WJEC Physics GCSE
Topic 2.7: Types of radiation
Mark Schemes for Questions by topic

1.

Question			Marking details	Mark
3.	(a)		$^{12}_{6}C$	1
	(b)		14 (1), 1 (1) N.B. must look like a subscript	2
	(c)		6 (1), 8 (1), 0 (1)	3
			Question total	**[6]**

2.

Question				Marking details	Marks
5.				X is iodine – 131 (1) Reasoning: count rate only reduced by lead / so must be gamma emitter (1) Y is silver – 110 (1) Reasoning: count rate reduced by aluminium and lead / so must be beta and gamma emitter (1) Z is radium – 226 (1) Reasoning: count rate reduced by paper and lead / so must be alpha and gamma emitter (1) **AWARD A MAXIMUM OF 5 MARKS ONLY** **Question total**	5 **[5]**

3.

Question			Marking details	Mark
3.			Beta stopped at aluminium (1) Gamma stopped at lead or passes through the lead (1) Alpha stopped at thin paper (1) **Question total**	3 **[3]**

4.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	One quarter / 25% (1) × 20 = 5 [cpm] (1)	Alternative routes to get an answer of 5		
	(ii)		2	Repeat the test / counts per minute / take more readings (1) and find the mean (1) **OR** count / reading / measure over longer period of time (1) and divide by that number of minutes (1)			
	(iii)		1	Radon **OR** buildings / soil	Ground / earth		Named rocks / uranium
(b)	(i)		2	350 – 20 (1 - for subtraction of 20 from any value) = 330 [cpm] (1)			
	(ii)		2	Alpha (1) Because the reading is reduced [to background level] by thin card / can't penetrate thin card (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	**Alternative for the 2nd mark:** If it was beta or gamma the reading wouldn't be reduced by thin card		Alpha with beta or gamma Alpha absorbed by card and gamma absorbed by lead
	(iii)		1	Range of alpha is only a few [about 30] cm in air / can't penetrate the skin or clothes / not very penetrating	Short range in air can't reach them		Only harmful inside the body
	(iv)		2	Aluminium has no effect on the count rate (1) because only gamma passes through aluminium / beta can't pass through aluminium (1) **The 2nd mark can only be awarded if it is linked to the 1st mark.**	There's still a [small] count rate [beyond lead] (1) only gamma goes through lead (1)	Reference to alpha	
	(v)		1	Background count varies over time / random			

5.

Question				Marking details	Marks
2.	(a)	(i)		Radioactive decay is random (more than one tick don't award the mark)	1
		(ii)		Dividing by 5 **or** total of 175 (1) mean = 35(1) (Answer alone gets both marks) (174/5 = 35 award 1 mark only)	2
		(iii)		Take the readings with no source (must be implied source is removed rather than distance increased)	1
	(b)	(i)	(I)	Nuclear industry	1
			(II)	50[%]	1
		(ii)		Different areas have different rocks in the ground / some areas have more uranium than others / more or less granite in the ground	1
				Question total	[7]

6.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			6	**Indicative content:** Cobalt – 60 is used in radiotherapy treating brain tumours. It is a gamma emitter which is necessary so the radiation can penetrate the skull to reach the tumour. Iodine – 123 is used to check thyroid function. It has a relatively short half-life which is important so that it decays quickly minimising harm to the patient. **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.			
				1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.			
(b)	(i)		2	95 (1) 237 (1)			
	(ii)		2	Radiation is alpha **or** it is alpha (1) Which is stopped by the plastic casing **or** which is stopped by air between the source and people (1) **The 2nd mark should be linked to the 1st mark.**	Source emits alpha which only travels a few cm in air (2)	Stopped by paper or skin (2nd mark)	
Total			**10**				

7.

Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
(a)			2	Ticks by ultraviolet (1) and X-rays (1) Deduct 1 mark for each extra tick to a maximum of 2 marks			
(b)	i		1	Gamma			
	ii		1	Gamma			
(c)			2	Reference to containment (1) Long term storage (1)	Long half-life / long time to decay / thousands of years to decay (1) Deep underground (1)	Security Monitoring Cost Leaks Highly penetrating	Highly radioactive / emits radiation / hundreds of (or many) years to decay / lasts for a long time / decompose
Total			6				

8.

Question			Marking details	Marks
5.	(a)		To smooth out random fluctuations in data / even out variations / reduces [the effect of] anomalies **Accept** less anomalies / odd results / closer estimate **Do not accept** prevents anomalies / more reliable / more accurate	1
	(b)		Plots (allow ± ½ small square division) (2) -1 for each error to a maximum of 2. Smooth curve of best fit drawn from last given point (4 rolls) onwards but must encompass all points (1)	3
	(c)	(i)	About 4 [rolls]. Accept any x where 4 > x > 3.6 inclusive	1
		(ii)	Method shown on grid (1)[line across or down probably at 200] ~3.8 [rolls] (1-value taken from their graph ± 0.1)	2
		(iii)	Allows (more) <u>precise / accurate</u> value to be obtained / to nearest 0.1 of a roll **Accept** graph is more accurate **Don't accept** exact value / more reliable value	1
		(iv)	7.6 (1-value taken from graph ± 0.1) value is approximately 2 half-lives (1) **Don't accept** ¼ of original value	2
	(d)	(i)	Identifying 3 half-lives (1) $\frac{210}{3}$ = 70 [s] (1-ans) **Don't accept** 80→40→20→10 without any qualification	2
		(ii)	5 half-lives required (1) 5 × 70(**ecf**) = 350 [s] (1)	2
		(iii)	becquerel, **accept** bq, Bq, any reasonable spelling	1
			Question total	**[15]**

9.

Question				Marking details	Marks
7.	(a)	(i)		[Same] number (accept amount) of protons / 53 protons / [same] proton number / Don't accept: same number of protons and electrons or same atomic number or 53 or reference to the mass number being equal to 53.	1
		(ii)		[Different] number of neutrons / nucleons Accept [different] number of protons and neutrons / one has 70 neutrons and the other has 78 neutrons. Don't accept different mass numbers or 123 and 131.	1
	(b)	(i)		[fast moving / high energy] electron (accept slow electron) Don't accept positive electron.	1
		(ii)		$I \rightarrow {}^{131(1)}Xe + {}_{-1(1)}\beta + \gamma$	2
	(c)			Gamma is less ionising (1) so is easily detected outside of the body / penetrates the body or skin well / is less harmful (1). OR because beta would be more ionising (1) so is less penetrating / less likely to get out of the body / more harmful (1). OR Iodine-123 has a shorter half-life [13 hours] (1) so it decays quicker (1) don't accept escapes quicker **Either mark can be awarded on its own but only award 2 marks if they are linked.**	2
	(d)	(i)		Plots (2) allow ± ½ small square division (deduct 1 mark for each incorrect plot) smooth curve (1) allow **ecf** Don't accept double lines /whispy / thick / disjointed / wobbly lines.	3
		(ii)		Lines/points on grid from 12 and 3 to the curve or down to time axis (1) time interval of 16 [days] ± 1 [day] / equal to two half-lives (1). Apply **ecf** for the graph.	2
				Question total	**[12]**