

# Radioactivity

## Mark Scheme 3

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Level	IGCSE
Subject	Physics
ExamBoard	CIE
Topic	Atomic Physics
Sub-Topic	Radioactivity
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 3

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**Time Allowed:** 42 minutes

**Score:** /35

**Percentage:** /100

- 1 (a) any mention background B1  
background/radiation varies randomly o.w.t.t.e. OR rate of decay very small OR  
sample nearly all decayed B1 [2]
- (b) correctly deducts correct background (13 – 15 /s) B1  
takes 2 detector readings, one twice the other B1  
correct working, with/without background subtraction, i.e. use of graph B1  
half life = 1.2 – 1.8 days OR follows from working B1 [4]
- (c)  $\alpha$  (very) short range in air OR will not reach researcher  
NOT will not penetrate skin B1  
 $\gamma$  long range/very penetrating/heavy shielding needed OR will reach researcher B1 [2]
- [Total: 8]**

- 2 (a) (i) alpha or  $\alpha$
- (ii) beta or  $\beta$
- (iii) gamma or  $\gamma$  B2
- Symbols must be clear  
3 correct B2  
2 correct B1
- (b) (i) repulsion B1  
 $\alpha$  particle and (gold) nucleus / protons of (gold) nucleus have positive charges B1
- (ii) Any two of:  
Nucleus is very small (compared to size of atom) OR Most of atom is empty space  
Nucleus is positive / contains protons OR Nucleus has (all) the positive charge of the atom  
Nucleus is heavy OR Nucleus has most / all of the mass of the atom B2 [6]  
Ignore neutrons

- 3 (a) A and C B1
- (b) ( i)  $4.2 \times 10^{10}$  years B1
- (ii) idea of decay OR changes proton/neutron/nucleon number  
OR change into another nuclide/isotope/element/type of atom  
OR emits  $\alpha/\beta$  particle (ignore  $\gamma$  / radiation) B1
- (iii) idea of insignificant change in activity during stated time up to  $5 \times 10^9$  years  
OR experiment time insignificant c.f.  $1.4 \times 10^{10}$  years OR long half life  
OR long time to decay B1 [4]
- 4 (a) (i) proton B1
- (ii) proton and neutron B1
- (b) number of protons = 47 B1  
number of neutrons = 60 B1
- (c) (i) 8 hrs  $\pm$  0.25 hrs B1
- (ii) first point plotted is half the count-rate of a point on the curve, and 8 hours  
after that point (ecf from (c)(i) ) B1
- second point plotted same as above or with respect to first point plotted B1
- possible points include:  
16 hrs, 80 counts/s  
24 hrs, 40 counts/s  
13.5 hrs, 100 counts/s  
21.5 hrs, 50 counts/s  
16.5 hrs, 75 counts/s [7]

- 5 (a) idea of background radiation M1  
random/different at different times NOT places A1
- (b) A nothing OR background M1  
reading doesn't change (when source removed) A1
- B gamma OR  $\gamma$  M1  
gamma undeflected (by magnetic field) A1  
uncharged/neutral OR electromagnetic radiation A1
- C beta OR  $\beta$  B1  
deflection is big/more deflection than alpha B1  
low mass/much smaller than alpha B1
- OR
- beta OR  $\beta$  B1  
negative B1  
deflects according to left-hand rule B1

[Total: 10]