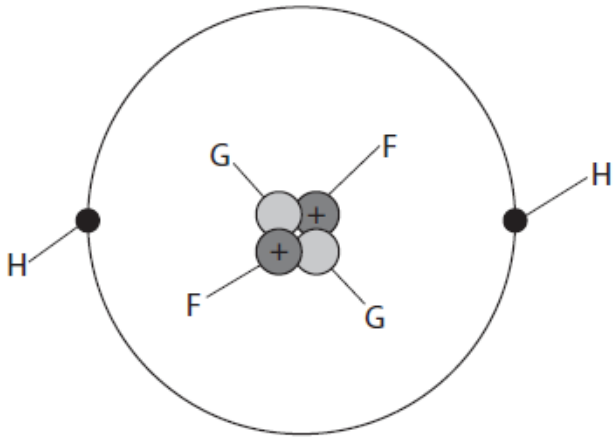


Figure 5

Complete the table for particles G and H, as shown in Figure 5.

(4)

particle	name of particle	charge
F	proton	positive
G		
H		

(Total for question = 4 marks)

(**QU03a 1SC0/1PF, June 2025**)

Q33.

State what is meant by the term 'half-life'.

(1)

.....

.....

(Total for question = 1 mark)

(**Q04bi 1SC0/1PH, SAM 2016**)

Q34.

Students are given the apparatus shown in Figure 8 and a protractor.

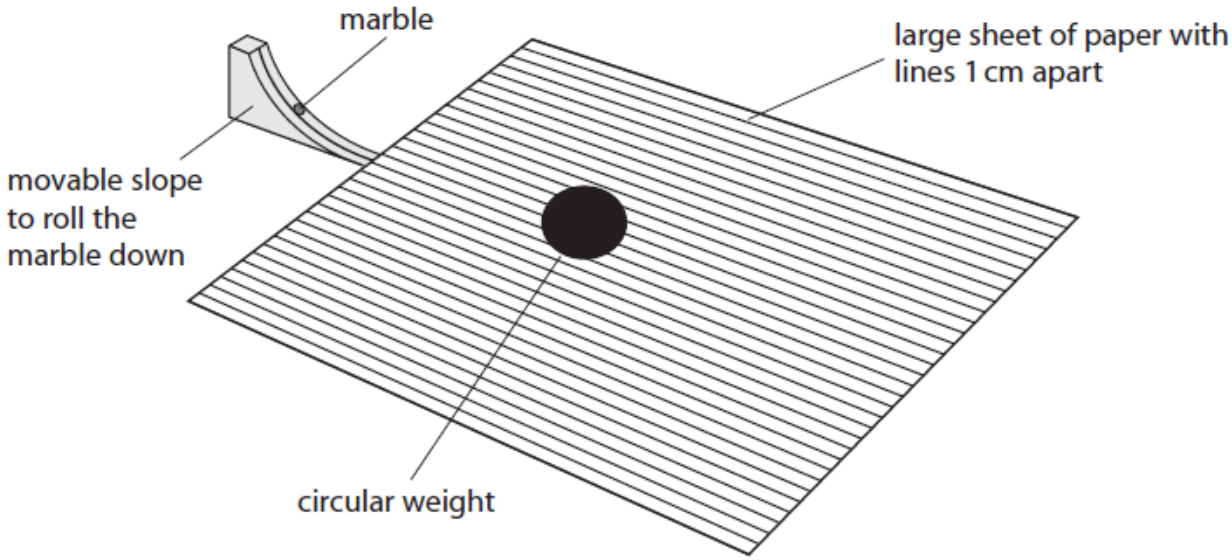


Figure 8

(i) Describe how the students could use the apparatus to model the scattering of alpha particles.

(2)

.....

.....

.....

.....

(ii) Give **one** limitation of this model.

(1)

.....

.....

(Total for question = 3 marks)

(**QU05c 1SC0/1PH, June 2022**)

Q35.

* Exposing people to radioactive sources can be dangerous.

Describe the dangers of exposure to radioactive sources and what can be done to protect hospital staff when they are working with radioactive sources.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

(**Q06d 1SC0/1PF, Nov 2021**)

Q36.

Radium-223 is a radioactive substance.

Radium-223 is an alpha emitter.

The half-life of radium-223 is 11 days.

A radioactive source contains 1.7×10^{23} nuclei of radium-223.

Calculate the number of radium-223 nuclei remaining in the source after a time of 33 days.

(2)

number of radium-223 nuclei remaining = ...

(Total for question = 2 marks)

(**Q02d 1SC0/1PH, Nov 2021**)

Q37.

Sometimes food can become contaminated with radioactive substances.

Describe the harmful effects of eating food contaminated with radioactive substances.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**Q06a 1SC0/1PH, Nov 2021**)

Q38.

Describe what happens in the nucleus of an atom when a beta plus particle is emitted.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**QU06b 1SC0/1PH, June 2025**)

Q39.

Describe what happens in the nucleus of an atom when a positron is emitted.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

(**QU05c 1SC0/1PH, June 2023**)

Q40.

Carbon-14 is radioactive and has a half-life of 5 700 years.

The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

(2)

age of wood = ... years

(Total for question = 2 marks)

(**Q06c 1SC0/1PF, June 2019**)