

PEARSON EDEXCEL GCSE PHYSICS (HIGHER) • 1PH0

PHYSICS



EXAM QUESTION PACK

TOPIC 6: RADIOACTIVITY (PACK 2)

SCORE

/88

PERCENTAGE

%

STEMUP

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Q1.

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)

Q2.

This question is about radioactivity.

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

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(Total for question = 2 marks)

Q3.

*The global demand for electricity is increasing.

There is a debate about whether nuclear power generation should or should not contribute to meeting this increasing demand.

Discuss the arguments for and against using nuclear power to meet the increasing global demand for electricity.

(6)

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(Total for question = 6 marks)

Q4.

The nucleus of americium-238 can absorb an electron.

When this happens, one of the protons in the nucleus becomes a neutron, as shown in Figure 8.

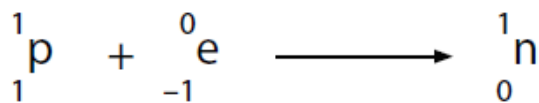


Figure 8

(i) Describe how absorbing an electron affects the proton number and the nucleon number of a nucleus.

(2)

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(ii) Deduce which nucleus is formed when americium-238 absorbs an electron.

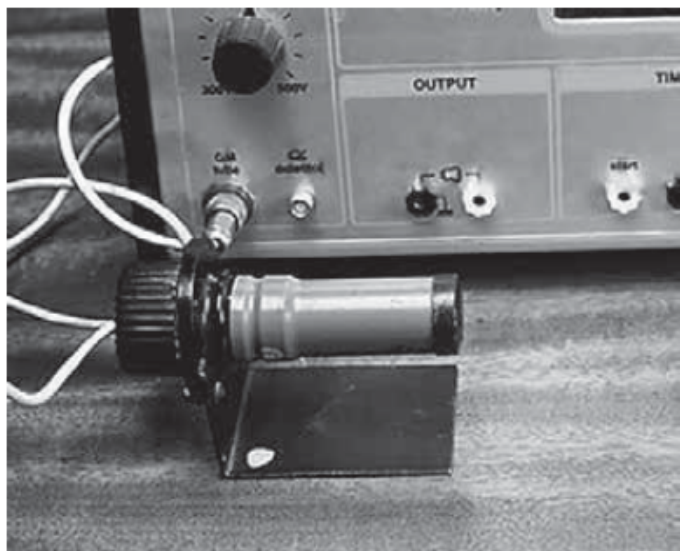
(1)

- ☐ **A** uranium-234
- ☐ **B** uranium-235
- ☐ **C** plutonium-238
- ☐ **D** americium-238

(Total for question = 3 marks)

Q5.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

One radioactive source used in hospitals is technetium (Tc).

Technetium is produced from the radioactive decay of molybdenum (Mo).

Complete the following nuclear equation.

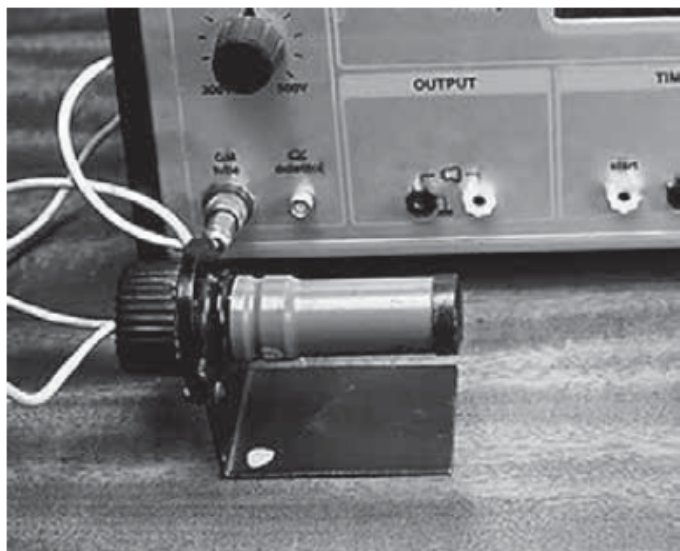
(1)



(Total for question = 1 mark)

Q6.

Figure 4 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



© Andrew Lambert Science Photo Library

Figure 4

One radioactive source used in hospitals is technetium (Tc).

Technetium is produced from the radioactive decay of molybdenum (Mo).

Complete the following nuclear equation.

(1)



(Total for question = 1 mark)

Q7.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

The apparatus that was used in the experiment is shown in Figure 6.

