

MARK SCHEME

GCSE

PHYSICS

AQA - COMBINED SCIENCE

P4 - TEST 6

ATOMIC STRUCTURE

Advanced

Mark schemes

- 1.** (a) 146 1
- (b) atomic number 1
- (c) (i) alpha 1
- (ii) number of protons changes
accept atomic number changes
accept loses or gains protons
*do **not** accept protons with any other particle e.g. number of protons and neutrons changes incorrect*
*do **not** accept any reference to mass number* 1
- [4]
- 2.** (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]

- 3.** (a) (i) alpha (particle) 1
- (ii) (unstable) nucleus 1
accept (unstable) nuclei
*do **not** accept middle*
*do **not** accept helium nucleus*
- (iii) same number of protons 1
accept same number of electrons
accept same atomic / proton number
accept they both have 92 protons
same number of neutrons negates answer
- (b) (i) 4500 million years 1
*do **not** accept 4500 years*
- (ii) curve starting at 100 000 with a correct general shape 1
 passing through (4500, 50 000) and (9000, 25 000)
allow 1 mark for points plotted
or
line passing through (4500, 50 000) and (9000, 25 000) 1

[6]

- 4.** (a) (i) (total) number of protons plus neutrons 1
accept number of nucleons
accept amount for number
do not accept number of particles in the nucleus
- (ii) number of neutrons decreases by one 1
 number of protons increases by one
accept for both marks a neutron changes into a proton 1
- (b) (i) ${}_{81}^{208}\text{Th}$ 1
correct order only 1
- (ii) the number of protons determines the element 1
accept atomic number for number of protons

alpha and beta decay produce different changes to the number of protons
there must be a comparison between alpha and beta which is more than a description of alpha and beta decay alone

or

alpha and beta decay produce different atomic numbers
ignore correct reference to mass number

1

[7]

5.

(a) 78

1

(b) atomic

1

(c) (i) 131

correct order only

1

54

1

(ii) 32 (days)

allow 1 mark for showing 4 half-lives provided no subsequent step

2

(iii) limits amount of iodine-131 / radioactive iodine that can be absorbed

accept increases level of non-radioactive iodine in thyroid

*do **not** accept cancels out iodine-131*

1

so reducing risk of cancer (of the thyroid)

accept stops risk of cancer (of the thyroid)

1

[8]

6.

(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]

7.

- (a) (i) (atoms / elements with) the same number of protons but different numbers of neutrons 1
- accept (atoms / elements with) different mass number but same atomic number*
- (ii) substances that give out radiation 1
- accept alpha, beta or gamma for radiation*
- accept an unstable nucleus that decays*
- radioactive decay takes place is insufficient*
- (b) 85 years 2
- ± 2 years*
- allow 1 mark for showing correct method on the graph*
- (c) (i) a helium nucleus 1
- accept 2 neutrons and 2 protons*
- accept ${}_2^4\text{He}$*
- do **not** accept helium atom*
- (ii) the rate of decay (of plutonium) decreases 1
- accept fewer (plutonium) nuclei (to decay)*
- accept radioactivity decreases*
- less heat produced 1
- do **not** accept energy for heat*

(d) (i) (outside the body)
alpha (particles) cannot penetrate into the body
(inside the body) 1

(heat produced from decay) damages / kills cells / tissues
accept causes cancer for damages / kills cells / tissues
*accept **highly** toxic* 1

(ii) any **one** from:

- worried same could happen again
- an accident may cause radiation to be spread around the Earth / atmosphere
- idea of soil contamination resulting from accident / release of radioactive material
- idea of negative effect on health resulting from accident / release of radioactive material

accept any sensible suggestion 1

[10]

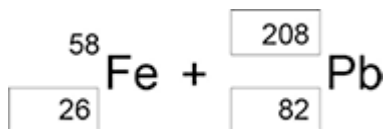
8. (a) (i) (atoms with the) same number of protons
allow same atomic number
***or** same proton number* 1

(atoms with) different number of neutrons
allow different mass number 1

(ii) 82 1

(iii) 124 1

(b) (i)



1 mark for each correct box

3

(ii) (a) neutron

1

(iii) 4.0×10^{-4} (s)

or

0.0004

$$3.00 \times 10^8 \times 0.1 = 12\,000 / t$$

gains 1 mark

2

(iv) particles need to travel a large distance

1

equipment would have to be very long

1

with circular paths long distances can be accommodated in a smaller space

1

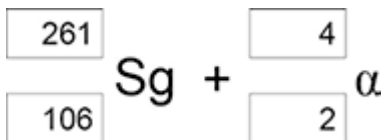
(c) (i) the average time for the number of nuclei to halve

1

the time for count rate to halve

1

(ii)



1 mark if top boxes total = 265

and bottom boxes total = 108

1 mark for 4 and 2 for alpha

2

- (d) (i) 3 plotted points
 $\pm \frac{1}{2}$ small square 1
- best line through points 1
- (ii) 190–205 (pm)
or correct from student's line 1
- [20]**