

PHYSICS



EXAM QUESTION PACK

TOPIC 6: RADIOACTIVITY (PACK 3)

SCORE

/51

PERCENTAGE

%

STEMUP

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Q1.

What is the approximate size of a hydrogen atom?

(1)

- ☐ **A** 10^{-3} m
- ☐ **B** 10^{-10} m
- ☐ **C** 10^{-19} m
- ☐ **D** 10^{-31} m

(Total for question = 1 mark)

Q2.

What is the approximate size of a hydrogen atom?

(1)

- ☐ **A** 10^{-3} m
- ☐ **B** 10^{-10} m
- ☐ **C** 10^{-19} m
- ☐ **D** 10^{-31} m

(Total for question = 1 mark)

Q3.

Figure 7 shows the nuclei of four atoms.

$^{234}_{92}\text{U}$ uranium-234	$^{235}_{92}\text{U}$ uranium-235	$^{238}_{94}\text{Pu}$ plutonium-238	$^{238}_{95}\text{Am}$ americium-238
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Figure 7

Which two nuclei have the same number of neutrons?

(1)

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

(Total for question = 1 mark)

Q4.

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) In a controlled chain reaction of uranium-235, which of these could cause a uranium-235 nucleus to undergo fission?

(1)

- ☐ **A** an alpha particle
- ☐ **B** a beta particle
- ☐ **C** a neutron
- ☐ **D** a proton

(ii) The kinetic energy of one of the particles released in a fission reaction is 1.2×10^{-11} J.

The mass of the particle is 1.4×10^{-25} kg.

Calculate the velocity of the particle.

(3)

velocity of the particle = ... m/s

(Total for question = 4 marks)

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 ☒.

Figure 7 represents a decay that can happen inside the nucleus of an atom.

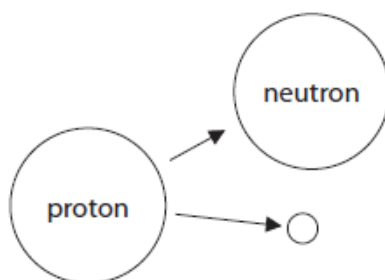


Figure 7

Which decay is represented in Figure 7?

(1)

- ☒ **A** alpha
- ☒ **B** beta minus
- ☒ **C** beta plus
- ☒ **D** gamma

(Total for question = 1 mark)

Q6.

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 ☐.

Figure 9 represents a decay that can happen inside the nucleus of an atom.

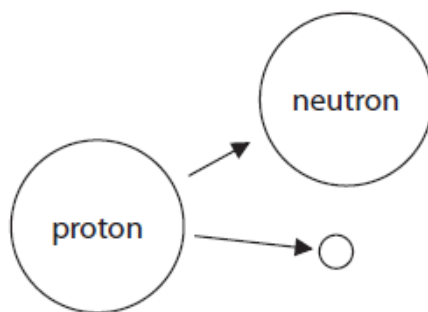


Figure 9

Which decay is represented in Figure 9?

(1)

- ☒ **A** alpha
- ☒ **B** beta minus
- ☒ **C** beta plus
- ☒ **D** gamma

(Total for question = 1 mark)

Q7.

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 ☐.

Which of these describes isotopes of an element?

(1)

☒ A	same atomic number	different number of neutrons
☒ B	same atomic number	different number of protons
☒ C	same mass number	different number of neutrons
☒ D	same mass number	different number of protons

(Total for question = 1 mark)

Q8.

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 ☐.

Which of these describes isotopes of an element?

(1)

☐ A	same atomic number	different number of neutrons
☐ B	same atomic number	different number of protons
☐ C	same mass number	different number of neutrons
☐ D	same mass number	different number of protons

(Total for question = 1 mark)

Q9.

Which of the following particles is absorbed and emitted during a nuclear fission reaction?

(1)

- ☐ A electron
- ☐ B neutron
- ☐ C positron
- ☐ D proton

(Total for question = 1 mark)

Q10.

The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave

Description 4

used in medical scanning

is emitted by the nucleus of an atom

typical wavelength 2.0×10^{-3} nm

name of wave

Q11.

The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave

Description 4

used in medical scanning

is emitted by the nucleus of an atom

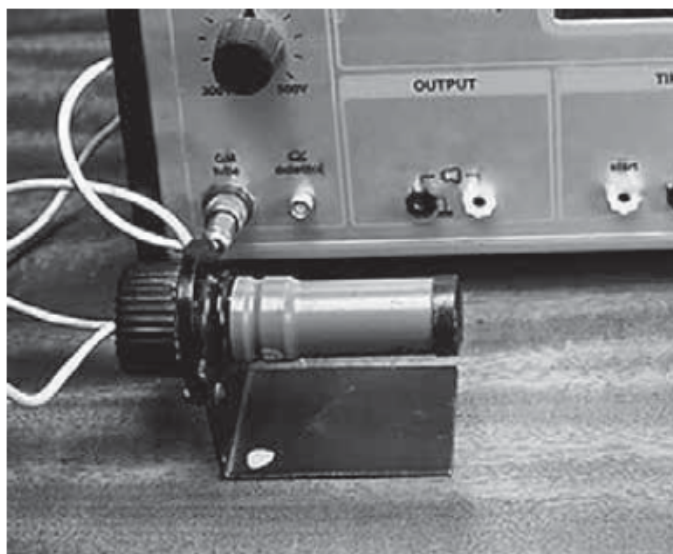
typical wavelength 2.0×10^{-3} nm

name of wave

(Total for question = 4 marks)

Q12.

