



Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. nucleus
2. atomic number
3. valence shell
4. valency
5. cation
6. covalent
7. radical
8. nuclear fusion

K • 4

Each carries 0.5 mark.

2 Label the diagram

1. Na atom (2, 8, 1)
2. $\text{Na} - \text{e}^- \rightarrow \text{Na}^+$
3. Na^+ ion (2, 8)
4. Cl atom (2, 8, 7)
5. $\text{Cl} + \text{e}^- \rightarrow \text{Cl}^-$
6. Cl^- ion (2, 8, 8)

U • 3

Each carries 0.5 mark.

3 Multiple choice

- i. b. atom

K • 1

An atom is the smallest particle of an element that can take part in a chemical reaction. A nucleus and a proton are parts of an atom; a molecule is usually made of atoms.

- ii. d. H_2O

U • 1

Water is made of two non-metals, hydrogen and oxygen, which share electrons. The other three are each a metal with a non-metal: ionic compounds.

- iii. c. aluminium

U • 1

Aluminium (2, 8, 3) loses its 3 valence electrons. Oxygen and calcium have valency 2, chlorine 1.

- iv. a. $\text{Mg}(\text{HCO}_3)_2$

A • 1

Mg has valency 2, HCO_3 valency 1; crossed over, $\text{Mg}_1(\text{HCO}_3)_2 = \text{Mg}(\text{HCO}_3)_2$. MgCO_3 is magnesium carbonate, a different compound.

- v. d. a magnesium ion, Mg^{2+}

A • 1

12 protons means it is magnesium, whatever its electrons. It has 2 more protons than electrons, so its charge is +2: Mg^{2+} . It has the same electronic configuration as neon (2, 8), but it is not neon.

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ Niels Bohr.

- b. MARKING SCHEME

A • 1

✓ 2, 8, 6.

- c. MARKING SCHEME

U • 1

✓ 2 electrons.



5 Short answers

a. MARKING SCHEME

U • 2

- ✓ Any one difference, e.g. a duplet is 2 electrons in the outermost shell; an octet is 8.
- ✓ Any second difference, e.g. a duplet is only in the K shell when it is the atom's only shell (helium); an octet is in the L, M or a later shell (neon, argon).

b. MARKING SCHEME

U • 2

- ✓ Helium has 2 electrons in its only shell (a duplet) and neon 8 in its outermost shell (2, 8: an octet).
- ✓ Their outer shells are full and stable, so they don't lose, gain or share electrons.

c. MARKING SCHEME

U • 2

- ✓ Methane is made of carbon and hydrogen, both non-metals; carbon (2, 4) shares one pair of electrons with each of four hydrogen atoms.
- ✓ Bonds formed by sharing electrons are covalent (carbon gets an octet and each hydrogen a duplet).

d. MARKING SCHEME

K • 2

- ✓ Any one characteristic, e.g. high melting and boiling points.
- ✓ Any second, e.g. most dissolve in water and conduct electricity when melted or dissolved.

6 Long answer

ANSWER

U • 4

Electrovalent bond, sodium chloride: sodium (2, 8, 1) loses its 1 valence electron and becomes Na^+ (2, 8); chlorine (2, 8, 7) gains it and becomes Cl^- (2, 8, 8). Both ions have an octet, and the attraction between the opposite charges is the electrovalent bond: $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$.

Covalent bond, hydrogen chloride: hydrogen (1) and chlorine (2, 8, 7) each need one more electron. Each puts one electron into a shared pair; hydrogen then has a duplet and chlorine an octet, and the shared pair holds them together: $\text{H}-\text{Cl}$.

MARKING SCHEME

- ✓ An electrovalent bond is formed by the transfer of electrons from a metal atom to a non-metal atom, making ions that attract each other.
- ✓ A correct example, e.g. Na (2, 8, 1) gives 1 electron to Cl (2, 8, 7): Na^+ (2, 8) and Cl^- (2, 8, 8) form NaCl .
- ✓ A covalent bond is formed by sharing pairs of electrons between non-metal atoms.
- ✓ A correct example, e.g. H and Cl share one pair: H gets a duplet and Cl an octet, $\text{H}-\text{Cl}$.

7 Formulae and molecular mass

a. ANSWER

A • 2

- Al (3) and O (2), crossed over: Al_2O_3 .
- Ca (2) and HCO_3 (1), crossed over: $\text{Ca}_1(\text{HCO}_3)_2 = \text{Ca}(\text{HCO}_3)_2$.

MARKING SCHEME

- ✓ Al_2O_3 , with the valencies crossed over.
- ✓ $\text{Ca}(\text{HCO}_3)_2$, with the radical in brackets.



b. ANSWER

A • 4

- i. $\text{CaCO}_3 = 40 + 12 + 3 \times 16 = 100 \text{ amu.}$
- ii. $\text{NH}_3 = 14 + 3 \times 1 = 17 \text{ amu.}$
- iii. $\text{CO}_2 = 12 + 2 \times 16 = 44 \text{ amu.}$
- iv. $\text{MgSO}_4 = 24 + 32 + 4 \times 16 = 120 \text{ amu.}$

MARKING SCHEME

- ✓ i. $\text{CaCO}_3 = 40 + 12 + 48 = 100 \text{ amu.}$
- ✓ ii. $\text{NH}_3 = 14 + 3 = 17 \text{ amu.}$
- ✓ iii. $\text{CO}_2 = 12 + 32 = 44 \text{ amu.}$
- ✓ iv. $\text{MgSO}_4 = 24 + 32 + 64 = 120 \text{ amu.}$

8 Think**ANSWER**

HA • 2

Salt is an ionic compound: every Na^+ is pulled by the Cl^- ions around it, all through the crystal, and melting it means pulling apart that whole network of strong attractions. Wax is made of covalent molecules that hold on to each other only weakly, so separating them needs little heat.

MARKING SCHEME

- ✓ Salt is ionic: strong attractions between oppositely charged ions all through the crystal need a lot of heat to break.
- ✓ Wax is covalent: its molecules hold each other only weakly, so little heat separates them.

9 Activity: Valence electrons and valency (Activity 14.2)

(not marked)

WHAT STUDENTS SHOULD FIND

Lithium 2, 1: 1 valence electron, valency 1. Nitrogen 2, 5: 5, valency 3. Magnesium 2, 8, 2: 2, valency 2. Chlorine 2, 8, 7: 7, valency 1. Argon 2, 8, 8: 8, valency 0. Potassium 2, 8, 8, 1: 1, valency 1. Atoms with 1–3 valence electrons lose them; with 5–7 they gain 8 minus that number; a full shell gives valency 0.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	8	16	9	2	35