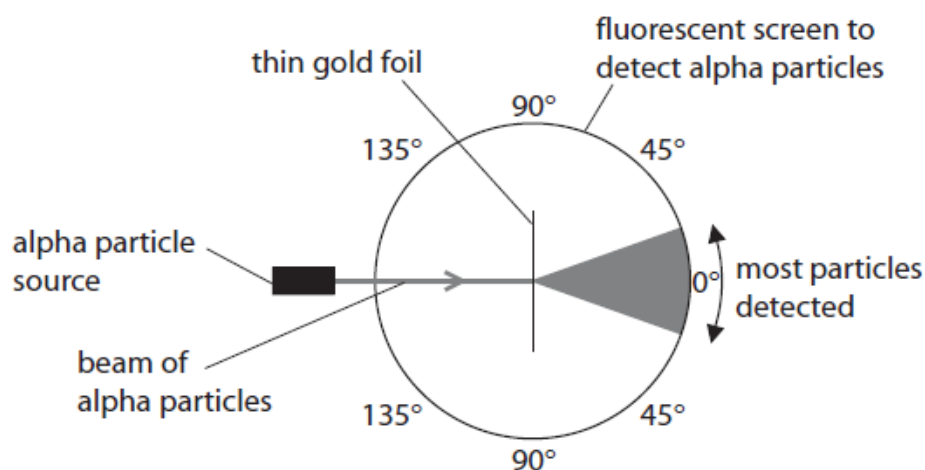


Figure 6

(i) The number of particles detected at each angle in a given time is shown on the graph in Figure 7.

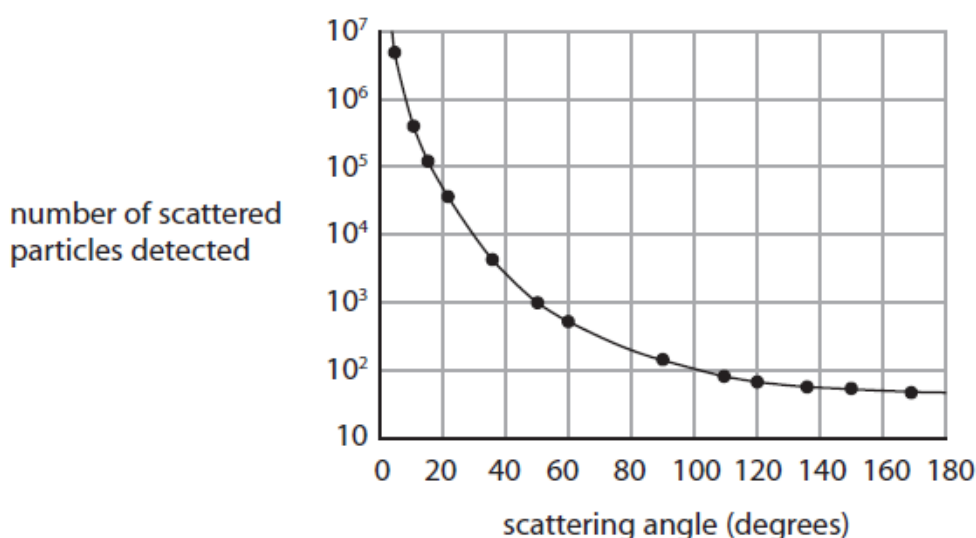


Figure 7

Use information from the graph.

Estimate the ratio of the number of particles scattered through 5° to the number of particles scattered through 100°.

(2)

ratio = ...

(ii) Explain how the difference in the number of particles scattered at different angles gives evidence for the current model of the structure of the atom.

(4)

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(Total for question = 6 marks)

Q8.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

It was found that alpha particles were scattered by the gold foil.

The gold foil was about 4.0×10^{-7} m thick.

A gold atom has a diameter of about 0.15 nm.

Estimate how many gold atoms would fit across this thickness of gold foil.

(2)

number of atoms = ...

(Total for question = 2 marks)

Q9.

Rutherford devised an experiment to fire alpha particles at thin gold foil.

It was found that alpha particles were scattered by the gold foil.

The gold foil was about 4.0×10^{-7} m thick.

A gold atom has a diameter of about 0.15 nm.

Estimate how many gold atoms would fit across this thickness of gold foil.

(2)

number of atoms = ...

(Total for question = 2 marks)

Q10.

The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38.5 kBq in the year 2000.

Estimate the activity of this source in the year 2020.

(3)

activity = ... kBq

(Total for question = 3 marks)

Q11.

The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38.5 kBq in the year 2000.

Estimate the activity of this source in the year 2020.

(3)

activity = ... kBq

(Total for question = 3 marks)

Q12.

The apparatus that was used in the experiment is shown in Figure 10.

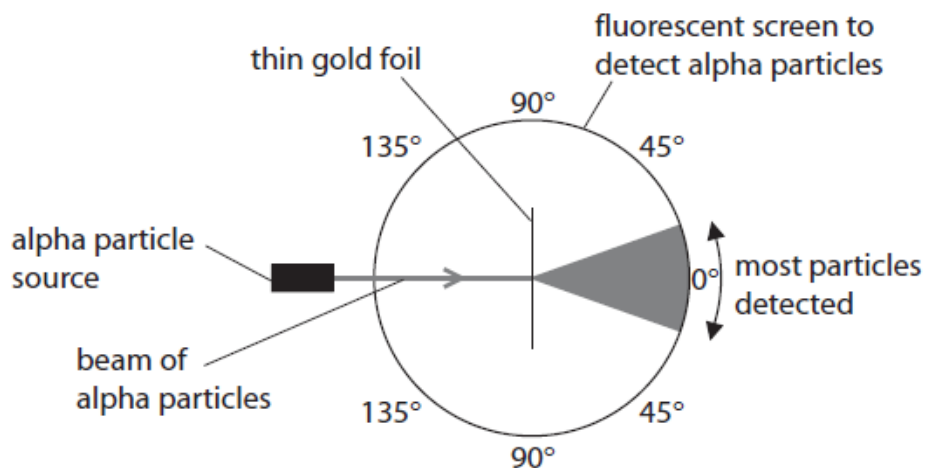


Figure 10

(i) The number of particles detected at each angle in a given time is shown on the graph in Figure 11.