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



© Andrew Lambert Science Photo Library

Figure 4

Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

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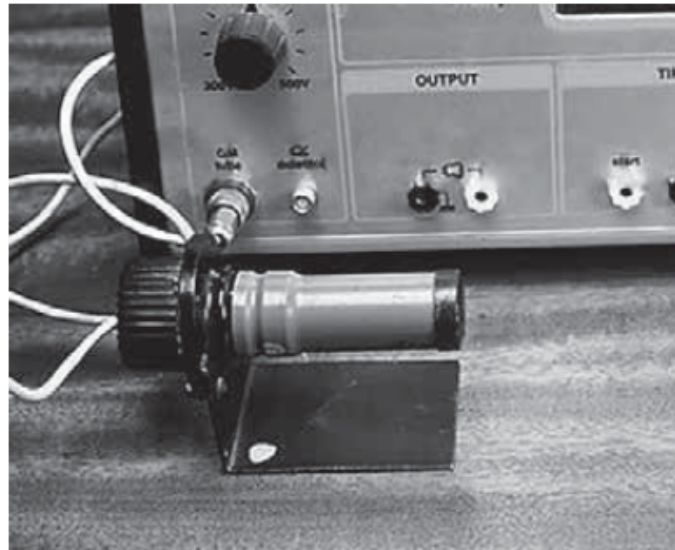
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(Total for question = 4 marks)

Q13.

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



© Andrew Lambert Science Photo Library

Figure 4

Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

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(Total for question = 4 marks)

Q14.

(i) State the name of an instrument that can be used to measure radioactivity.

(1)

.....

(ii) State **two** sources of background radiation.

(2)

1

2

(Total for question = 3 marks)

Q15.

(i) State the name of an instrument that can be used to measure radioactivity.

(1)

.....

(ii) State **two** sources of background radiation.

(2)

1

2

(Total for question = 3 marks)

Q16.

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

* Nuclear fission is used in nuclear reactors in some power stations.

In the reactor, a fission chain reaction is maintained and controlled to produce a supply of energy to generate electricity.

Figure 14 is a diagram of a nuclear reactor.

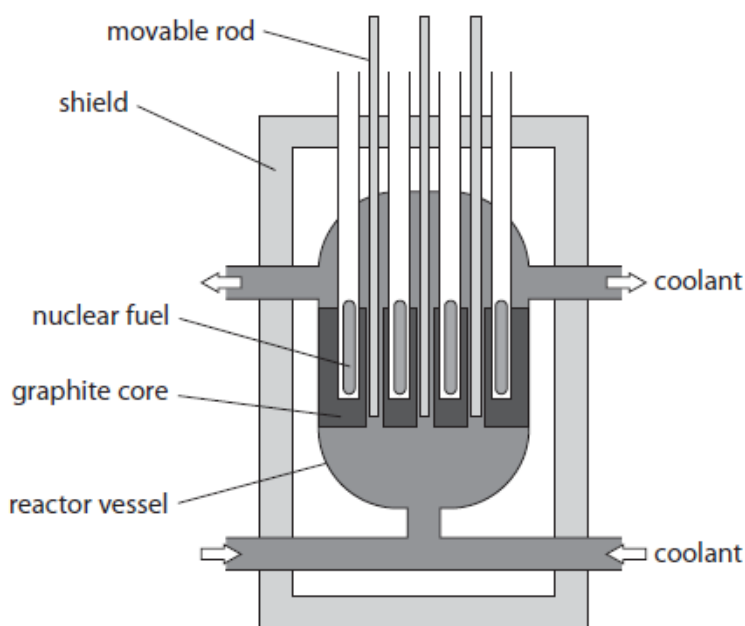


Figure 14

Explain how the graphite core and the movable rods are used to maintain and control the chain reaction.

(6)

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(Total for question = 6 marks)

Q17.

Many countries generate electricity using nuclear fission.

(a) The decay products from nuclear fission emit different types of ionising radiation.

Draw **one** line from each type of radiation to its correct description.

(2)

type of radiation		description
alpha	●	● electromagnetic wave
beta	●	● electron
gamma	●	● helium nucleus

(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

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Q18.

Engineers are trying to generate electricity using the energy from nuclear fusion reactions.

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

High temperatures and pressures are needed in a nuclear fusion reactor. This is to overcome

(1)

- ☐ **A** the kinetic energy of nuclei
- ☐ **B** the electrostatic repulsion of protons
- ☐ **C** the magnetic repulsion of neutrons
- ☐ **D** nuclear fission

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

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Q19.

(a) Fast neutrons are released during nuclear fission.

(i) Three different components of a nuclear fission reactor are shown. Three different materials used in a nuclear fission reactor are also shown.

Draw one line from each component to the material it contains.

