Mark scheme

Half-life

Physics 0625 · Questions from Paper 3 and Paper 4

Total marks

58

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	Total
4	5	5	6	6	7	7	9	9	**58**

Question 1 [4]

1(a)	$9.6 \times 10^8 / 8$ 1.2×10^8 (atoms)	**C1** **A1**
1(b)	160 – 16 OR 144 (144 / 8 + 16 = 18 + 16 =) 34 counts / minute	**C1** **A1**

Question 2 [5]

2 (a) 37.5 ± 0.4 s — B1

(b) 3 — B1

(c) his(a) / his(b) — C1
in range 12 to 13 OR his value calculated correctly — A1

(d) curve above existing line at all points and roughly parallel — B1 [5]

STEM | Exam Builder

Question 3 **[5]**

3	**(a)**	12 counts / min	B1	[1]
	(b) **(i)**	72 counts / min (e.c.f. from **11(a)**)	B1	
	(ii)	9 counts / min (note: if background not subtracted, **(i)** 84 and **(ii)** 21 gains 1 compensatory mark)	B1	[2]
	(c)	9/72 **or** 1/8 **or** 3 (half-lives) **or** (e.c.f.) 21/84 **or** 1/4 **or** 2 (half-lives)	C1	
		3.0 minutes **or** 4.5 minutes (i.e. background not subtracted but otherwise correct)	A1	[2]

[Total: 5]

Question 4 **[6]**

4	**(a)**	student C OR the last one	B1	
	(b)	half-life ticked	B1	
	(c) **(i)**	4 (hours)	B1	
	(ii)	1	B1	
	(iii)	17 hours (gives 100 cpm)	C1	
		13 (hours)	A1	[6]

Question 5 **[6]**

5	**(a)**	(radio)activity OR count rate OR counts/s OR particles emitted/s OR rate of decay OR number of <u>undecayed</u> atoms/nuclei OR radiation OR original number of atoms/nuclei NOT mass/substance/material, unless clearly specified	B1	
		to decrease to half (original value) NOT half the time	B1	
	(b) **(i)**	53 ± 1 (s)	B1	
	(ii)	84 ± 1 (s)	B1	
	(iii)	candidate's **(ii)** + candidate's **(i)**	C1	
		correct evaluation of candidate's **(ii)** + candidate's **(i)**	A1	[6]

STEM | Exam Builder

Question 6 [7]

6(a)	78	B1
6(b)	(radiations that) remove electrons OR break molecules	B1
6(c)	pair of count-rate values used	C1
	clear indication of use of graph, expect two vertical lines or two clear indications on axes using their values	C1
	8 days (± 1 day)	A1
6(d)	2 half-lives	C1
	240 hours	A1
	Total:	**7**

Question 7 [7]

7(a)	line from A to middle box: nucleon number	B1
	line from Z to bottom box: proton number	B1
7(b)(i)	(from June 2004 to June 2014 =) 10 (years)	B1
	(decrease in activity from) 80 000 (Bq) to 20 000 (Bq) takes 2 half-lives	B1
	10 ÷ 2 = (5 years)	B1
7(b)(ii)	(decrease in activity from) 20 000 (Bq) to 10 000 (Bq) is one half-life	C1
	so half the time difference = 5 years OR 2019	A1

Question 8 [9]

8 **(a)** all 5 points plotted ± ½ small square -1 e.e.o.o. B2

smooth best-fit single line curve through most of the points, not joining points dot to dot B1

(b) **(i)** half / 50% / 0.5 / ½ B1

(ii) indication of correct use of graph B1

idea of halving, e.g. 175 or mark at 175 on graph, **NOT** halving number of days, i.e. 7 C1

3.4 – 4.0, accept nearest integer from candidate's graph A1

(iii) **1.** candidate's **(ii)** **OR** integer either side of candidate's **(ii)** M1

2. half-life not affected by sample size / starting point
accept idea that half-life does not change. A1

[Total: 9]

STEM | Exam Builder

Question 9 [9]

9(a)	(nucleus of carbon-14 contains) more neutrons **OR** (nucleus of) carbon-12 has fewer neutrons	**B1**
	*any **one** from:* • (atom / nucleus of carbon-14) is heavier • (atom / nucleus of carbon-14 is) not stable • (nucleus of carbon-14 contains) two more neutrons	**B1**
9(b)(i)	Every 5700 years the (remaining) carbon-14 decreases by half **OR** amount of C-14 halved every half life	**A2**
	amount of carbon-14 halves in 5700 years **OR** amount of carbon-14 decreases at a decreasing rate (with time)	C1
9(b)(ii)	11 000 (years ago)	**A3**
	2 × half-life have elapsed	C1
	25% of C-14 at time of death is still present in tree OR 75% of C-14 has decayed**.**	C1
9(c)	medical tracers **OR** medical imaging **OR** medical diagnosis	**B1**
	*any **one** from:* • keep dose low • doesn't stay in body too long • less damage (to body) OR less harmful (to humans)	**B1**

STEM | Exam Builder