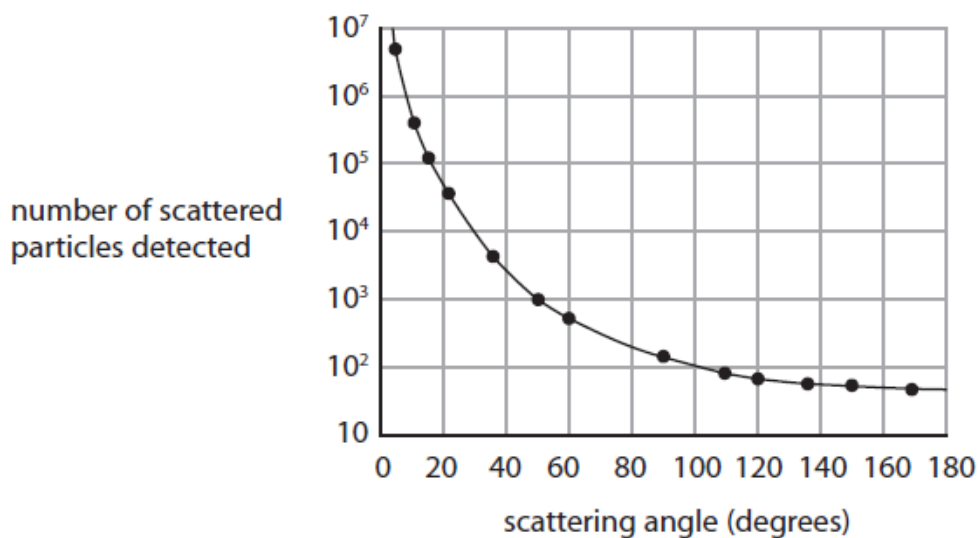


Figure 11

Use information from the graph.

Estimate the ratio of the number of particles scattered through 5° to the number of particles scattered through 100°.

(2)

ratio = ...

(ii) Explain how the difference in the number of particles scattered at different angles gives evidence for the current model of the structure of the atom.

(4)

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(Total for question = 6 marks)

Q13.

Figure 6 is a diagram of a nuclear reactor.

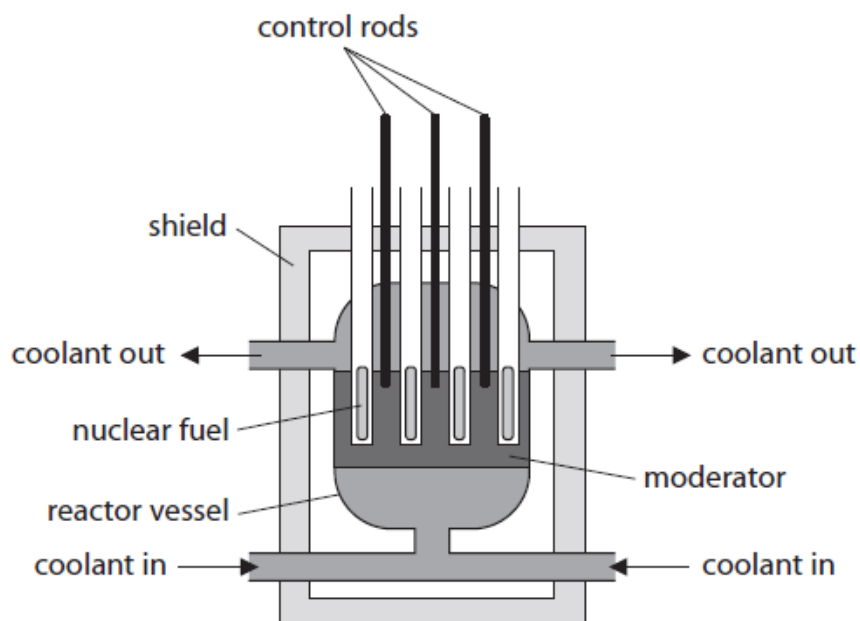


Figure 6

(i) Explain how pushing the control rods further into the reactor slows down the nuclear chain reaction.

(2)

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(ii) The moderator in a nuclear reactor slows down the neutrons so that the neutrons are more likely to start other fission reactions.

In a nuclear reactor,

- the average speed of the fast neutrons is 3.0×10^7 m/s
- the average speed of the slow neutrons is 4.0×10^3 m/s

Calculate the average speed of the slow neutrons as a percentage of the average speed of the fast neutrons.

(2)

..... %

(iii) The nuclear reaction is the first stage in the process of generating electricity.

Describe how energy is transferred from the nuclear reaction to the next stage in the process.

(2)

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(Total for question = 6 marks)

Q14.

Some isotopes are unstable.
They emit β^- particles when they decay.

