

# MARK SCHEME

# GCSE

## PHYSICS

## AQA - COMBINED SCIENCE

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P4 - TEST 4

ATOMIC STRUCTURE

Intermediate

## Mark schemes

1. A  $\beta$  / beta  
B  $\gamma$  / gamma  
C  $\alpha$  / alpha

*for 1 mark each*

[3]

2. 2 weeks

*if answer is incorrect 2 gains two marks weeks gains one mark  
half of 68 or 34 gains one mark / allow working shown on graph*

[3]

3. (a) 1, 0  
X, -I (X = negligible / very small / (1/1840) to (1/2000), but not nothing  
*2 for 4 correct  
1 for 2/3 correct*

2

- (b) has a nucleus which is positive charge  
negative charges (electrons) orbit nucleus  
*each for 1 mark*

3

[5]

4. (a) (i) cannot penetrate aluminium  
*allow can only pass through air / paper too weak is neutral*

1

- (ii) gamma rays not affected (by aluminium)  
*allow all / most (gamma rays) to pass through  
too strong is neutral  
danger is neutral*

1

- (b) (i) (nuclei) unstable

1

- (ii) causes harm / damage to body / cells  
*allow radiation sickness*

1

*detail e.g., causes mutations / causes cancer / damages DNA /  
damages chromosomes*

*allow two effects for 2 marks*

1

[5]

- 5.** (a) (i) alpha particles cannot penetrate covering  
*do not credit any answer not relating to film badge or its case* 1
- (ii) film gets fogged **or** blackened  
*accept film gets exposed*  
*do not credit film changes colour **or** goes white **or** blotchy* 1
- (b) (i) any **one** from  
  
may cause cancer may damage cells **or** cell nucleii causes mutations  
changes DNA  
*accept (causes) burns **or** kills cells* 1
- (ii) any **two** from  
  
treating cancers  
tracers in body  
sterilising instruments **or** bandages  
*accept two descriptions of named treatments, eg thyroid check and circulation monitoring*  
*accept is a source of X-rays, eg for dentistry **or** taking X-rays of bones* 2
- (c) calculation that 1000 is 3 half lives on  
*8000 → 4000 → 2000 → 1000* 1
- time elapsed is 3 × half life = 31.8 hr  
**award both marks for 31.8 hr or 1 day 7.8 hr with no working shown** 1

[7]

- 6.** (a) one relevant point correctly plotted  
*gains 1 mark*
- but** two relevant points correctly plotted  
*gains 2 marks*
- but** three relevant points correctly plotted  
*gains 3 marks*
- curved line drawn accurately through the points  
*for 1 further mark* 4
- (b) age of igneous rock =  $400 \pm 100$  million years 1

- (c) sandstone is a sedimentary rock  
for 1 mark

there is likely to be some lead-207 present  
or from the rocks from which the sandstone was formed  
for 1 mark

(allow  $^{207}\text{Pb}$  may not have come from this  $^{235}\text{U}$ )

2

[7]

7.

- (a) (i) and (ii) in any order

1

- (i) alpha  
accept Greek symbol ( $\alpha$ )

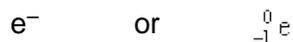
1



1

- (ii) beta  
accept Greek symbol ( $\beta$ ) or electron

1



mass and automatic numbers are not required  
accept e

1

- (b) (i) alpha  
accept symbol

1

- (ii) decreases  
then stops (entirely) or after a few cm  
accept stops because  $\alpha$  can only travel a few cm in air

1

- (c) it's gamma  
accept its not ionising or it is not charged or it's not  $\alpha$  or  $\beta$  because  
a spark counter only measures  $\alpha$  or  $\beta$

1

[8]

- 8.** (a) at least **6** points correctly plotted  
*gains 1 mark*
- (to better than half a square) **but all** points correctly plotted  
*gains 2 marks* 2
- any **line** graph related to plotted points;  
point (3,29) discounted;  
best fit smooth curve  
*each for 1 mark* 3
- (b) radiation decreases with time  
*gains 1 mark*
- but** decreases quickly at first then more slowly  
*gains 2 marks*
- but idea that** it (about) halves every 2 weeks **or** half-life is (about) 2 weeks  
*gains 3 marks* 3

**[8]**

- 9.** (a) (i) **K and L**  
*both answers required either order* 1
- (ii) (1) same number of protons  
*accept same number of electrons*  
*accept same atomic number* 1
- (2) different numbers of neutrons 1
- (b) (i) 90 1
- (ii) 140 1
- (c) alpha (particle)  
*reason may score even if beta or gamma is chosen* 1

mass number goes down by 4

**or**

number of protons and neutrons goes down by 4

**or**

number of neutrons goes down by 2

*candidates that answer correctly in terms of why gamma  
and beta decay are not possible gain full credit*

1

atomic / proton number goes down by 2

**or**

number of protons goes down by 2

*accept an alpha particle consists of 2 neutrons and 2 protons for 1  
mark*

*accept alpha equals  ${}^4_2\text{He}$  or  ${}^4_2\alpha$  for 1 mark*

*an alpha particle is a helium nucleus is insufficient for this mark*

1

[8]

10.

(a) (an equal amount of) positive charge

*do **not** accept charge on the atom / nucleus is positive*

1

(b) (i) a (significant) number of alpha particles were scattered by more than  $4^\circ$

**or**

alpha particles deflected backwards

*accept (some) measurements / results were unexpected*

1

measurements / results could not be explained by 'plum pudding' model

**or**

measurements / results did not support predictions

*can be explained by the nuclear model is insufficient*

*accept measurements / results did not support hypothesis*

1

(ii) many / (over)100 000 measurements / results taken

*accept Rutherford (and Marsden) were respected scientists*

**or**

*scientists were respected*

*accept measurements / results taken over several months*

*the experiment was repeated many times is insufficient*

1

- (c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

**0 marks**

no relevant content

**Level 1 (1–2 marks)**

A brief description is given with some particles correctly named

**Level 2 (3–4 marks)**

A description is given with all three particles named

**plus either**

the polarity of charge associated with the three particles

**or**

the relative mass of the three particles

**or**

the relative mass for one particle and the relative charge for one particle given

**Level 3 (5–6 marks)**

A more detailed description is given, naming the particles and polarity of charge

**and either**

the relative mass is given for at least two particles

**or**

the relative charge is given for at least two particles

**Examples of the points made in the response**

**brief description**

contains protons, neutrons and electrons

protons are positive

electrons are negative

neutrons are uncharged

has a nucleus

**relative charge**

proton +1

electron – 1

neutron 0

**relative mass**

proton 1

neutron 1

electron (about)  $1 / 2000$

*accept protons and neutrons have the same mass*

*accept electrons have tiny / negligible mass*

*zero mass is neutral*

**more detailed description**

protons and neutrons make up the nucleus

electrons orbit the nucleus

electrons are in shells

most of the atom is empty space

nucleus occupies a very small fraction of the volume of the atom

electrons orbit at a relatively large distance from the nucleus

most of the mass of the atom is contained in the nucleus

the nucleus as a whole is positively charged total number of protons in the nucleus

equals the total number of electrons orbiting it in an atom

6

[10]