GCSE Chemistry

History of the Atom

Mark Scheme

Time available: 40 minutes
Marks available: 40 marks

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Mark schemes

1. (a) electron

1

(b) plum pudding

1

(c) alpha

1

(d) Bohr

1

(e) protons

1

neutrons

1

protons (and) electrons

either order

1

(f) a sports arena of radius 100 m

1

[8]

2. (a) any **three** from: (nuclear model)
- mostly empty space

  allow the plum pudding model has no empty space
  allow the plum pudding model is solid

- the positive charge is (all) in the nucleus

  allow in the plum pudding model the atom is a ball of positive charge (with embedded electrons)
  *do **not** accept reference to protons*

- the mass is concentrated in the nucleus

  allow in the plum pudding model the mass is spread out
  *do **not** accept reference to neutrons*

- the electrons and the nucleus are separate

  allow in the plum pudding model the electrons are embedded
  allow in the nuclear model the electrons are in orbits

3

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(b)   electrons orbit the nucleus

        *do **not** accept reference to protons / neutrons*

        allow electrons are in energy levels around the nucleus

        or

        allow electrons are in shells around the nucleus

1

    electrons are at specific distances from the nucleus

1

(c)   atomic number is the number of protons

1

    (and) protons were not discovered until later

        ignore electrons / neutrons were not discovered until later

1

(d)   so their properties matched the rest of the group

        allow converse

1

[8]

3.   (a)   (neutron)   1   0

        both needed

        allow (neutron)   1   neutral

1

    proton   1   (+1)

        both needed

1

(b)   number of protons plus neutrons

        allow number of protons and neutrons

        ignore protons and neutrons unqualified

        *do **not** accept references to mass or relative mass of protons and / or neutrons*

1

(c)   (the isotopes contain) different numbers of neutrons

1

(d) most (alpha) particles passed (straight) through (the gold foil)

1

(so) the mass of the atom is concentrated in the nucleus / centre
or
(so) most of the atom is empty space

1

some (alpha) particles were deflected / reflected

1

(so) the atom has a (positively) charged nucleus / centre
if not awarded for MP2 allow (so) the mass of the atom is concentrated in the nucleus / centre.

1

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4.   (a) B

1

(b) C

1

(c) A

1

(d) sum of protons and neutrons
allow number of protons and neutrons

1

(e) between 69.5 and 70.0

1

(f) Chadwick provided the evidence to show the existence of neutrons
allow Chadwick discovered neutrons

1

(this was necessary because) isotopes have the same number of protons
allow (this was necessary because) isotopes have the same atomic number

or
(this was necessary because) isotopes are atoms of the same element
ignore isotopes have the same number of electrons

1

but with different numbers of neutrons
allow but with different mass (numbers)

1

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5.   (a) mass number
allow the number of protons + neutrons

1

(b) 6.02×10^{23}

1

(c)   **Level 2 (3-4 marks):**
Scientifically relevant features are identified; the ways in which they are similar / different is made clear.

Level 1 (1-2 marks):
Relevant features are identified and differences noted.

Level 0
No relevant content.

Indicative content

similarities
*   both have positive charges
*   both have (negative) electrons
*   neither has neutrons

differences

plum pudding model	nuclear model
ball of positive charge (spread throughout)	positive charge concentrated at the centre
electrons spread throughout (embedded in the ball of positive charge)	electrons outside the nucleus
no empty space in the atom	most of the atom is empty space
mass spread throughout	mass concentrated at the centre

4

(d) $\dfrac{(24 \times 78.6) + (25 \times 0.1) + (26 \times 11.3)}{100}$

or
$(24 \times 0.786) + (25 \times 0.101) +$
(26×0.113)

1

= 24.3

1

*an answer of 24.3 scores **2** marks*

[8]