Explain how a nucleus changes when a β^- particle is emitted.

(2)

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(Total for question = 2 marks)

Q15.

Some isotopes are unstable.
They emit β^- particles when they decay.

Explain how a nucleus changes when a β^- particle is emitted.

(2)

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(Total for question = 2 marks)

Q16.

Explain how neutrons enable a nuclear chain reaction to take place.

(2)

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Q17.

Early in the twentieth century, scientists fired a beam of alpha particles at thin gold foil.

Figure 2 shows the main parts of their experiment with some results.

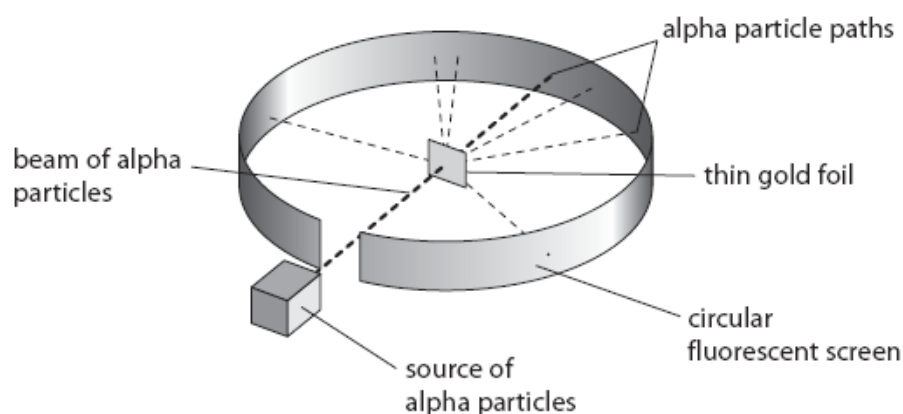


Figure 2

Explain how the results of the experiment shown in Figure 2 support the nuclear model of an atom.

(3)

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Q18.

Early in the twentieth century, scientists fired a beam of alpha particles at thin gold foil.

Figure 2 shows the main parts of their experiment with some results.

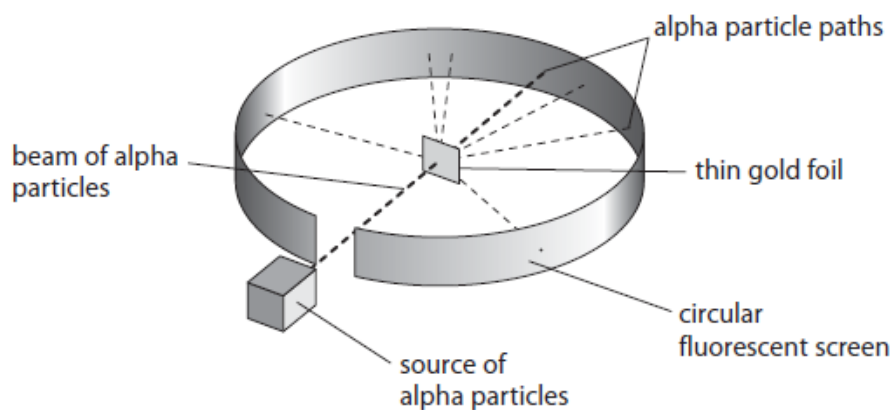


Figure 2

Explain how the results of the experiment shown in Figure 2 support the nuclear model of an atom.

(3)

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(Total for question = 3 marks)

Q19.

In a nuclear reactor, a chain reaction is produced and controlled.

Explain what happen inside a nuclear reactor if neutron speeds are not controlled.

(3)

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(Total for question = 3 marks)

Q20.

Explain the use of a moderator in a nuclear reactor.

(3)

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(Total for question = 3 marks)

Q21.

Carbon-14 decays into nitrogen-14.

The symbol for nitrogen-14 is ${}^{14}_{7}\text{N}$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

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.....

(Total for question = 2 marks)

Q22.

Carbon-14 decays into nitrogen-14.

The symbol for nitrogen-14 is ${}^{14}_{7}\text{N}$

Explain what happens in a carbon-14 nucleus when it decays to a nitrogen-14 nucleus.

(2)

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(Total for question = 2 marks)

Q23.

Nuclear fusion is another type of nuclear reaction.

Explain why there are no power stations using nuclear fusion.

(3)

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(Total for question = 3 marks)

Q24.

Fusion and fission are nuclear reactions in which large amounts of energy are released.

(i) In a fusion reaction, two hydrogen nuclei are forced together to form a helium nucleus.

Explain why a very high temperature is needed for this reaction to happen.

(3)

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(ii) In a fusion reaction, the combined mass of the two small nuclei is greater than the mass of the resulting nucleus.

This decrease in mass, m , appears as energy, E , according to the equation.

$$E = mc^2$$

c is the speed of light = 3.0×10^8 m/s.

The energy released in one fusion reaction is 4.5×10^{-12} J.

Calculate the decrease in mass.

(3)

decrease in mass = ... kg

(Total for question = 6 marks)

Q25.

This question is about radioactivity.

Figure 3 shows a Geiger-Muller (G-M) tube attached to a counter.
The G-M tube is used to measure the activity of a source of beta (β) radiation.
There is an aluminium sheet between the beta source and the G-M tube.
The counter is switched on and after 1 minute shows a count of 268.