Component	Material
fuel	boron (absorbs neutrons)
control rod	uranium (releases neutrons)
moderator	graphite (slows neutrons)

(ii) Another type of nuclear reactor is a fusion reactor.
Nuclear fusion also releases fast neutrons.

Suggest why a nuclear fusion reactor does not need anything to slow these neutrons down.

(1)

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(b) Both nuclear fission and nuclear fusion release thermal energy.

Describe how the thermal energy released could be converted into electrical energy in a power station.

(3)

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*(c) Scientists and engineers are still trying to build a practical and economic nuclear fusion reactor.

They have not been able to sustain the extreme conditions needed for controlled nuclear fusion.

Explain what these conditions are and why they are needed.

(6)

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(Total for Question = 12 marks)

Q20.

Plutonium-238 is used in spacecraft to provide heat to power generators.

One of these generators contains 925 g of plutonium-238 when it is manufactured.

One gram of plutonium-238 has a power density of 0.54 W/g.

Plutonium-238 has a half-life of 87.7 years.

Calculate the average energy released per second by the generator after 263 years.

(4)

average energy released per second = ... (J)

(Total for question = 4 marks)

Q21.

One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:



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

The number of neutrons in a nucleus of potassium-40 is

(1)

☐ **A** 19

☐ **B** 21

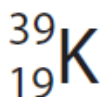
☐ **C** 40

☐ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

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

(1)



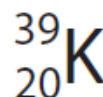
☐ **A**



☐ **B**



☐ **C**



☐ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

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Q22.

One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:



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

The number of neutrons in a nucleus of potassium-40 is

(1)

☐ **A** 19

☐ **B** 21

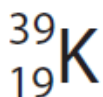
☐ **C** 40

☐ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

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

(1)



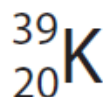
☐ **A**



☐ **B**



☐ **C**



☐ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

(2)

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The table gives the average dose of radiation a person received from various sources.

radiation source	average radiation dose (arbitrary units)
average yearly background	3000
one chest X-ray	20
one CT scan of the chest	6000
one whole body CT scan	20000
one PET scan	6000

(i) Explain why a CT scan of the chest gives a much higher dose of radiation than a chest X-ray.

(2)

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(ii) Justify the use of medical procedures which give patients large doses of radiation.

(2)

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Q24.

The table gives the average dose of radiation a person received from various sources.

radiation source	average radiation dose (arbitrary units)
average yearly background	3000
one chest X-ray	20
one CT scan of the chest	6000
one whole body CT scan	20000
one PET scan	6000

(i) Explain why a CT scan of the chest gives a much higher dose of radiation than a chest X-ray.

(2)

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(ii) Justify the use of medical procedures which give patients large doses of radiation.

(2)

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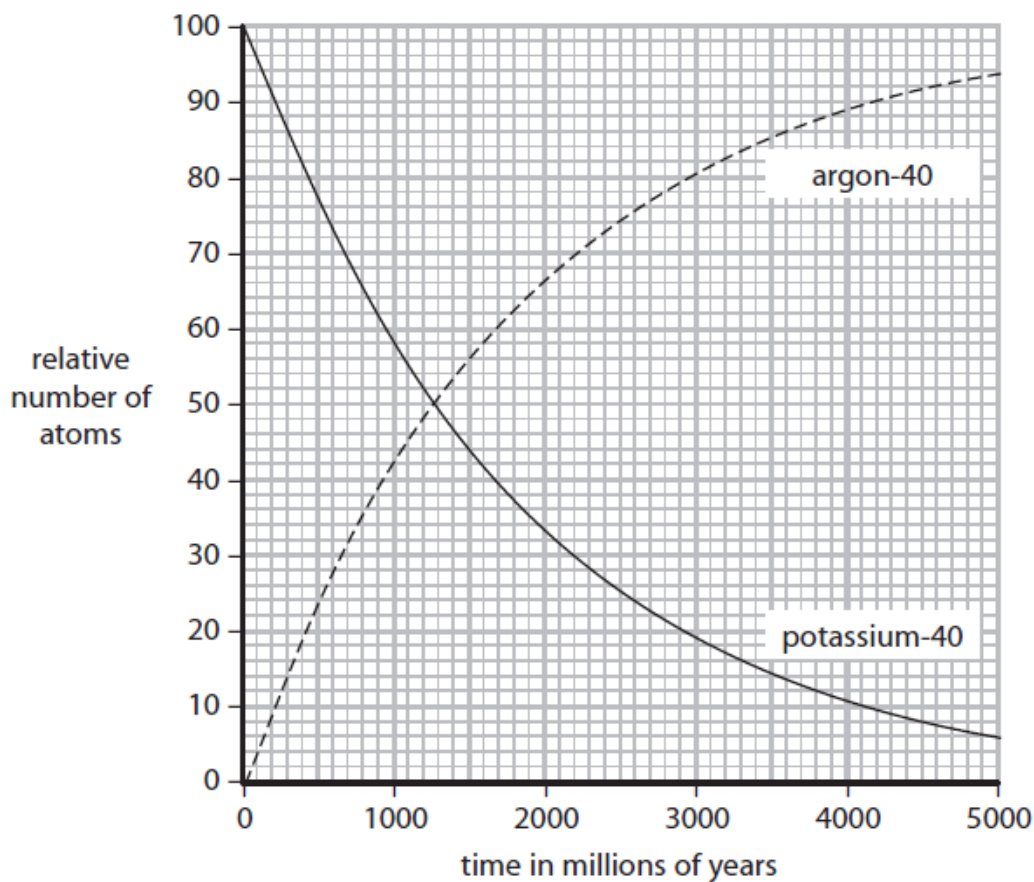
Q25.

Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

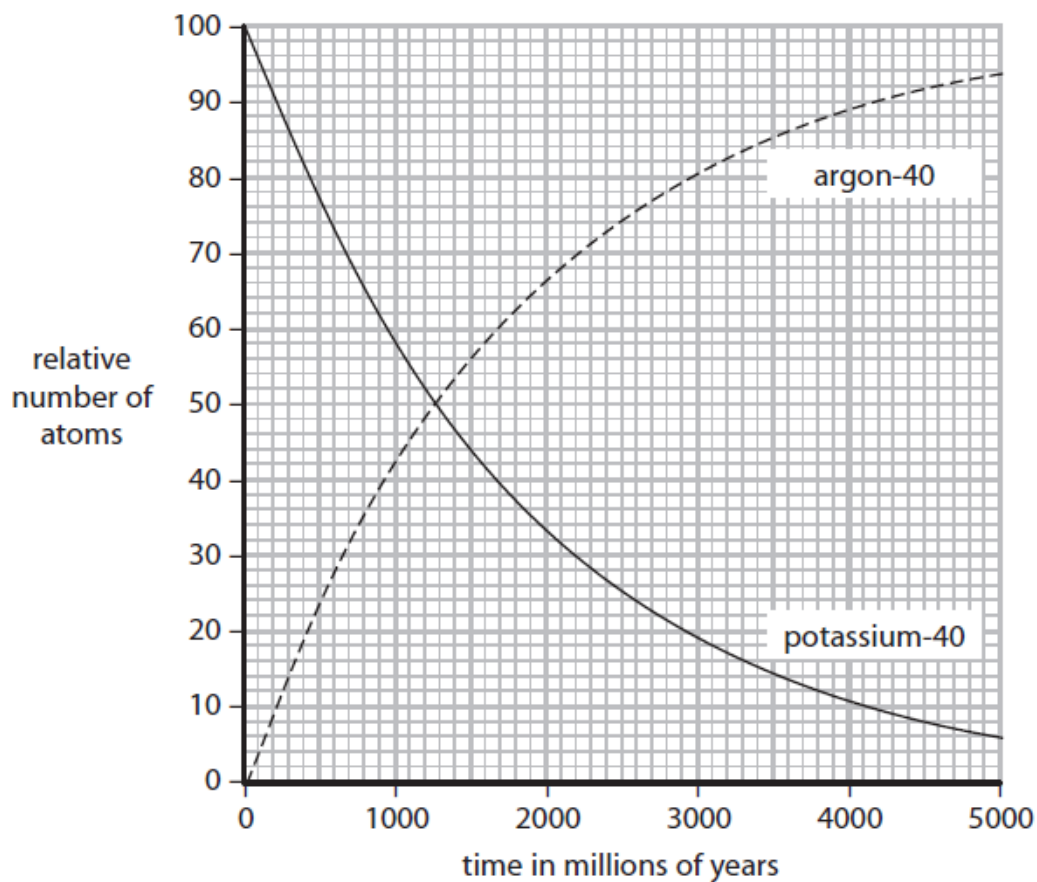
Q26.

Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

Q27.

Many different types of radioactive isotope are used for the diagnosis and treatment of medical conditions.

(i) Iodine-123 is used as a radioactive tracer to diagnose thyroid problems.

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

This tracer must have a half-life of

(1)

- ☐ **A** a few days
- ☐ **B** a few hours
- ☐ **C** less than a second
- ☐ **D** several weeks

(ii) Pellets which contain radium-223 can be put inside the body to treat cancers.

Radium-223 has a half-life of 11.4 days and emits alpha radiation.

Explain why radium-223 is suitable for use inside the body to treat cancers.

(3)

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Q28.

Many different types of radioactive isotope are used for the diagnosis and treatment of medical conditions.

(i) Iodine-123 is used as a radioactive tracer to diagnose thyroid problems.

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

This tracer must have a half-life of

(1)

- ☐ **A** a few days
- ☐ **B** a few hours
- ☐ **C** less than a second
- ☐ **D** several weeks

(ii) Pellets which contain radium-223 can be put inside the body to treat cancers.

Radium-223 has a half-life of 11.4 days and emits alpha radiation.

Explain why radium-223 is suitable for use inside the body to treat cancers.

