

Atoms and Isotopes

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.4 Atomic Structure
Sub-Topic	Atoms and Isotopes
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 57 minutes

Score: /54

Percentage: /100

Grade Boundaries:

- M1.(a)** electromagnetic radiation from the nucleus
'electromagnetic radiation' is insufficient 1
- (b) (Gamma is the most penetrating) so a large proportion of the emitted radiation will leave the body 1
- more easily detected outside the body 1
- (c) (average) time it takes for the number of nuclei of the isotope in a sample to halve
or
(average) time it takes for the count rate from a sample containing the isotope to fall to half its initial level 1
- (d) initially there is a high level of hazard. 1
- level of hazard drops to a low level quickly 1
- answer must imply short period of time*
(activity initially high) due to short half-life
or
(drops to safe level quickly) due to short half-life 1

- (e) it is exposed to ionising radiation 1
- (f) does not become radioactive 1
- [9]

M2.(a) 10 000 1

(b) **Increase**
absorb electromagnetic radiation 1

Decrease
emit electromagnetic radiation 1

(c) atomic number is the number of protons 1

mass number is the number of protons and neutrons 1

(d) **Level 2 (3–4 marks):**
A clear comparison, with logical structure.

Level 1 (1–2 marks):
Fragmented points, with no logical structure.

0 marks:
No relevant content

Indicative content

Beta decay

- Atomic number increases by one
- When a neutron decays into a proton

Alpha decay

- Atomic number decreases by two
- When an alpha particle is emitted

Comparison

Both change number of protons (hence new element / transmutation)

Beta decay increases atomic number and alpha decay decreases (explicit)

NB No credit is given for different number of protons = new element.

4

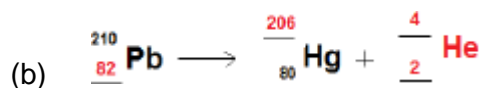
[9]

M3.(a) half-life read from graph = 2 hours

1

time to fall to 1.56 is six half lives = $6 \times 2 = 12$ (hours)

1



one mark for each correct element in the equation

3

(c) ionising radiation turns atoms into ions

1

which can break up molecules

1

this can change DNA

1

causing mutations to genes

1

which can cause cancer

1

[10]

M4.(a) protons, electrons

both required, either order

1

neutrons

1

electron, nucleus

both required, this order

1

(b) 2.7 (days)

allow 1 mark for showing correct use of the graph

2

(c) put source into water at **one** point on bank

accept the idea of testing different parts of the river bank at different times

1

see if radiation is detected in polluted area

accept idea of tracing

or

put source into water at three points on bank (1)

see if radiation is detected downstream of factory **or** farmland **or** sewage treatment works (1)

1

[7]

M5. any **two** pairs from:

*to gain credit it must be clear which model is being described
do **not** accept simple descriptions of the diagram without
comparison*

- nuclear model mass is concentrated at the centre / nucleus (1)
*accept the nuclear model has a nucleus / the plum pudding
model does not have a nucleus for 1 mark*

plum pudding model mass is evenly distributed (1)

- nuclear model positive charge occupies only a small part of the atom (1)

plum pudding model positive charge spread throughout the atom (1)

- nuclear model electrons orbit some distance from the centre (1)
*accept electrons in shells / orbits provided a valid
comparison is made with the plum pudding model*

plum pudding electrons embedded in the (mass) of positive (charge) (1)
*do **not** accept electrons at edge of plum pudding*

- nuclear model the atom mainly empty space (1)

plum pudding model is a 'solid' mass (1)

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M6. (a) **B E G**

*all 3 required and no other
any order*

1

same number of / 88 protons (and different numbers of neutrons)
same number of electrons is insufficient

1

- (b) (i) 222 1
- 86 1
- (ii) 4800
allow 1 mark for obtaining 3 half-lives 2
- (c) ethical 1
- deceived / lied to (about safety of working conditions)
accept (women) not warned of the dangers
given no protection is insufficient
or
value own / scientists' lives more than women **or**
did not treat women humanely 1
- (d) accept any sensible suggestion
eg
too many interests in continued use of radium
evidence may cause public unrest
*do **not** accept not enough evidence*
doctors not want to be blamed for illnesses (caused by radium)
accept doctors not wanting to be sued (for harm caused by using radium)
doctors thought (possible) benefits outweighed (possible) risks
*do **not** accept did not know radium could be harmful*
believe radium could treat illnesses is insufficient 1

- M7.** (a) has an equal amount of positive charge
accept pudding/it is positive 1
- (b) (experimental) results could not be explained using 'plum pudding' model
or (experimental) results did not support plum pudding model
accept (experimental) results disproved plum pudding model 1
- (c) (i) **A** – most of atom is empty space
or most of atom concentrated at the centre 1
- B** – nucleus is positive (so repels alpha particles)
accept nucleus has the same charge as alpha 1
- C** – nucleus is very small
accept nucleus is positive if not scored for B
or nucleus is a concentrated mass
accept nucleus has a very concentrated charge 1
- (ii) (if predictions correct, this) supports the new model
answers should be in terms of the nuclear model
accept supports his/new/nuclear theory
accept proves for supports
accept shows predictions/ Rutherford was correct 1

[6]