Mark schemes

1

(a) **L**

J

K

all 3 in correct order

*allow **1** mark for 1 correct*

2

(b) number of electrons = number of protons

accept amount for number

1

(c) neutrons

this answer only

1

(d) loses / gains electron(s)

1

[5]

2

(a) (i) B

for one mark

1

(ii) has 4 electrons / protons others only 3; B has a different no. of electrons / protons - *not* A and C have same no. of protons / electrons

for one mark

1

(b) (i) A and C

for one mark

1

(ii) same no. of protons / electrons different no. of neutrons

or

nuclei have the same charge but different mass

for 1 mark each

2

(c) (i) ○

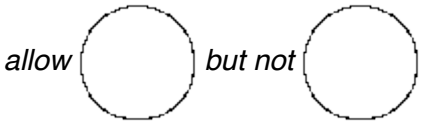
(ii) ○

(iii) \

for 1 mark each

3

(d) 2p.2n



allow *but not*

(i.e. no mark if electrons shown)

for one mark

1

[9]

3 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]

4

(a) any **two** pairs from:

- nuclear model mass is concentrated at the centre / nucleus (1)

  plum pudding model mass is evenly distributed (1)

  accept the nuclear model has a nucleus/the plum pudding model does not have a nucleus for 1 mark

- nuclear model positive charge occupies only a small part of the atom (1)

  plum pudding model positive charge spread throughout the atom (1)

  accept electrons in shells/ orbits provided a valid comparison is made with the plum pudding model
  *do **not** accept on its own*
  *do **not** accept electrons at edge of plum pudding*

- nuclear model electrons orbit some distance from the centre / nucleus (1)

  plum pudding electrons embedded in the (mass) of positive (charge) (1)

- nuclear model the atom mainly empty space (1)

  plum pudding model is a 'solid' mass (1)

  to gain credit it must be clear which model is being described
  *do **not** accept simple descriptions on the diagram without comparison*

4

(b) nucleus must be <u>positive</u> to deflect/ repel alpha particles

answers in terms of electrons/negative charge causing deflection negates mark answers in terms of reflection negates mark

1

nucleus (very) small so few alpha particles deflected backwards

accept most of atom empty space so <u>most</u> pass through

1

(c) many/ 100 000 measurements taken

accept results for measurements accept data valid / reliable

1

findings could not be explained by plum pudding model

accept a specific finding that could not be explained
eg some alpha particles were deflected backwards

1

[8]

5

Level 3 (5–6 marks):
A detailed and coherent explanation is provided. The student gives examples that argue a strong case and demonstrate deep knowledge. The student makes logical links between clearly identified, relevant points.

Level 2 (3–4 marks):
An attempt to link the description of the experiment and the results with differences between the two models. The student gives examples of where the plum pudding model does not explain observations. The logic used may not be clear.

Level 1 (1–2 marks):
Simple statements are made that the nuclear model is a better model. The response may fail to make logical links between the points raised.

0 marks:
No relevant content.

Indicative content

- alpha particle scattering experiment
- alpha particles directed at gold foil
- most alpha particles pass straight through
- (so) most of atom is empty space
- a few alpha particles deflected through large angles
- (so) mass is concentrated at centre of atom
- (and) nucleus is (positively) charged
- plum pudding model has mass spread throughout atom
- plum pudding model has charge spread throughout atom

[6]

6

(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]

7 (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

full credit may be scored for a description of an electron emitting electromagnetic radiation

1

(and) move further from the nucleus

1

to a higher energy level

1

[7]

8 (a) (an equal amount of) positive charge

*do **not** accept charge on the atom / nucleus is positive*

1

(b) (i) a (significant) number of alpha particles were scattered by more than 4°
or
alpha particles deflected backwards
accept (some) measurements / results were unexpected

1

measurements / results could not be explained by 'plum pudding' model
or
measurements / results did not support predictions
can be explained by the nuclear model is insufficient
accept measurements / results did not support hypothesis

1

(ii) many / (over)100 000 measurements / results taken
accept Rutherford(and Marsden) were respected scientists
or
scientists were respected
accept measurements / results taken over several months
the experiment was repeated many times is insufficient

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks
no relevant content

Level 1 (1−2 marks)
A brief description is given with some particles correctly named

Level 2 (3−4 marks)
A description is given with all three particles named
plus either
the polarity of charge associated with the
three particles
or
the relative mass of the three particles
or
the relative mass for one particle and the relative charge for one particle given

Level 3 (5−6 marks)
A more detailed description is given, naming the particles and polarity of charge
and either
the relative mass is given for at least two particles
or
the relative charge is given for at least two particles

Examples of the points made in the response

brief description
contains protons, neutrons and electrons

protons are positive
electrons are negative
neutrons are uncharged

has a nucleus

relative charge
proton +1
electron − 1
neutron 0

relative mass
proton 1
neutron 1
electron (about) 1 / 2000

accept protons and neutrons have the same mass
accept electrons have tiny / negligible mass
zero mass is neutral

more detailed description
protons and neutrons make up the nucleus
electrons orbit the nucleus
electrons are in shells
most of the atom is empty space
nucleus occupies a very small fraction of the volume of the atom
electrons orbit at a relatively large distance from the nucleus
most of the mass of the atom is contained in the nucleus
the nucleus as a whole is positively charged total number of protons in the nucleus equals the total number of electrons orbiting it in an atom

6

[10]

9 (a) 1.
-1

2

for 1 mark each

(b) (i) 19p,
20n,
19e

all correct for 2 marks
2 correct for 1 mark

2

(ii) K40 has an extra neutron/different number of neutrons/ it has more neutrons/21 neutrons

for 1 mark
NOT fewer neutrons

1

(iii) radioactive/unstable nucleus/ nucleus disintegrates/ emits radiation/it has too many neutrons

for 1 mark

1

(iv) calcium/Ca

for 1 mark

1

(v) 1 (e) in outer shell/same number of electrons/outer electron same distance from the nucleus

for 1 mark

1

(c) (i) Geiger-Muller tube (photographic) film

for 1 mark

1

(ii) cancer, leukaemia, radiation sickness etc.

for 1 mark

1

[10]

10 (a) nucleus positive charge / protons in nucleus electrons / negative charges orbit nucleus

each for 1 mark

3

(b) (i) positive dough repels positive alpha particles **or** 2 positive charges repel forces small

each for 1 mark

2

(ii) large force needed + ves in plum pudding spread out – *may appear in (i)*

positive charge must be concentrated / in nucleus
(ignore references to electrons)

for 1 mark each

3

(c) 1, 0
X,–l (X = negligible / very small/(1/1840) (1/2000),but not nothing)

each row for 1 mark

2

(d) (i) 4

for 1 mark

1

(ii) B and C have the same number of protons / atomic number
but different number of neutrons / mass number

each for 1 mark

3

[14]