(3)

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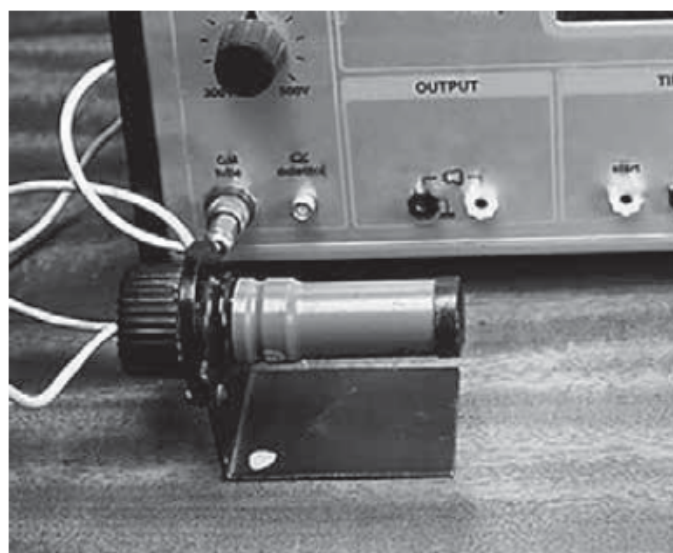
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Q29.

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



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Figure 4

A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

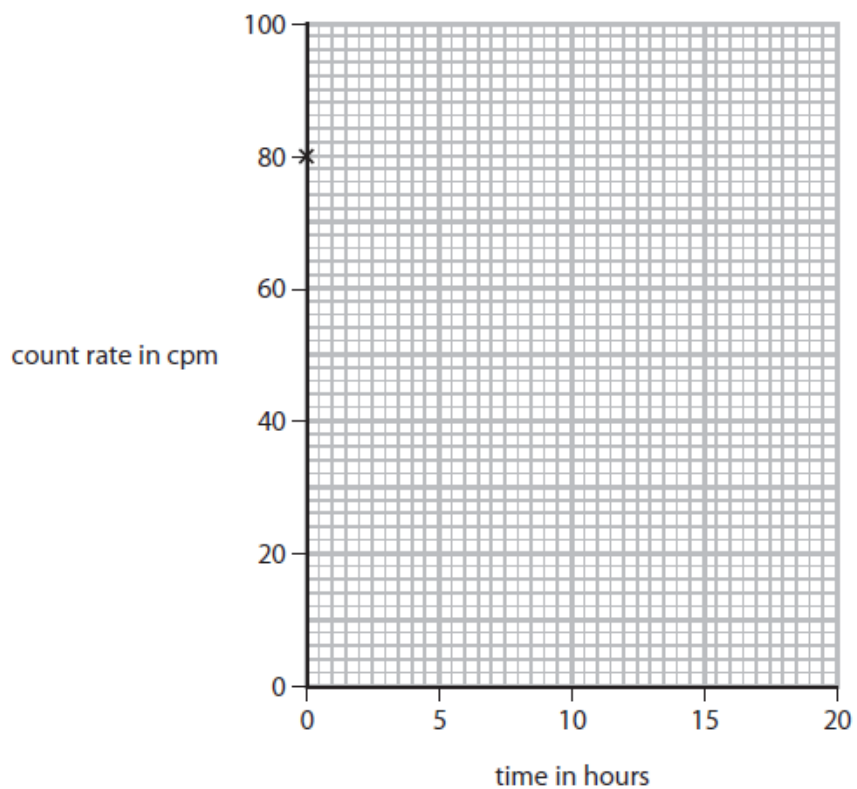


Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

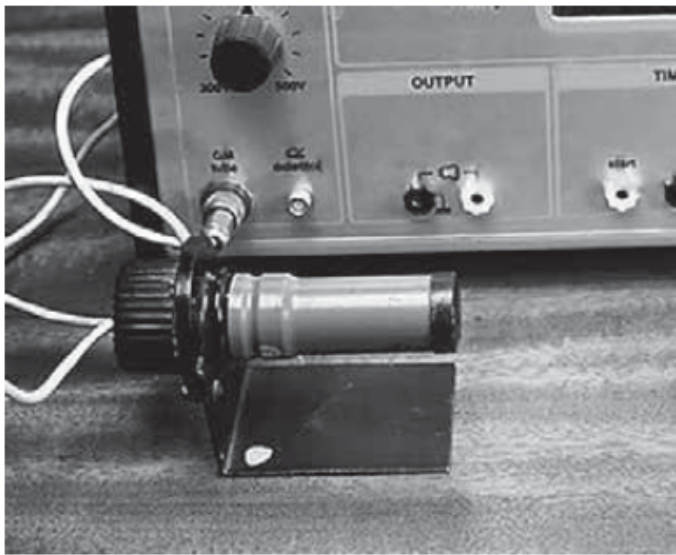
The first point is already drawn in Figure 5.

(3)

(Total for question = 3 marks)

Q30.