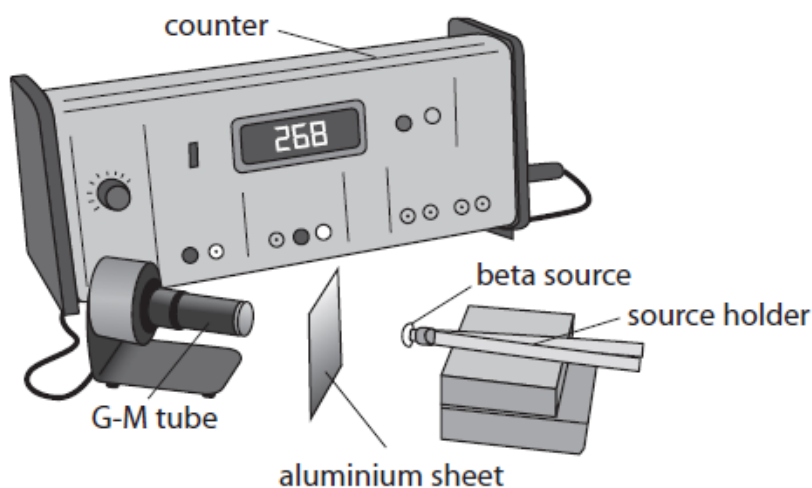


Figure 3

- (i) The aluminium sheet is taken away.
The counter is reset to zero and then switched on again.
A new count is taken for 1 minute.

Explain why the new count is greater than 268.

(2)

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- (ii) The beta source is then also taken away.
The counter is reset to zero and switched on again.
A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.

(1)

.....

.....

- (iii) State the SI unit for the activity of a radioactive source.

(1)

.....

(Total for question = 4 marks)

Q26.

Figure 3 shows a Geiger-Muller (G-M) tube attached to a counter. The G-M tube is used to measure the activity of a source of beta (β) radiation. There is an aluminium sheet between the beta source and the G-M tube. The counter is switched on and after 1 minute shows a count of 268.

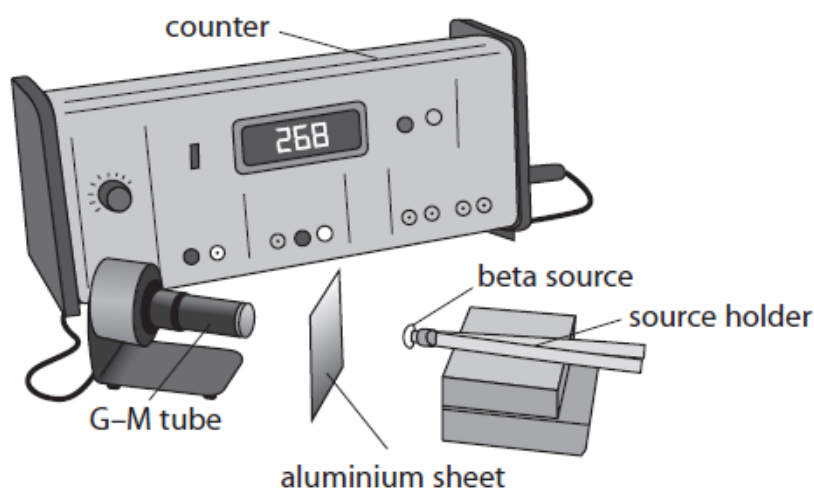


Figure 3

- (i) The aluminium sheet is taken away.
The counter is reset to zero and then switched on again.
A new count is taken for 1 minute.

Explain why the new count is greater than 268.

(2)

.....

.....

.....

.....

- (ii) The beta source is then also taken away.
The counter is reset to zero and switched on again.
A new count is taken for 1 minute.

Give a reason why there would now be a reading on the counter.

(1)

.....

.....

- (iii) State the SI unit for the activity of a radioactive source.

(1)

(Total for question = 4 marks)

Q27.

Figure 1 is a diagram of three atoms.

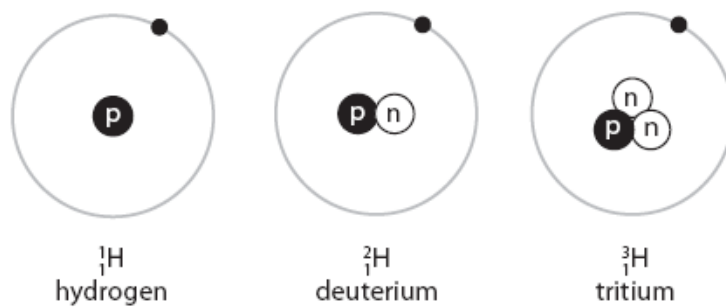


Figure 1

Give reasons why these atoms are isotopes.

(2)

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(Total for question = 2 marks)

Q28.

Figure 1 is a diagram of three atoms.

