



# **GCSE Physics**

## **Radiation**

### **Mark Scheme**

**Time available: 60 minutes**

**Marks available: 57 marks**

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## Mark schemes

<b>1.</b>	(a) most alpha particles pass straight through the atom	1
	which shows that the atom is mostly empty space	1
	very few alpha particles are deflected through a large angle	1
	which shows the atom contains a nucleus where the mass / charge of the atom is concentrated	1
	(b) electron may absorb electromagnetic radiation	
	<i>full credit may be scored for a description of an electron emitting electromagnetic radiation</i>	1
	(and) move further from the nucleus	1
	to a higher energy level	1
		<b>[7]</b>
<b>2.</b>	(a) Alpha – two protons and two neutrons	1
	Beta – electron from the nucleus	1
	Gamma – electromagnetic radiation	1
	(b) Gamma	
	Beta	
	Alpha	
	<i>allow 1 mark for 1 or 2 correct</i>	2
	(c) any <b>two</b> from:	
	• (radioactive) source not pointed at students	
	• (radioactive) source outside the box for minimum time necessary	
	• safety glasses <b>or</b> eye protection <b>or</b> do not look at source	
	• gloves	
	• (radioactive) source held away from body	
	• (radioactive) source held with tongs / forceps	
	<i>accept any other sensible and practical suggestion</i>	2

1

(d) half-life = 80 s

counts / s after 200 s = 71

*accept an answer of 70*

1

(e) very small amount of radiation emitted

*accept similar / same level as background radiation*

1

[10]

3.

(a) 2 protons and 2 neutrons

*accept 2p and 2n*

*accept (the same as a) helium nucleus*

*symbol is insufficient*

*do not accept 2 protons and neutrons*

1

(b) (i) gamma rays

1

(ii) loses/gains (one or more) electron(s)

1

(c) any **one** from:

- wear protective clothing
- work behind lead/concrete/glass shielding
- limit time of exposure
- use remote handling

*accept wear mask/gloves*

*wear goggles is insufficient*

*wear protective equipment/gear is insufficient*

*accept wear a film badge*

*accept handle with (long) tongs*

*accept maintain a safe distance*

*accept avoid direct contact*

1

[4]

4.

- (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

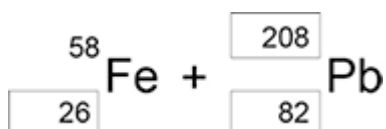
- (ii) 82

1

- (iii) 124

1

- (b) (i)



1 mark for each correct box

3

- (ii) (a) neutron

1

- (iii)  $4.0 \times 10^{-4}$  (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

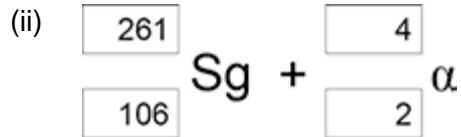
with circular paths long distances can be accommodated in a smaller space

1

1

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

1



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  
best line through points

1

1

- (ii) 190–205 (pm)  
or correct from student's line

1

[20]

5.

- (a) neutrons and protons
- (b) 0  
(+)1
- (c) (i) total positive charge = total negative charge  
accept protons and electrons have an equal opposite charge  
  
(because) no of protons = no of electrons
- (ii) ion  
  
positive

1

1

1

1

1

1

1

[7]

6.

(a) (i) neutron

1

(ii) neutron  
proton

*both required, either order*

1

(iii) 2

1

number of protons

*do not accept number of electrons*

1

(b) (i) any **one** from:

- beta
  - gamma
- accept correct symbols*  
*accept positron / neutrino / neutron*  
*cosmic rays is insufficient*

1

(ii) electrons

1

(iii) are highly ionising

1

(c) (i) mutate / destroy / kill / damage / change / ionise

*Harm is insufficient*

1

(ii) much smaller than

1

[9]