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



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Figure 4

A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

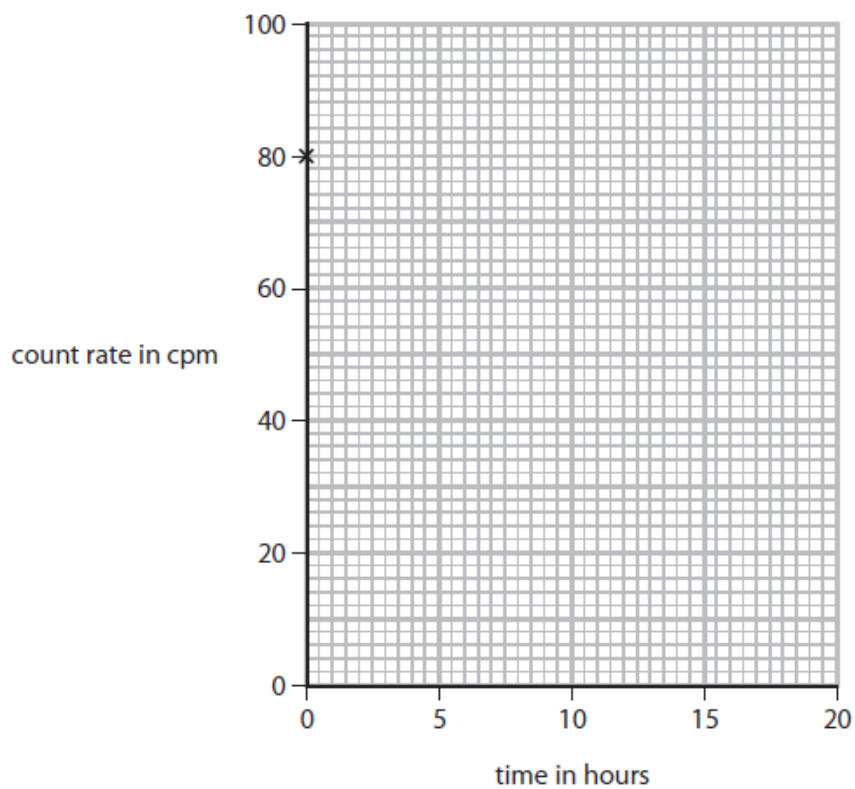


Figure 5

Complete the graph on Figure 5, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 5.

(Total for question = 3 marks)

Q31.

Gamma radiation is part of the electromagnetic spectrum.

When the nucleus of an atom emits a gamma ray, the number of protons in the nucleus and the number of neutrons in the nucleus **do not** change.

State how the nucleus **does** change when it emits a gamma ray.

(1)

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(Total for question = 1 mark)

Mark Scheme

Q1.

Question number	Answer	Mark
	B 10^{-10} m	(1)

Q2.

Question number	Answer	Mark
	B 10^{-10} m	(1)

Q3.

Question number	Answer	Mark
	B	(1)

Q4.

Question Number:	Answer	Mark
(i)	☐ C a neutron The only correct answer is C (neutron causes U-235 fission) A is not correct – incorrect particle B is not correct – incorrect particle D is not correct – incorrect particle	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	recall and substitution (1) $1.2 \times 10^{-11} = \frac{1}{2} \times 1.4 \times 10^{-25} \times v^2$ rearrangement (1) $v^2 = \frac{2 \times 1.2 \times 10^{-11}}{1.4 \times 10^{-25}}$ evaluation (1) (v=) 1.3×10^7 (m/s)	accept rearrangement and substitution in either order ignore POT until evaluation $v^2 = 1.71 \times 10^{14}$ allow numbers that round to 1.3×10^7 (m/s) 1.3 to any other power of ten scores 2 marks award full marks for the correct answer without working	(3)

Q5.

Question number	Answer	Mark
	☒ C beta plus Options A, B and D are not represented by Figure 9.	(1)

Q6.

Question number	Answer	Mark
	☒ C beta plus Options A, B and D are not represented by Figure 9.	(1)

Q7.

Question number	Answer	Mark			
	<table border="1"> <tr> <td>A</td><td>same atomic number</td><td>different number of neutrons</td></tr> </table> Options B, C and D have wrong combinations	A	same atomic number	different number of neutrons	(1)
A	same atomic number	different number of neutrons			

Q8.

Question number	Answer	Mark			
	<table border="1"> <tr> <td>A</td><td>same atomic number</td><td>different number of neutrons</td></tr> </table> Options B, C and D have wrong combinations	A	same atomic number	different number of neutrons	(1)
A	same atomic number	different number of neutrons			

Q9.

Question number	Answer	Mark
	B neutron	(1)

Q10.

Question Number	Answer	Additional guidance	Mark
	in this order infrared (wave) / IR (1) micro(wave) (1) radio (wave) (1) gamma (ray/wave)(1)	accept μ (wave) accept γ not X	(4) AO 1 1

Q11.

Question Number	Answer	Additional guidance	Mark
	in this order infrared (wave) / IR (1) micro(wave) (1) radio (wave) (1) gamma (ray/wave)(1)	accept μ (wave) accept γ not X	(4) AO 1 1

Q12.

Question Number	Answer	Additional guidance	Mark
	a description that combines 4 points from the following: 1. put rock(s) in front of/near tube (1) 2. measure (count rate) separately for the two different rocks (1) 3. measure each count for the same time period (1) 4. keep source-detector distance the same for both rocks (1) 5. take (into account)/measure background count (1) 6. repeat readings and take average(s) (1)	not "in" tube keep rocks apart	(4) AO 2 2

Q13.

Question Number	Answer	Additional guidance	Mark
	a description that combines 4 points from the following: 1. put rock(s) in front of/near tube (1) 2. measure (count rate) separately for the two different rocks (1) 3. measure each count for the same time period (1) 4. keep source-detector distance the same for both rocks (1) 5. take (into account)/measure background count (1) 6. repeat readings and take average(s) (1)	not "in" tube keep rocks apart	(4) AO 2 2

Q14.