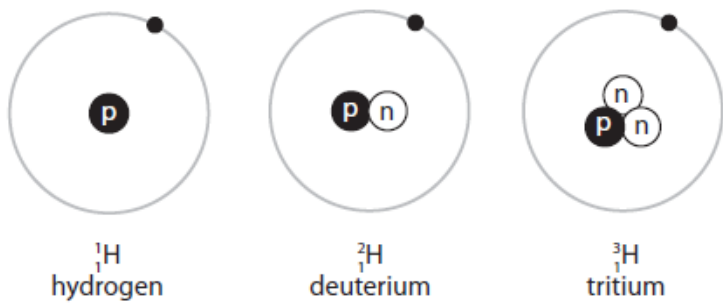


Figure 1

Give reasons why these atoms are isotopes.

(2)

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(Total for question = 2 marks)

Q29.

Other unstable isotopes emit alpha particles.

Which of these describes an alpha particle?

(1)

- ☐ **A** a hydrogen nucleus
- ☐ **B** a hydrogen atom
- ☐ **C** a helium nucleus
- ☐ **D** a helium atom

(Total for question = 1 mark)

Q30.

Figure 1 is a diagram of three atoms.

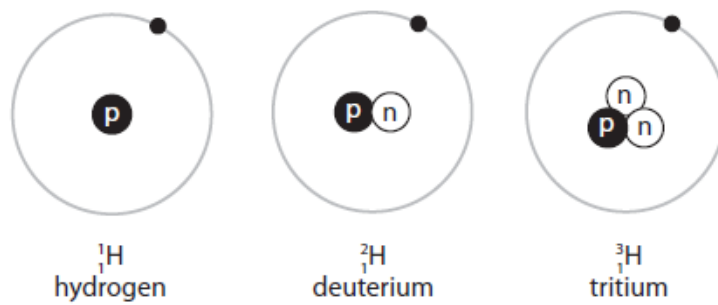


Figure 1

Some unstable isotopes emit alpha particles.

Which of these describes an alpha particle?

(1)

- ☐ **A** a hydrogen nucleus
- ☐ **B** a hydrogen atom
- ☐ **C** a helium nucleus
- ☐ **D** a helium atom

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
	processing (1) $\frac{125\,000}{1\,000\,000}$ OR $\frac{1}{8}$ OR 3 half-lives or 3×5700 evaluation (1) 17 100	accept an appropriate attempt using more than one halving 17 000 award full marks for the correct answer without working	(2)

Q2.

Question number	Answer	Additional guidance	Mark
CS2	same number of protons (1)	same atomic number	(2) AO2
	different number of neutrons (1)	different mass number	

Q3.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 1 (6 marks) <u>Arguments for using nuclear power</u> • we are running out of fossil fuels SO the use of nuclear can play its part where we have previously used fossil fuels • no carbon emissions SO does not contribute towards global warming, rise in sea-levels etc. • low running costs SO a good economical alternative to other power sources • with reprocessing can last hundreds of years • large power output compared with wind farms / solar etc. <u>Arguments against using nuclear power</u> • expensive to set up and decommission SO the use of other sources could be more economical • nuclear disasters possible SO there could be a loss of life / contamination of an area • nuclear toxic waste lasts a long time • waste storage issues – contamination of ground water • terrorism / bomb making	(6)Exp

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

SUMMARY, for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Unbalanced incomplete argument Elements of physics present isolated knowledge for or against	<u>Possible candidate responses</u> no CO ₂ emissions high cost
Level 2	3–4	<u>Additional guidance</u> Argument linked with evidence, but not entirely coherent or balanced Uses evidence for or against but lacks balance / focus / with logical connections made on one side and statement from the other	<u>Possible candidate responses</u> no CO ₂ emissions so no contribution to global warming large power output compared with wind farms
Level 3	5–6	<u>Additional guidance</u> Developed detailed arguments, including use of evidence, advanced both for and against the use of nuclear power	<u>Possible candidate responses</u> no CO ₂ emissions so no contribution to global warming large power output compared with wind farms nuclear toxic waste lasts a long time

Q4.

Question number	Answer	Mark
(i)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: - proton number/atomic number decreases by 1 (1) - nucleon number/mass number remains unchanged (as p and n have same mass and mass of electron is (assumed) negligible) (1)	(2)

Question number	Answer	Mark
(ii)	C	(1)

Q5.

Question Number	Answer	Mark
	an answer containing both of the following numbers in the correct places (1) $\begin{array}{c} 99 \\ \hline 43 \end{array} \text{Tc}$	(1) AO 2 1

Q6.

Question Number	Answer	Mark
	an answer containing both of the following numbers in the correct places (1) $\begin{array}{c} 99 \\ \hline 43 \end{array} \text{Tc}$	(1) AO 2 1

Q7.

	Answer	Additional guidance	Mark
(ii)	an explanation including any four from: Observations most (alpha particles) pass (straight) through the foil (with little deflection) (1) some (alpha particles) are {scattered / deflected} through {small angles / less than 90 degrees} (1) (very) few (alpha particles) are {scattered / deflected} through {large angles / greater than 90 degrees} (1) Conclusions atoms are mainly empty space (1) there must be a nucleus / something inside the atom (1) (nucleus / something) must be {small / heavy / dense / concentrated / charged / positive} (1)	Ignore electrons ignore refracted allow repelled allow rebound / reflect / back scattering / bounce back ignore electrons	(4) AO1,AO3

Q8.

