Q1.

(a) 1×10^{-10} m

1

(b) (a helium atom) has 2 <u>electrons</u>

accept it has more mass

allow it is not charged

1

(c) 2

1

(d) neutral

accept 0 or 'no charge'

1

(because) protons have positive charge and electrons have negative charge

1

(and) there are equal numbers of protons and electrons

1

(e) helium will one day run out

1

there will be none left for medical uses so balloons waste helium

1

[8]

Q2.

- 4
- 9

each for 1 mark

[2]

Q3.

(i) 86

1

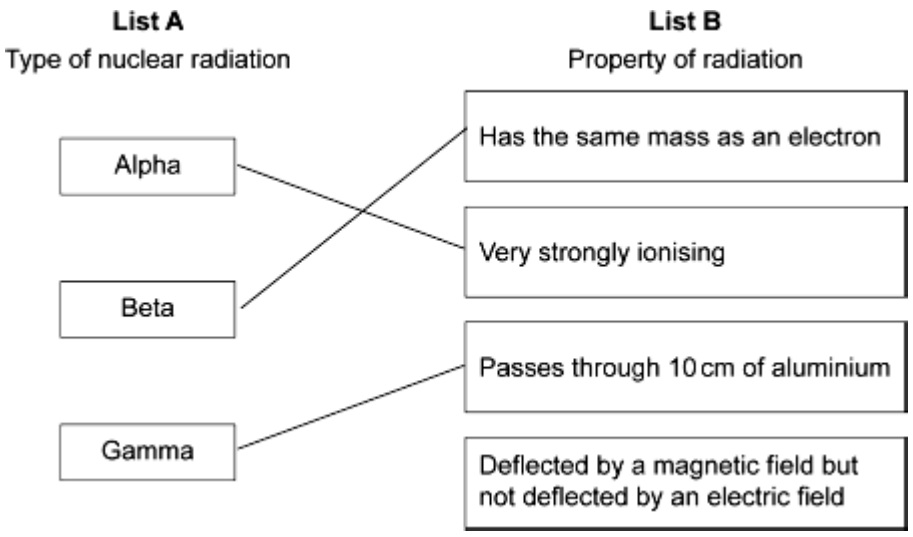
(ii) 222

1

[2]

Q4.

(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]

Q5.

(a) a type of electromagnetic radiation

1

(b) a thick sheet of lead

1

(c) to decrease the rate of decay of the food

1

to prevent food poisoning

1

(d) gamma rays cause mutations

1

(e) decrease the distance between the food and the radioactive source

1

increase the time for which the food is close to the radioactive source

1

(f) (because) the source of radiation is not in the food

allow source of radiation is / remains outside food

1

[8]

Q6.

(a) atoms with the same number of protons

allow atoms of the same element

1

but with a different number of neutrons

1

(b) protons = 11

1

neutrons = 12

1

(c) electrons falling to a lower energy level

1

(d)

Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4
Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2
No relevant content	0
Indicative content **solid** •atoms closely packed •atoms in a regular arrangement •atoms vibrate about a fixed position **liquid**	

•atoms are close together •atoms are not in regular arrangement •atoms can move past each other **gas** •atoms are well separated •atoms are not in regular arrangement •atoms move randomly at high speeds	

4

(e) 60 × 60

1

E = 150 × 3600

1

E = 540 000 (J)

*an answer of 540 000 (J) scores **3** marks*

1

(f) less energy transferred

1

not as bright

1

[14]

Q7.

(a) (i) **K** and **L**

both answers required either order

1

(ii) (1) same number of protons

accept same number of electrons

accept same atomic number

1

(2) different numbers of neutrons

1

(b) (i) 90

1

(ii) 140

1

(c) alpha (particle)

reason may score even if beta or gamma is chosen

1

mass number goes down by 4

or

number of protons and neutrons goes down by 4

or

number of neutrons goes down by 2

*candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit*

1

atomic / proton number goes down by 2

or

number of protons goes down by 2

*accept an alpha particle consists of 2 neutrons and 2 protons for **1** mark*

*accept alpha equals $^{4}_{2}He$ or $^{4}_{2}\alpha$ for **1** mark*

an alpha particle is a helium nucleus is insufficient for this mark

1

[8]

Q8.

(a) protons

1

protons

accept electrons

1

neutrons

1

(b) protons

reject mass

1

[4]

Q9.

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)

[4]

Q10.

(a) (gamma emission) does not change the number of protons

1

(because gamma emission) is not a particle

allow (gamma emission) is an (electromagnetic) wave

1

(b) prevents food poisoning

1

(by) killing the bacteria / microorganisms / moulds

1

that produce toxins

ignore references to decay

1

(c) (only) gamma rays can pass (all the way) through packaging (to reach the food / bacteria)

allow converse

1

(and also) gamma rays pass all the way through the food without damaging / ionising the food

allow converse

1

ignore contamination
ignore no damage to food unqualified

(d) radioactive food contains a source of radiation
or
radioactive food is emitting radiation

1

(whereas)
irradiated food has been exposed to (an external source of nuclear) radiation

1

[9]

Q11.

(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) $\square^{58}_{26}Fe + \square^{208}_{82}Pb$

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) $\square^{261}_{106}Sg + \square^{4}_{2}\alpha$

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
± ½ small square

1

best line through points

1

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

1

[20]