Question Number	Answer	Additional guidance	Mark
(i)	Geiger (Müller counter) (1)	GM (tube/meter) or other appropriate detector e.g. dosimeter, film badge, scintillation counter accept incorrect spellings such as "giga" ignore radioactive counter	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	any two acceptable sources from cosmic (rays) (1) Sun (1) rocks / ground (1) {nuclear / atomic} tests / nuclear waste (1) (nuclear) power stations (1) plant (sources) (1) buildings (1) food (1) water (1) medical (1) radon (1)	cosmic microwave background radiation (CMBR) accept nuclear accidents (Chernobyl, Fukushima etc) accept named foods accept X-rays, radiotherapy ignore alpha, beta, gamma	(2)

Q15.

Question Number	Answer	Additional guidance	Mark
(i)	Geiger (Müller counter) (1)	GM (tube/meter) or other appropriate detector e.g. dosimeter, film badge, scintillation counter accept incorrect spellings such as "giga" ignore radioactive counter	(1)

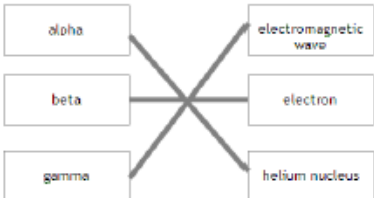
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Q16.

Question Number	Answer	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 • neutrons released in a chain reaction • slow(er) neutrons needed for fission • (some) neutrons are too fast • control rods can be moved in and out • control rods control speed of the reaction AO2 • graphite core is the moderator • graphite core slows down the neutrons • moveable rods absorb neutrons • moveable rods make more or fewer neutrons available for fission	(6) AO 1 1 AO 2 1

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	• An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Q17.

Question Number	Answer	Acceptable answers	Mark
(a)	Three lines as shown:  (2)	Any one line correct only scores 1 mark	(2)

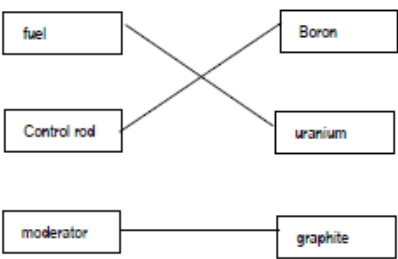
Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking Absorb (more) neutrons (1) (to) reduce the number of fission reactions (1)	ignore slow down neutrons slow down (the rate of) the reaction/fission	(2)

Q18.

Question Number	Answer	Acceptable answers	Mark
(i)	B electrostatic repulsion of protons		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	A description to include (two/or more/smaller) nuclei combine/fuse/join (1) (to produce) a larger nucleus (1)	{(two or more) hydrogen nuclei/protons OR deuterium and tritium} combine/fuse (forming) helium nucleus ONLY penalise use of atoms instead of nuclei ONCE ignore references to release of energy as this is given earlier in the question.	(2)

Q19.

Question Number	Answer	Acceptable answers	Mark
(a) (i)		All three correct for 2 marks One or two only correct for 1 mark Reject any box with more than one line	(2)

Question Number	Answer	Acceptable answers	Mark
(a) (ii)	A suggestion to include Neutrons do not need to be captured (by another nucleus) / do not play a part in the fusion process	Fusion does not use neutrons No chain reaction	(1)

Question Number	Answer	Acceptable answers	Mark
(b)	A description to include Thermal energy used to create steam / boil water(1) (Steam used to drive) turbine (1) (Turbine used to turn) generator (1)	Ignore detail of fission process.	(3)

Question Number		Indicative Content	Mark
QWC	* (c)	An explanation including some of the following points • Description of the problem - Nuclei have positive charge - Repel each other - Reduces possibility of suitable collisions - Rate of fusion too small to be useful • Description of how this can be overcome ○ Very high temperature (of fuel) ○ Very high KE / speed of nuclei ○ High KE can overcome repulsion ○ Very high density / pressure ○ Increases possibility of suitable collisions	(6)
Level	0	No rewardable content	
1	1 - 2	A limited explanation e.g. The fuel has to be at a high temperature to start the reaction/to make particles collide. Or The fuel has to be at a very high temperature and pressure. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	3 - 4	• A simple explanation. e.g. We need to overcome repulsion of nuclei to make them collide. This is achieved by having a high temperature and pressure. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	5 - 6	• A detailed explanation • e.g. The nuclei repel each other. To overcome this they need very high kinetic energy which is achieved by generating high temperature and pressure. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question = 12 marks)

Q20.

Question number	Answer	Additional guidance	Mark
	Determines number of half-lives and rounds (1) $263/87.7 = 3$ Determines that 3 half-lives is $1/2 \times 1/2 \times 1/2 = 1/8$ (1) Determines mass of Pu-238 after 3 half-lives (1) $925/8 = 115.625$ (g) Determines average energy released per second (1) $115.625 \times 0.54 = 62.4$ (J)	allow repeated division by 2 allow ecf from step 2 for 1 mark (mass of Pu-238 after 1 half-life $925/2 = 462.5$ (g)) allow ecf from 1 half-life or from step 3	(4)

Q21.

