Radioactivity

Mark Scheme 2

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Atomic Physics
Sub-Topic	Radioactivity
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 2

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

1 **(a)**	γ not deflected	NOT extra(s) in γ column	B1
	α towards –ve or +ve AND β opposite	NOT extra(s) in α or β column	B1
	α towards –ve AND β towards +ve	NOT extra(s) in α or β column	B1

(b) atoms / molecules (condone particles) lose / gain electrons OR become charged
NOT α or β particles lose / gain electrons OR become charged B1

(c) maximum three points (to include at least one explanation) from:
maximum two points from:

- α is charged / is a helium <u>ion</u> (is scored if 3rd explanation bullet point scored)
- γ is not charged
- α has mass
- γ does not have mass
- α has large size
- γ has negligible / no size
- γ is electromagnetic (wave) / photon
- α travels more slowly (than γ, but NOT more slowly than speed of light unless next bullet point is also scored)
- γ travels at the speed of light / faster (than α)

any explanation (maximum three) e.g.:

- α makes frequent collisions (with air molecules) so range short
- γ has few (successful) collisions (with electrons) so not very ionising / range long
- α more ionising because it has <u>greater</u> charge
- γ has no charge so less ionising
- α loses some energy with each collision so range short
- γ loses energy in single rare collision so takes longer distance before losing all energy
- γ faster so travels further before energy is lost
- different methods of ionisation make α more ionising

B3

[Total: 7]

2 **(a** background (radiation) **OR** a specific source of background radiation e.g. rocks / building materials / radon gas / cosmic rays B1

(b) any three from:
low count rate due to background radiation only
slightly less reading due to random nature of radioactivity
very high reading due to α-particles OR emission from source
sudden increase of count rate at limit of range of α-particles B3

(c) (i) downward curve B1

(ii) (count rate) decreases / background only B1
deviation starts at start of plates B1

[Total: 7]

3 **(a) (i) 1.** electron B1

2. sensible mention of decay (of source) **NOT** decay of something inappropriate B1
half-life mentioned sensibly **OR** activity decreases **OR** fewer (radioactive/unstable) atoms / nuclei present B1

(ii) α-particles range < 10 cm **OR** short owtte B1

α more ionising (than β) **OR** have more mass / charge / size / collisions **OR** shorter range than β **OR** reading is background radiation B1

(b) no part of electron path from R to L (note: no mark for this point, but must be present for subsequent marks to be awarded) M0

curve starts at end of plates **AND**
curve up and only up **OR** down and only down **OR** 3 or more curves, all up or all down B1

deflection down **AND** only down B1

[Total: 7]

4 **(a)** any one specific source of background radiation
e.g. rocks, ground, building materials, radon, radiation from space, Su
cosmic rays, nuclear waste B1

(b) (i) electromagnetic radiation **OR** photons B1
(very) high frequency **OR** (very) short wavelength **or** high energy B1

(ii) (count rate) decreases B1

(count rate decreases but) not completely absorbed (by lead)
OR only some γ-rays detected B1

(c) (i) no deflection (last / fifth box ticked) B1

(ii) (γ-rays) are uncharged / neutral (**IGNORE** not affected by magnetic fields) B1

[Total: 7]

5 **(a) (i)** 2 protons B1
2 neutrons B1

(ii) a (fast moving) electron B1

(b) electron/electrons removed from/gained by the molecule B1

(c) force because particle is charged
OR the force on the particles is perpendicular to their paths
OR direction of force changes as direction of motion changes B1

(ii) α-particle curve up the page in at least half of width of field B1

β-particle curve opposite to α-particle curve OR down page if α line has no curvature anywhere B1
smaller radius of β path clear B1

[Total 8]

6	**(a)**	**(i)**	same number of / 92 protons (in nucleus) (IGNORE electrons)	B1	
		(ii)	different number of neutrons	B1	
	(b)		most α-particles travel straight (through the foil)	M1	
			nucleus small / atom mostly empty space	A1	
			small number deflected (through large angles)	M1	
			most of mass in nucleus ACCEPT nucleus positive/charged	A1	[6]
7	**(a)**		12 counts / min		[1]
	(b)	**(i)**	72 counts / min (e.c.f. from **11(a)**)	B	
		(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]