

M1. (a) Alpha – two protons and two neutrons 1

Beta – electron from the nucleus 1

Gamma – electromagnetic radiation 1

(b) Gamma

Beta

Alpha

allow 1 mark for 1 or 2 correct

2

(c) any **two** from:

- (radioactive) source not pointed at students
- (radioactive) source outside the box for minimum time necessary
- safety glasses **or** eye protection **or** do not look at source
- gloves
- (radioactive) source held away from body
- (radioactive) source held with tongs / forceps

accept any other sensible and practical suggestion

2

(d) half-life = 80 s

1

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]

- M2.** (a) alpha particles **cannot** pass through...
do not accept gamma particles...
or
 alpha particles can pass through a very thin sheet of **paper / card**
credit answers where correct amendments are made to boxed statement
- 1
- (b) (i) horizontal and vertical line drawn at correct positions on the graph
accept a cross drawn at 4500 / 500 on the curve
or
two pairs of lines drawn, for example, at 600 and 300
accept a horizontal line drawn at 500 on its own
do not accept vertical lines only
- 1
- (ii) 4500 million years
- 1
- (iii) half-life too long
do not accept simply its half-life is 4500 million years
- 1
- no (measurable) change in count rate
do not accept have not got the equipment
do not accept it's harmful (to children)
if neither of the above points scored, accept not enough time to measure it for 1 mark
- 1

[5]

M3. (a) neutrons and protons 1

(b) 0 1

(+)1 1

(c) (i) total positive charge = total negative charge
accept protons and electrons have an equal opposite charge 1

(because) no of protons = no of electrons 1

(ii) ion 1

positive 1

(d) Marks awarded for this answer will be determined by the quality of communication as well as the standard of the scientific response. Examiners should apply a best-fit approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
There is a basic description of at least **one** of the particles in terms of its characteristics.

Level 2 (3 – 4 marks)
There is a clear description of the characteristics of **both** particles
or
a full description of either alpha **or** beta particles in terms of their characteristics.

Level 3 (5 – 6 marks)

There is a clear and detailed description of **both** alpha and beta particles in terms of their characteristics.

examples of the physics points made in the response:**structure**

- alpha particle consists of a helium nucleus
- alpha particle consists of 2 protons and 2 neutrons
- a beta particle is an electron
- a beta particle comes from the nucleus

penetration

- alpha particles are very poorly penetrating
- alpha particles can penetrate a few cm in air
- alpha particles are absorbed by skin
- alpha particles are absorbed by thin paper
- beta particles can penetrate several metres of air
- beta particles can pass through thin metal plate / foil
- beta particles can travel further than alpha particles in air
- beta particles can travel further than alpha particles in materials eg metals

deflection

- alpha particles and beta particles are deflected in opposite directions in an electric field
 - beta particles are deflected more than alpha particles
 - alpha particles have a greater charge than beta particles but beta particles have much less mass
- or**
- beta particles have a greater specific charge than alpha particles

6

[13]

M4. (a) (i) L

1

(ii) M

1

(b) To make a smoke detector work.