	Answer	Additional guidance	Mark
	substitution (1) $\text{number of atoms} = \frac{4.0 \times 10^{-7}}{0.15 (\times 10^{-9})}$ evaluation (1) 2 700	$\frac{4.0 \times 10^{-7}}{1.5 (\times 10^{-10})}$ $\frac{0.000\ 000\ 4}{0.000\ 000\ 000\ 15}$ accept any value that rounds to 2 700 award full marks for correct answer without working	(2) AO2

Q9.

	Answer	Additional guidance	Mark
	substitution (1) $\text{number of atoms} = \frac{4.0 \times 10^{-7}}{0.15 (\times 10^{-9})}$ evaluation (1) 2 700	$\frac{4.0 \times 10^{-7}}{1.5 (\times 10^{-10})}$ $\frac{0.000\ 000\ 4}{0.000\ 000\ 000\ 15}$ accept any value that rounds to 2 700 award full marks for correct answer without working	(2) AO2

Q10.

Question number	Answer	Additional guidance	Mark
	recognition of there being 4 half lives involved (1) so fraction of 1/16 involved (1) evaluation (1) 2.4 (kBq)	allow 2 marks for 4.8 (kBq) (used three instead of 4 half lives) allow 1 mark for any other $(1/2)^n$ being involved i.e. for answers that round to 19.3 (kBq), 9.63 (kBq), 1.2(kBq) award full marks for the correct answer without working	(3)

Q11.

Question number	Answer	Additional guidance	Mark
	recognition of there being 4 half lives involved (1) so fraction of 1/16 involved (1) evaluation (1) 2.4 (kBq)	allow 2 marks for 4.8 (kBq) (used three instead of 4 half lives) allow 1 mark for any other $(1/2)^n$ being involved i.e. for answers that round to 19.3 (kBq), 9.63 (kBq), 1.2(kBq) award full marks for the correct answer without working	(3)

Q12.

	Answer	Additional guidance	Mark
(i)	reading from graph (1) (at 5 degrees:) number between 10^6 and 10^7 AND (at 100 degrees:) 10^2 evaluation (1) $\frac{\text{number between } 10^6 \text{ and } 10^7}{10^2}$ OR between $10^4:1$ and $10^5:1$ between 10 000:1 and 100 000:1 OR between 10^4 and 10^5 between 10 000 and 100 000	(e.g. $10^{6.5}$) (e.g. $10^{4.5}:1$ or $10^7:10^2$) allow any correct ratio not in its simplest form (e.g. $10^{4.5}$) award full marks for correct answer without working inverted ratio scores 1 mark maximum	(2) AO2

	Answer	Additional guidance	Mark
(ii)	an explanation including any four from: Observations most (alpha particles) pass (straight) through the foil (with little deflection) (1) some (alpha particles) are {scattered / deflected} through {small angles / less than 90 degrees} (1) (very) few (alpha particles) are {scattered / deflected} through {large angles / greater than 90 degrees} (1) Conclusions atoms are mainly empty space (1) there must be a nucleus / something inside the atom (1) (nucleus / something) must be {small / heavy / dense / concentrated / charged / positive} (1)	ignore electrons ignore refracted allow repelled allow rebound / reflect / back scattering / bounce back ignore electrons	(4) A01,A03

Q13.

	Answer	Additional guidance	Mark
(i)	an explanation linking: (control rods) absorb <u>neutrons</u> (1) (so) fewer (neutrons) available for chain reaction (1)	ignore slow down the nuclear chain reaction accept (control rods) block <u>neutrons</u> accept <u>neutrons</u> can't pass through (control rods) fewer fission(s) (reactions)	(2) A01

	Answer	Additional guidance	Mark
(ii)	$\frac{4(.0 \times 10^3)(\times 100)}{3(.0 \times 10^7)}$ (1) $1.3 \times 10^{-2} \text{ (\%)} (1)$	0.013 (%) allow 0.01 (%) power of ten error scores 1 mark maximum award full marks for the correct answer without working	(2) AO2

	Answer	Additional guidance	Mark
(iii)	A description to include: (from) kinetic energy (of fission fragments) (1) (transferred to) thermal energy (of coolant) (1)	accept references to energy stores accept energy in nuclear store accept nuclear energy / gamma radiation energy / binding energy / mass (to) thermal store (in coolant) accept heat for thermal if no other marks awarded allow steam transfers thermal energy/heat from reactor to kinetic energy of turbine for 2 marks	(2) AO1

Q14.

Question number	Answer	Additional guidance	Mark
	An explanation that combines understanding (1 mark) and reasoning (1 mark) linking: - number of neutrons decreases by one (1) - number of protons increases by one.(1)	a neutron becomes a proton plus an electron for (2) marks	(2)

Q15.

Question number	Answer	Additional guidance	Mark
	An explanation that combines understanding (1 mark) and reasoning (1 mark) linking: • number of neutrons decreases by one (1) • number of protons increases by one.(1)	a neutron becomes a proton plus an electron for (2) marks	(2)

Q16.

