



C1F Atomic Structure and the Periodic Table: Foundation Tier Practice

AQA 8462 · Calculator allowed · about 90 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

1 An atom is made from three main particles: protons, neutrons and electrons.

(a) Name the particle in an atom that has a positive charge. (1)

(Total for Question 1 is 1 mark)

2 An atom of carbon has 6 protons and 6 neutrons.

(a) Calculate the mass number of this carbon atom. (1)

(b) State how many electrons a neutral carbon atom has. (1)

(Total for Question 2 is 2 marks)

3 A silicon atom has atomic number 14. Its electrons are arranged in shells as 2,8,4 (2 electrons in the first shell, 8 in the second shell and 4 in the third shell, with no further shells).

(a) State whether the 4 electrons in the third shell of this silicon atom are in the outermost shell. (1)

(b) Give one reason why electrons are shown in shells in simple models of atoms. (1)

(Total for Question 3 is 2 marks)

4 Elements in the periodic table are arranged in groups (vertical columns) and periods (horizontal rows).

(a) State what the group number tells you about an element in the main group. (1)

(b) State what the period number tells you about an element. (1)

(Total for Question 4 is 2 marks)

5 Sodium is in Group 1 of the periodic table. A sodium atom has 11 protons.

(a) State how many electrons a neutral sodium atom has. (1)

(b) Explain why sodium atoms tend to form ions with a charge of +1. (2)

(Total for Question 5 is 3 marks)

6 The table shows some information about three elements: A, B and C.

Element A: atomic number 3, mass number 7

Element B: atomic number 8, mass number 16

Element C: atomic number 11, mass number 23

(a) For element A, state the number of protons and the number of neutrons. (2)

(Total for Question 6 is 2 marks)

7 Chlorine is in Group 7 (also called Group 17 in some numbering) and is a non-metal.

(a) State how many electrons chlorine has in its outer shell. (1)

(b) Explain why chlorine tends to form negative ions with a charge of -1. (2)

(Total for Question 7 is 3 marks)

8 A student is given a sample of an element and measures its reactivity with water. This is a practical test to compare reactivity in Group 1.

(a) Suggest one safety precaution the student should take when testing reactivity with water. (1)

(b) Give one variable that should be kept the same for fair comparison between different metals. (1)

(Total for Question 8 is 2 marks)

9 The electronic configuration of neon (Ne) is 2,8.

(a) State whether neon is a metal or a non-metal. (1)

(b) Explain why neon is chemically unreactive. (2)

(Total for Question 9 is 3 marks)

10 Argon is another noble gas. Its relative atomic mass on the periodic table is approximately 40.

- (a) Write down a reasonable value for the number of neutrons in the most common argon isotope, using atomic number 18. (2)

.....
(Total for Question 10 is 2 marks)

11 Lithium and sodium are both in Group 1. A simple reaction is lithium + water $\rightarrow$ lithium hydroxide + hydrogen.

- (a) State which of lithium or sodium is more reactive with water and give one reason based on atomic structure. (3)

.....
(Total for Question 11 is 3 marks)

12 Relative atomic mass (A_r) can be used to compare masses of atoms. Oxygen has $A_r = 16$ and carbon has $A_r = 12$.

- (a) Calculate the mass of one molecule of carbon dioxide CO_2 in relative atomic mass units (A_r units). Use A_r : C = 12, O = 16. (2)

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(b) State how many times more massive one carbon dioxide molecule is than one oxygen atom (use A_r values). (2)

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(Total for Question 12 is 4 marks)

13 A student is asked to draw the electronic configuration for magnesium, which has atomic number 12.

(a) Write the electronic configuration of magnesium using commas to separate shells. (2)

(b) State the group number for magnesium using its outer electron count. (2)

(Total for Question 13 is 4 marks)

14 Some atoms have isotopes. Isotopes of the same element have the same number of protons but different numbers of neutrons.

(a) Define the term isotope. (1)

(b) Explain one reason why isotopes of an element have nearly identical chemical behaviour. (2)

(Total for Question 14 is 3 marks)

15 The periodic table groups elements with similar properties. Predict the property and give a reason.

(a) Predict whether elements in Group 0 (noble gases) have high or low boiling points compared with Group 1 metals, and give one reason. (4)

(Total for Question 15 is 4 marks)

- 16** Explain how the periodic table provides evidence for the existence of atomic structure and patterns in elements. In your answer include how properties change across a period and down a group, and refer to electron arrangement.

(Total for Question 16 is 6 marks)

Mark scheme · C1F Atomic Structure and the Periodic Table: Foundation Tier Practice

Question 1

- (a) **B1** proton cao
- (a) **Answer: Proton**

Question 2

- (a) **B1** mass number = protons + neutrons, so $6 + 6 = 12$ cao
- (a) **Answer: 12**
- (b) **B1** 6 electrons (in a neutral atom the number of electrons equals the number of protons) cao
- (b) **Answer: 6**

Question 3

- (a) **B1** yes, the third shell is the outermost shell, because there are no electrons in a fourth shell ($2+8+4 = 14$ accounts for all the electrons) cao
- (a) **Answer: Yes, the third shell is the outermost shell.**
- (b) **B1** to show the arrangement of electrons around the nucleus or to show energy levels, oe
- (b) **Answer: To show the arrangement of electrons or energy levels**

Question 4

- (a) **B1** the number of electrons in the outer shell (for main group elements) cao
- (a) **Answer: Number of electrons in the outer shell**
- (b) **B1** the number of electron shells (energy levels) that the atoms have cao
- (b) **Answer: Number of electron shells**