1

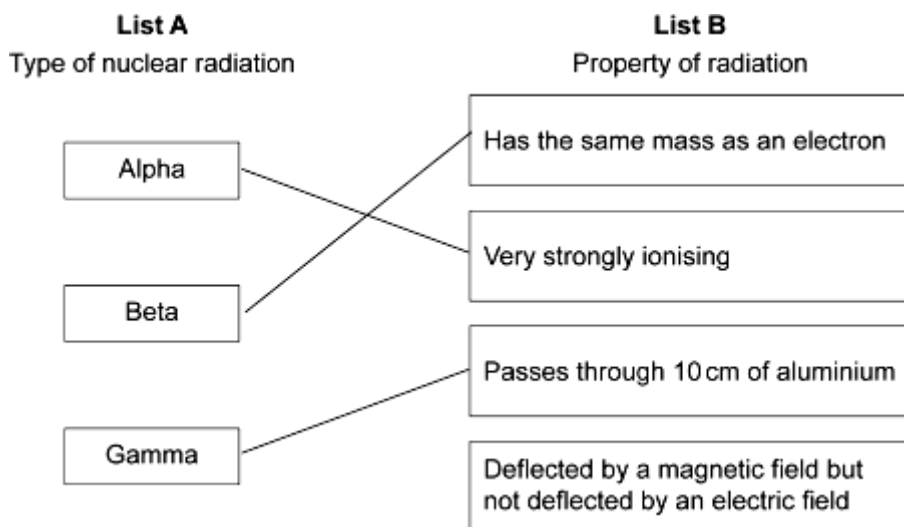
(c) 40

no tolerance

1

[4]

M5. (a) 1 mark for each correct line



if more than 1 line is drawn from any box in List A, none of those lines gain any credit

3

(b) (i) (the detector) reading had gone down

'it' equals detector reading

accept the reading in the table is the smallest

accept 101 is (much) lower than other readings / a specific value eg 150

do not accept this answer if it indicates the readings are the thickness

1

more beta (particles / radiation) is being absorbed / stopped

accept radiation for beta particles / radiation

accept fewer particles being detected

1

(ii) six years

1

(iii) alpha would not penetrate the cardboard

accept the basic property – alpha (particles) cannot pass through paper / card

*accept alpha (particles) are less penetrating (than beta)
range in air is neutral*

1

[7]

- M6.** (a) nucleus
*do **not** accept core / centre / middle* 1
- (b) radiation damages our cells
accept radiation is dangerous / poisonous / harmful / toxic
accept radiation can cause cancer / kills cells / change DNA /
cause mutations / harm health
accept so precautions can be taken
accept so they know they may be exposed to / harmed by
radiation it refers to radiation (source)
to stop people being harmed is insufficient 1
- (c) **C** 1
- (d) gamma 1
- gamma will pass through the lead
reason only scores if gamma chosen
or
 alpha and beta will not pass through lead
accept correct symbols for alpha, beta and gamma 1
- (e) (i) range of alpha too short
accept alpha would not reach detector
or
 alpha absorbed whether box is full or empty
accept alpha (always) absorbed by box / card
accept alpha will not pass through the box / card
alphas cannot pass through objects / solids is insufficient
alpha not strong enough is insufficient 1

(ii) **M**

reason only scores if M chosen

1

less radiation / beta (particles) absorbed

accept more radiation / beta particles pass through

or

more radiation absorbed by full boxes

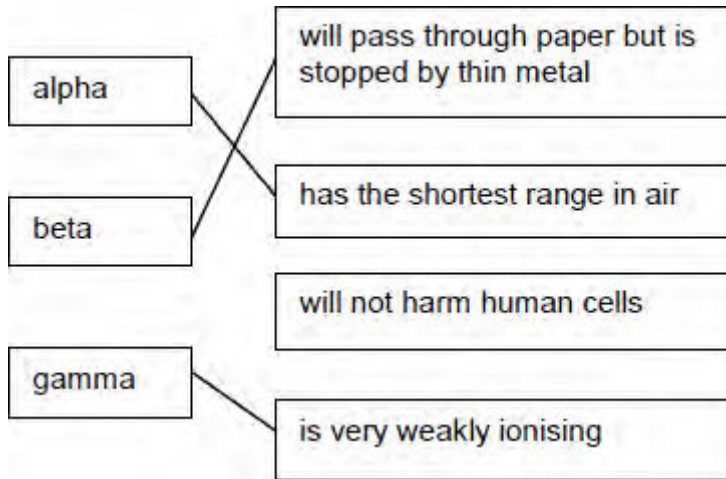
accept reading is higher

1

[8]

M7.

(a) 3 lines correct



allow 1 mark for each correct line

if more than one line is drawn from any type of radiation box then all of those lines are wrong

3

(b) Gamma radiation will pass through the body

1

(c) half

1

(d) protons

1

[6]