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

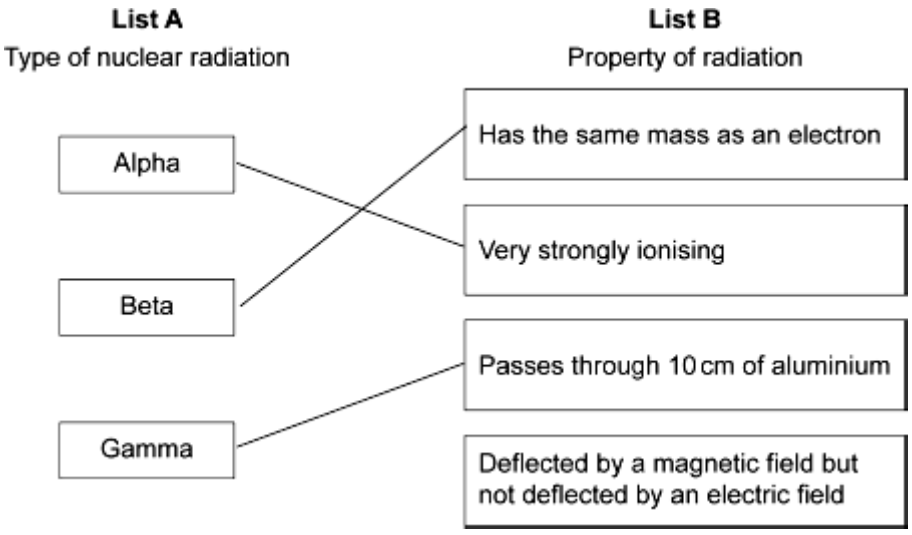
(c) **40**

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

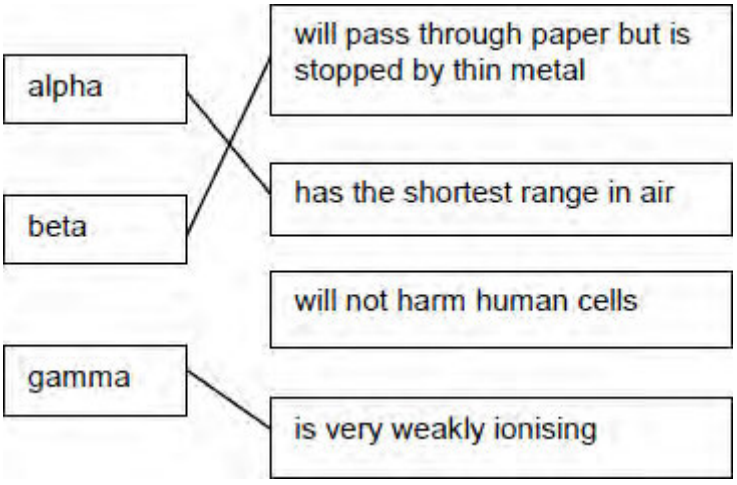
more radiation absorbed by full boxes

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]