

WJEC Physics GCSE
Topic 2.8: Half life
Mark Schemes for
Questions by topic

Marking Scheme

1.

Question			Marking details	Marks
3.	(a)	(i)	Emits an electron	1
		(ii)	<u>It is the time taken to halve</u> / it takes <u>5 720 years to halve</u> (1) the number of C-14 nuclei (or atoms) / the mass (or amount) of C-14 / the activity / count rate (1) Treat radioactivity as neutral.	2
	(b)	${}^{14}_7\text{N}$ (2) ${}_{-1}^0\text{e}$ (1) beware of missing minus sign	3	
	(c)	(i)	It takes 4 half-lives (1) so time = $4 \times 5720 = 22\,880$ [years] (1)	2
		(ii)	100 years is only a [small] fraction or $\frac{1}{57}$ of a half-life (1) so difference in C-14 readings will be small / won't have decayed by very much (1) To award both marks both statements must be linked.	2
Question total			[10]	

2.

Question			Marking details	Marks
3.	(a)	(i)	4 (half-lives) (1)	1
		(ii)	2 or 120 (allow ecf from (i) above) (1). Hours or minutes (1). Unit must complement the answer. Accept min or h but not m for unit. If the unit is given with the answer, the unit given must agree with it.	2
		(iii)	4 [grams] (allow ecf from (i) above) If answer of 16 in (i) then award no mark here for 64/16	1
	(b)	Emits gamma (1) so it would not ionise [cells] much / radiation can be detected outside of the body / can get out of the body (1) Don't accept doesn't harm. Only gamma passes through the skin award 1 mark only OR Has a short half-life / has a half-life of <u>only</u> 30 mins (1) but doesn't last for long in the body / decays quicker (1). Accept safe after a short time. Don't accept escape quickly. To award both marks both statements must be linked.	2	
	Question total			[6]

3.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	2	<p>No credit is given for just naming the radioisotope</p> <p>Astatine Alpha particles highly ionising or easily absorbed [by cancer cells] or would not penetrate beyond the tumour [to affect healthy cells] (1) It decays [to a safe level] quickly or equivalent (1)</p> <p>Alternative solution: Tellurium Beta penetrates all of the tumour (1) It decays [to a safe level] quickly or equivalent (1)</p>	Alpha is not able to spread far [The source] won't last long in the body		Answers for any other radioisotope Attacks / kills the cancer cells the best. It is highly ionising. Any statement implying that it leaves the body quickly / the half-life is short.
	(ii)	2	<p>Cobalt / Caesium Beta / gamma will penetrate the <u>packaging/box</u> or kills bacteria (1) It won't need replacing for a long time / it lasts a long time (1)</p>			It has a long half-life
(b)	(i)	1	5			
	(ii)	2	<p>288 – 144 – 72 – 36 – 18 - 9 Process of halving from 288 (1) 5 times to arrive at 9 (1) ecf</p>	Answer only of 9 gets 2 marks		An incorrect answer with no workings shown e.g. 18 except for 4 half-lives in (b)(i) which gets 2 marks

4.

	ii	1	Helium nucleus / 2 protons + 2 neutrons			helium helium atom helium ion ${}^4_2\text{He}$
	iii	2	<p>Alpha particles have low penetrating power (1) so, cannot get through plastic or air to reach people (1) The 2nd mark can only be awarded if it is linked to the 1st mark.</p>	Alpha is highly ionising for the 1 st mark Alpha can't travel far through air = 2 marks	Cannot get through the skin, paper	
Total		12				

5.

Question		Answer / Explanatory Notes	Marks Available
		Question total	[8]
2.	(a)	(i) Helium <u>nucleus/nuclei</u> / 2 protons and 2 neutrons (accept 2p and 2n)	1
		(ii) Gamma more penetrating than alpha / so would not be blocked by smoke / wouldn't change the current / weakly ionising. <u>Any 2 x (1) due to all points being interlinked.</u> Or gamma is more weakly ionising (1) so doesn't cause an electric current (1) (Don't accept gamma is not ionising.)	2
		(iii) Distance between detector / ceiling and the human body (1) so / hence alpha is easily absorbed by the air / case (1) (Answer must be relevant to this context so don't accept alpha will be blocked by skin.)	2
	(b)	(i) <u>Longer ½-life</u> (1) (don't accept longer to decay) so detector stays active / works longer or doesn't need replacing [as often] (1)	2
		(ii) I. becquerel [accept [Becquerel!]/ Bq / bq]	1
		II. 26 000 is half of 52 000 (1 – method) so time is one ½-life = <u>432</u> [years] (1)	2
		(Accept $\frac{52000}{2}$ as recognition of half-life – don't allow any other value divided by 2). III. $\frac{864}{432} = 2$ or 864 years is 2 ½-lives (1) so ¼ of the mass remains = <u>0.1</u> [µg] (1)	2
		Question total	[12]

6.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	Ticks in boxes 3 and 4 (2)	Crosses in boxes		Extra crosses in other boxes (minus 1 for each)
(b)	(i)	1	400 [counts/min]		
	(ii)	1	100 [days]		
	(iii)	1	Same answer as (ii)		
	(iv)	1	Line drawn below the curve from (0,800) Allow ± one small square tolerance on (0,800) plot	Line that curves upwards at the end Line that does not extend all the way to 400	A straight line. A line that crosses / touches the one given / touches the time axis. Line on previous grid.
Total Mark	6				

7.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		2	The time taken for the mass / number of un-decayed particles / count rate / cpm / activity / number of nuclei / number of atoms (1) to reduce by half (1)	Amount of radioactive material	Reference to named radioisotope	Size / volume Decay Radioactivity Amount Radiation Radioactive substance Atom Particles
(b)		2	At least one construction line demonstrating halving (1) Half-life = 11 ± 0.4 [days] (1)			
(c)		2	Convert values or graph scale by some suitable factor [draw lines across and down to find the required time interval] (1) To give a pair of stated values that fall within the range of the graph (1) Note that the lowest stated value can't be lower than 20			
Total		6				