

The Nuclear atom

Mark Scheme 2

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

Time Allowed: 74 minutes

Score: /62

Percentage: /100

- 1 (a) (i) 90 B1
- (ii) 39 B1 [2]
- (b) tick corresponds to candidate's (a)(ii) B1 [1]
- (ii) zirconium c.a.o. B1 [1]
- (c) X (and) Z (are isotopes of same element) M1
- same proton number A1 [2]
- [Total: 6]**
- 2 (a) α deflected NOT tick in 'no deflection' box C1
 α deflected into paper NO A1
 γ no deflection NOT more B1 [3]
- (b) α will be stopped by air/won't move far B1
 γ will continue OR air ionised by α
do not give the ionisation mark if it is unclear whether the air or α is ionised B1 [2]
NB air is underlined but accept it/which etc. if clearly refers to air
- (c) only particles/rays in line with hole can pass through
OR lead absorbs radiation(α or γ or unspecified ignore β) B
to produce a (thin) beam of α or γ or particles or rays or radiation B1 [2]

- 3 (a) $^{234}_{91}\text{Pa}$ (c.a.o.) B
 $^{234}_{91}\text{Pa}$ (c.a.o.) B
 $^0_{-1}\beta$ (c.a.o.) B
- (b) (i) correctly curved path upwards (ignore lines not between plates)
(not in/out not if some section is downwards) B1
- (ii) attracted by/move towards the positive/opposite plate/charge or
repelled by the negative/same plate/charge **no** ecf from (b)(i) B1 [5]
- 4 (a) (i) $x = 88$
AND $y = 38$ B1
- (ii) 50 B1
- (iii) 38 B1 [3]
- (b) different numbers of neutrons / nucleons NOT different no of protons / electrons C1
(strontium-90 has) 52 neutrons / 90 nucleons OR 2 more neutrons / nucleons A1 [2]
- 5 (a) idea of absorption by paper e.g. put between source and detector M1
 α is absorbed, β is not A1
idea of deflection in magnetic field e.g. magnet near source M1
 β is deflected much more/opposite direction A1
- (b) (i) 6 B1
14 B1
- (ii) 3 half-lives C1
17 190 / 17 200 / 17 000 / 1.7×10^4 years A1 [8]

- 6 (a) proton number OR atomic number OR (number of) protons / electrons
OR position in periodic table OR chemical properties B1
- (b) mass (number) OR nucleon number OR (number of) neutrons / nucleons
OR (number of) protons plus (number of) neutrons B1
- (c) (i) mass (number) OR nucleon number OR (number of) nucleons
OR (number of) protons plus (number of) neutrons B1
- (ii) proton number OR atomic number OR (number of) neutrons
OR (number of) protons / neutrons / electrons
OR position in periodic table OR chemical properties
OR a neutron changes into a proton B1 [4]
- 7 (a) γ straight up B1
 α to left AND β to right B1
- (b) into or out of paper C1
into paper A1 [4]
- 8 (a) **top** bent down to R of layer B1
middle straight on B1
bottom deflected back to left B1
for all 3 ignore subsequent curving away from layer of nuclei
- (b) deflection $> 90^\circ$ /the bottom one B1
- (ii) positive ignore numbers B1
- (iii) nothing/vacuum/space/electrons B1

[Total: 6]

- 9 (a) 11 protons, 11 electrons -1 e.e.o.o. B2
- (b) 24 B1
- (c) same/identical ignore (very) similar B1
- (d) 14 B1

[Total: 5]

- 10 (a) number of protons 17 and 17 B1
 number of neutrons 18 and 20 B1
 number of electrons 17 and 17 B1
- (b) alpha, beta, gamma words or symbols, any order NO B1
- (c) (mark (i) and (ii) together)
- (i) any correct use M1
- (ii) simple correct explanation A1

[6]

- 11 (a) Particle 1 carries straight on B1
 Particle 2 (slightly) deflected (less than 90°) B1
 Particle 3 "turns back" / (deflected more than 90°) B1 3
- (b) Nucleus is heavy /dense / all or most of mass in atom in nucleus B1
 Most of atom is space or nucleus is (very) small cf. atom B1 2
- (c) (mass) 4 B1 1

[6]