Question Number	Answer	Acceptable answers	Mark
(i)	B 21		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	A 39 19 K		(1)

Question Number	Answer	Acceptable answers	Mark
(iii)	A description to include any two of • (nucleus/isotope is) unstable (1) • (nucleus/isotope is) radioactive (1) • decay is random (1) • long half life (1)		(2)

Q22.

Question Number	Answer	Acceptable answers	Mark
(i)	B 21		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	A $^{39}_{19}\text{K}$		(1)

Question Number	Answer	Acceptable answers	Mark
(iii)	A description to include any two of • (nucleus/isotope is) unstable (1) • (nucleus/isotope is) radioactive (1) • decay is random (1) • long half life (1)		(2)

Q23.

Question Number	Answer	Acceptable answers	Mark
(i)	An explanation linking two of the following:- CT scan lasts much longer / X-ray short exposure (1) CT scan is many X-ray (slices) (1) The <u>intensity</u> of radiation for CT scans is higher than for normal X-rays (1)	For CT scan X-ray machine moves (slowly) around the body many pictures / series of X-rays/ 3D image	(2)

Question Number	Answer	Acceptable answers	Mark
(ii)	Justification including:- appreciation that there would be risks (1) ONE from:- non-invasive/ not painful (1) OR more accurate/better/earlier diagnosis (1) OR life-saving/ provide cure (1)	the benefits outweigh the risks/drawbacks/concerns/dangers gives more useful information	(2)

Q24.

Question Number	Answer	Acceptable answers	Mark
(i)	An explanation linking two of the following:- CT scan lasts much longer / X-ray short exposure (1) CT scan is many X-ray (slices) (1) The <u>intensity</u> of radiation for CT scans is higher than for normal X-rays (1)	For CT scan X-ray machine moves (slowly) around the body many pictures / series of X-rays/ 3D image	(2)

Question Number	Answer	Acceptable answers	Mark
(ii)	Justification including:- appreciation that there would be risks (1) ONE from:- non-invasive/ not painful (1) OR more accurate/better/earlier diagnosis (1) OR life-saving/ provide cure (1)	the benefits outweigh the risks/drawbacks/concerns/dangers gives more useful information	(2)

Q25.

Question Number	Answer	Acceptable answers	Mark
(i)	1250 (million years) (1)	Between 1200 and 1300 (my) inclusive	(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	2 half lives (1) 2500 (million years) (1)	Allow ecf from (bi) Give full marks for answer between 2400 and 2600 with no working.	(2)

Q26.

Question Number	Answer	Acceptable answers	Mark
(i)	1250 (million years) (1)	Between 1200 and 1300 (my) inclusive	(1)
(ii)	2 half lives (1) 2500 (million years) (1)	Allow ecf from (bi) Give full marks for answer between 2400 and 2600 with no working.	(2)

Q27.

Question Number	Answer	Acceptable answers	Mark
(i)	B a few hours		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	An explanation including three of the following: MP1 alpha/the radiation is (highly) ionising (1) MP2 the radiation destroys cancers/tumours (1) MP3 alpha particles/ do not penetrate very far in the body/inserted close to the cancer (1) MP4 half-life is long enough for the treatment to take effect (1) MP5 half-life is short enough so that the pellets do not need to be removed (1)	kills/ destroys/mutates cells mutates DNA alpha particles do not/ get out of the organ being treated/ damage cells in other organ Ignore patients being radioactive Ignore replacement of pellets	(3)

Q28.

Question Number	Answer	Acceptable answers	Mark
(i)	B a few hours		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	An explanation including three of the following: MP1 alpha/the radiation is (highly) ionising (1) MP2 the radiation destroys cancers/tumours (1) MP3 alpha particles/ do not penetrate very far in the body/inserted close to the cancer (1) MP4 half-life is long enough for the treatment to take effect (1) MP5 half-life is short enough so that the pellets do not need to be removed (1)	kills/ destroys/mutates cells mutates DNA alpha particles do not/ get out of the organ being treated/ damage cells in other organ Ignore patients being radioactive Ignore replacement of pellets	(3)

Q29.

Question Number	Answer		Mark
	- point after first half-life 6, 40 (1) - point after second half-life 12, 20 (1) - point after third half-life 18, 10 (1)	within 1 small square by eye smooth curve starting at 80, with a decreasing gradient passing through one correct half-life point scores 2 marks smooth curve starting at 80, with a decreasing gradient passing through two correct half-life points scores 3 marks if no other mark scored smooth curve showing decreasing gradient but not going through any correct points scores 1 mark	(3) AO 3 1a

Q30.

Question Number	Answer		Mark
	- point after first half-life 6, 40 (1) - point after second half-life 12, 20 (1) - point after third half-life 18, 10 (1)	within 1 small square by eye smooth curve starting at 80, with a decreasing gradient passing through one correct half-life point scores 2 marks smooth curve starting at 80, with a decreasing gradient passing through two correct half-life points scores 3 marks if no other mark scored smooth curve showing decreasing gradient but not going through any correct points scores 1 mark	(3) AO 3 1a

Q31.

	Answer	Additional guidance	Mark
	One from: rearrangement (of particles) (1) loses/emits energy (1) becomes (more) stable (1)		(1) AO1