

10 (a) Americium-241 is a radioactive isotope that emits alpha particles.

Americium-241 is used in smoke alarms.

Give a reason why it is safe to use americium-241 in smoke alarms.

(1)

(b) Iodine-131 is a radioactive isotope with a half-life of 8 days.

The activity of a sample of iodine-131 is 480 Bq.

Calculate the activity of the sample after 16 days.

(2)

activity = Bq

(c) A student uses 59 dice to model radioactive decay.

He starts by rolling all the dice at the same time.

He removes all the dice that show a six.

He then rolls the remaining dice.

The student repeats this process five more times.

State **two** improvements the student could make to his model of radioactive decay.

(2)

1.....

2.....

***(d) Radioactive isotopes can be used to investigate cancer and other illnesses.**

The thyroid gland in the neck absorbs most of the iodine that our bodies need.

A person can become ill if their thyroid absorbs too little iodine.

Explain how a radioactive isotope with suitable properties may be used to investigate the uptake of iodine by this gland.

(6)

(Total for Question 10 = 11 marks)

Question number	Answer	Additional guidance	Mark
10(a)	alpha cannot penetrate casing	alpha only travel a few cm in air	(1)

Question number	Answer	Mark
10(b)	<ul style="list-style-type: none"> • evidence of division of activity by 2 (1) • 120 (Bq) (1) 	(2)

Question number	Answer	Mark
10(c)	<ul style="list-style-type: none"> • increase number of starting dice (1) • do more rolls (1) 	(2)

*10(d)	<p>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.</p> <p>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.</p> <p style="text-align: center;">AO2 (6 marks)</p> <ul style="list-style-type: none"> • use a radioactive isotope of iodine as this is taken up by the gland • isotope given by injection or orally • gland is in the neck, so cannot use an alpha emitter as alpha will not exit through the skin • use beta or gamma emitter • isotope has to have a short enough half-life to minimise exposure to radiation but long enough for the reading to be taken • allow time for isotope to reach gland • use Geiger-Müller tube and counter to determine count rate of isotope in gland • compare with normal count rate to determine whether uptake of iodine is normal 	(6)
---------------	---	------------

Level	Mark	Descriptor
	0	No awardable content.
1	1–2	<ul style="list-style-type: none"> 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) Lines of reasoning are unsupported or unclear. (AO2)
2	3–4	<ul style="list-style-type: none"> 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) Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
3	5–6	<ul style="list-style-type: none"> 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) Lines of reasoning are supported by sustained application of relevant evidence. (AO2)