Question 5

- (a) **B1** 11 electrons (equal to protons in a neutral atom) cao
- (a) **Answer: 11**
- (b) **M1** states that sodium loses one electron to achieve a full outer shell (octet) or to have a noble gas electron arrangement
- (b) **A1** forms a positive ion with charge +1 (Na^+), cao
- (b) **Answer: Sodium loses one electron to get a full outer shell, forming Na^+**

Question 6

- (a) **B1** protons = atomic number = 3
- (a) **B1** neutrons = mass number - atomic number = $7 - 3 = 4$
- (a) **Answer: Protons 3; Neutrons 4**

Question 7

- (a) **B1** 7 electrons in the outer shell for Group 7 element cao
- (a) **Answer: 7**
- (b) **M1** states that chlorine gains one electron to complete its outer shell
- (b) **A1** forms Cl^- with charge -1 cao
- (b) **Answer: Chlorine gains one electron to complete its outer shell, forming Cl^-**

Question 8

- (a) **B1** wear safety goggles, or use a small piece of the metal, or keep distance, or perform behind a safety screen, oe
- (a) **Answer: Wear safety goggles**
- (b) **B1** volume of water, temperature of water, size of metal piece, or concentration if using solution, oe
- (b) **Answer: Same volume of water**

Question 9

- (a) **B1** non-metal cao
- (a) **Answer: Non-metal**
- (b) **M1** states that neon has a full outer shell (2,8) so it is stable
- (b) **A1** therefore it does not readily gain or lose electrons and is unreactive cao
- (b) **Answer: Neon has a full outer shell (2,8) so it is stable and unreactive**

Question 10

- (a) **M1** uses neutron = mass number - atomic number, so $40 - 18$
- (a) **A1** 22 neutrons cao
- (a) **Answer: 22 neutrons**

Question 11

- (a) **M1** identifies sodium as more reactive than lithium (Group 1 reactivity increases down the group)
- (a) **A1** because sodium atoms have more electron shells so the outer electron is further from the nucleus and more easily lost, oe
- (a) **A1** or equivalent explanation of easier loss of outer electron in sodium cao
- (a) **Answer: Sodium is more reactive because it has more electron shells so its outer electron is further from the nucleus and lost more easily**

Question 12

- (a) **M1** adds relative atomic masses: $\text{Ar}(\text{CO}_2) = 12 + 2 \times 16$
- (a) **A1** 44 Ar units cao
- (a) **Answer: 44 Ar units**
- (b) **M1** divides $\text{Ar}(\text{CO}_2)$ by $\text{Ar}(\text{O})$: $44 / 16$
- (b) **A1** 2.75 times (allow 2.8 to 2.75) cao
- (b) **Answer: 2.75 times**

Question 13

- (a) **B1** first shell 2 electrons
- (a) **B1** second shell 8 electrons and third shell 2 electrons so 2,8,2 cao
- (a) **Answer: 2,8,2**
- (b) **M1** uses outer electrons = 2, so group 2
- (b) **A1** Group 2 cao
- (b) **Answer: Group 2**

Question 14

- (a) **B1** atoms of the same element with the same number of protons but different numbers of neutrons cao
- (a) **Answer: Atoms of the same element with the same number of protons but different numbers of neutrons**
- (b) **M1** states that chemical behaviour depends on electrons and electron arrangement
- (b) **A1** since isotopes have the same number of electrons they behave similarly chemically cao
- (b) **Answer: Chemical behaviour depends on electron arrangement; isotopes have the same electrons so behave similarly**

Question 15

- (a) **M1** states relative boiling points: noble gases have lower boiling points than Group 1 metals
- (a) **M1** gives reason that noble gases are monatomic with weak intermolecular forces (London forces) while metals have metallic bonds requiring more energy to break, oe
- (a) **A1** links weaker forces to lower boiling point for noble gases cao
- (a) **A1** explicit comparative statement that noble gases boil at much lower temperatures than typical Group 1 metals cao
- (a) **Answer: Noble gases have lower boiling points because they are monatomic with weak intermolecular forces, whereas metals have strong metallic bonds requiring more energy**

Question 16

- **Level 3** (5-6): Detailed explanation linking periodic table patterns to atomic structure. Describes change across a period (e.g. increasing proton number and electrons filling same shell leading to changes in properties such as metallic to non-metallic behaviour, change in reactivity) and change down a group (e.g. more shells, outer electron further from nucleus, trends in reactivity). Refers to electron arrangement and gives at least two linked examples or clear reasoning.
- **Level 2** (3-4): Reasonable explanation with some link to electron arrangement. Describes either across-period or down-group trend correctly and gives limited explanation using electrons. May have one clear example.
- **Level 1** (1-2): Basic statements about the periodic table or atomic structure. May state that elements are arranged by atomic number or that elements in groups have similar properties, without linking to electron arrangement or giving clear examples.
- **Indicative content:**
 - Trend across a period: proton number increases, electrons are added to the same shell, atoms change from metallic to non-metallic; electron arrangement explains changes in reactivity and bonding.
 - Trend down a group: atoms have more electron shells, outer electrons are further from nucleus so they are lost more easily in metals (reactivity increases down Group 1) or gained less easily in non-metals (reactivity decreases down Group 7).
 - Periodic table order by atomic number gives evidence for protons and a structured arrangement of electrons in shells.
 - Examples: Group 1 metals losing one electron to form +1 ions; noble gases having full outer shells and being unreactive.