

# Radioactivity

## Mark Scheme 1

Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Atomic Physics
Sub-Topic	Radioactivity
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 1

**Time Allowed:** 59 minutes

**Score:** /49

**Percentage:** /100

- 1 (a) (i) Protons: 53 neutrons: 78 electrons: 53 B2
- (ii)  $^{131}_{54}\text{Xe}$  B1  
B1
- (b) Points plotted at 3 of: 0 s, 50 s, 100 s, 150 s B
- 3 corrected counts/minute plotted at any from :
- (0, 280)
  - (50, 140)
  - (100, 70)
  - (150, 35)
- Graph drawn as curve through correct points M1  
A1
- [Total: 7]**
- 
- 2  $\gamma$  rays [1]
- ( $\gamma$  rays) detected at B [1]
  - ( $\gamma$  rays) not deflected by field / not charged [1]
  - charged particles /  $\beta$  particles (accept  $\alpha$  for charged particles) [1]
  - $\beta$  particles detected at C [1]
  - reference to direction of deflection / LH rule [1]
  - no  $\alpha$ -particles OR only background detected at A [1]

- 3 (a) electromagnetic (waves / radiation / rays / spectrum) B1  
OR (high energy) photons
- (b)  $\alpha$  and  $\beta$  deflected in opposite directions B1
- any 1 from: B1
- $\beta$  deflected more (than  $\alpha$ )
  - deflections perpendicular to field direction and to paths of particle
  - paths (of particles) are curves / circular / arcs
- (c) curved path B1
- (deflected/attracted) towards positively charged plate B1  
OR in opposite direction to field
- (d) (i)  $\alpha$ -particle OR helium nucleus OR 2 protons + 2 neutrons B1
- (ii)  $A = 210$   $Z = 84$  B1
- [Total: 7]**
- 4 (a) 2 protons and 2 neutrons OR helium nucleus B1
- (b)  $\alpha$  in direction of field OR  $\alpha$  towards negative (plate)  
OR  $\beta$  in opposite direction to field OR  $\beta$  towards positive (plate)  
OR  $\alpha$  and  $\beta$  deflected in opposite directions C1
- $\alpha$  in direction of field OR  $\alpha$  towards negative (plate)  
AND  
 $\beta$  in opposite direction to field OR  $\beta$  towards positive (plate) A1
- (c) not deflected B1
- (d) versions owtte of same element owtte B1
- (isotopes of same element have) same proton number/number of protons/atomic number/Z B1
- (isotopes of same element have) different nucleon numbers/ number of neutrons/mass number/A B1

- 5 (a) (i) gamma emitter used B1  
can penetrate ground to surface/for several metres B1
- (ii) long enough to find leak B1  
short enough to disappear quickly B1
- (b) proton number and electron number: tick for both in box 3, equal B1  
nucleon number: tick in box 5, 2 fewer B1

**[Total: 6]**

- 6 (a) (i) 800 counts/s B  
(ii)  $\frac{1}{4}$  of (i) B1
- (b) sample 1  $\gamma$  B1  
sample 2  $\beta$  NOT  $\gamma$  as extra B1  
sample 3  $\alpha$  NOT extras B1
- (c)  $\alpha$  B1

**[Total: 6]**

- 7 (a)  $\gamma$ : none/zero/0/neutral AND  
2 cm (or more) of lead/thick lead/50 cm (or more) of concrete B1
- $\beta$ : particle/electron AND  
any named metal/glass/concrete OR 1 m of air B1
- $\alpha$ : particle/helium nucleus/2 protons + 2 neutrons/ ${}^4_2\text{He}/{}^4_2\alpha$  AND  
positive OR + OR +2 B1
- (b) (i) 38
- (ii) 90
- (iii) 52
- (iv) 38 B3
- (c) 36 hours = 3 half-lives  
OR halving in steps from 4800 to 600 seen C1
- half-life = 12 hours OR 3 half-lives OR 2/3 of 36 C1
- (further time to reduce to 150 Bq =) 24 (hours) A1

**[Total: 9]**