Question number	Answer	Additional guidance	Mark
	An explanation linking two of a neutron collides with/fired at a (uranium) nucleus (1) releasing (2/3) extra neutron(s) (1) which go on to collide with more nuclei (1)	neutron absorbed by nucleus. accept atom for nucleus accept atom for nucleus	(2)

Q17.

Question number	Indicative content	Mark
	An explanation that combines identification via a judgment (2 marks) to reach a conclusion via justification/reasoning (1 mark): • some alpha particles go straight through (1) • some alpha particles scattered (1) • idea of all mass / (positive) charge concentrated in centre /nucleus (1) • mainly empty space (in rest of atom) (1)	(3)

Q18.

Question number	Indicative content	Mark
	An explanation that combines identification via a judgment (2 marks) to reach a conclusion via justification/reasoning (1 mark): • some alpha particles go straight through (1) • some alpha particles scattered (1) • idea of all mass / (positive) charge concentrated in centre /nucleus (1) • mainly empty space (in rest of atom) (1)	(3)

Q19.

Question number	Answer	Additional guidance	Mark
	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – knowledge (2 marks): • reaction will slow down (1) • because there are fewer fissions (1) • because fission more likely with slow neutrons (1)	allow reactor shuts down/eq fission requires slow neutrons thermal neutrons for slow neutrons	(3)

Q20.

Question number	Answer	Additional guidance	Mark
	An explanation that combines understanding (1 mark) and reasoning/justification - understanding (2 marks): • slows down neutrons (1) • increase chance of collision / fission (1) • maintain the reaction rate (1)	to allow capture by nucleus increase the reaction rate	(3)

Q21.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: neutron (decays) to proton (1) beta emitted (1)	mass number stays the same but atomic number increases by 1 accept answers in terms of quarks (dud becomes uud) beta decay / β seen NOT β^+/beta plus allow (fast) electron emitted allow for 2 marks: $n \rightarrow p + e$ OR ${}^{14}_6\text{C} \rightarrow {}^{14}_7\text{N} + {}^0_{-1}\beta^{(-)}$	(2)

Q22.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: neutron (decays) to proton (1) beta emitted (1)	mass number stays the same but atomic number increases by 1 accept answers in terms of quarks (dud becomes uud) beta decay / β seen NOT β^+/beta plus allow (fast) electron emitted allow for 2 marks: $n \rightarrow p + e$ OR ${}^{14}_6\text{C} \rightarrow {}^{14}_7\text{N} + {}^0_{-1}\beta^{(-)}$	(2)

Q23.

Question number	Answer	Additional guidance	Mark
	An explanation that makes reference to identification - knowledge (2 marks) and reasoning/justification - knowledge (1 mark): • fusion requires high temperatures and pressures (1) • (in order to overcome) electrostatic repulsion of nuclei (1) • (we are currently) unable to maintain these conditions (in a commercial reactor) (1)		(3)

Q24.

Question Number	Answer	Additional guidance	Mark
(i)	an explanation linking: (high temperature means) high energy (1) (needed) to overcome (force of) repulsion (1) between nuclei / because they both have the same charge (1)	accept "them" / hydrogen for nuclei	(3) AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	substitution (1) $4.5 \times 10^{-12} = m (3.0 \times 10^8)^2$ rearrangement (1) $(m =) \frac{4.5 \times (10^{-12})}{9.0 \times (10^{16})}$ evaluation (1) $5.0 \times 10^{-29} \text{ (kg)}$	accept substitution and rearrangement in either order ignore POT errors until evaluation award full marks for the correct answer with no working	(3) AO 2 1

Q25.

Question number	Answer	Additional guidance	Mark
(i) CS2	An explanation to include; there is no aluminium to absorb β particles (1) (therefore) more β particles reach the G-M tube (1)	aluminium absorbs/stops/blocks beta particles accept reverse arguments accept radiation for beta particles	(2) AO2

Question number	Answer	Additional guidance	Mark
(ii) CS2	(idea of) background radiation	a named source of background radiation	(1) AO3

Question number	Answer	Additional guidance	Mark
(iii) CS2	becquerel	accept Bq accept close spelling	(1) AO1

Q26.

Question number	Answer	Additional guidance	Mark
(i)	An explanation to include; there is no aluminium to absorb β particles (1) (therefore) more β particles reach the G-M tube (1)	aluminium absorbs/stops/blocks beta particles accept reverse arguments accept radiation for beta particles	(2) AO2

Question number	Answer	Additional guidance	Mark
(ii)	(idea of) background radiation	a named source of background radiation	(1) AO3

Question number	Answer	Additional guidance	Mark
(iii)	becquerel	accept Bq accept close spelling	(1) AO1

Q27.

Question number	Answer	Mark
	one from • same atomic number (1) • same number of protons (1) • same element (1) and one from • different numbers of neutrons (1) • different mass numbers (1)	(2)

Q28.

Question number	Answer	Mark
	one from • same atomic number (1) • same number of protons (1) • same element (1) and one from • different numbers of neutrons (1) • different mass numbers (1)	(2)

Q29.

Question number	Answer	Mark
	C a helium nucleus	(1)

Q30.

Question number	Answer	Mark
	C a helium nucleus	(1)