AP CHEMISTRY • EXERCISE SHEET

1.8 Valence Electrons and Ionic Compounds

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

Objective

Build the skills to answer exam questions on **valence electrons and ionic compounds**.

You must be able to:

- identify **valence electrons** 价电子 as the outermost electrons that drive bonding
- describe how metals form **cations** 阳离子 and nonmetals form **anions** 阴离子
- write the formula of an **ionic compound** 离子化合物 by balancing charges
- apply the octet rule to predict common ion charges

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ Valence electrons and ions

Metals lose valence electrons to form positive cations; nonmetals gain electrons to form negative anions, each reaching a full octet.

■ Balancing charges

An ionic compound is neutral overall. Combine ions so the charges cancel:

$$\mathrm{Na^+ + Cl^- \rightarrow NaCl}, \qquad \mathrm{Mg^{2+} + 2\,Cl^- \rightarrow MgCl_2}.$$

■ Criss-cross

The magnitude of each ion's charge becomes the other's subscript. $\mathrm{Al^{3+}}$ with $\mathrm{O^{2-}}$ gives $\mathrm{Al_2O_3}$.

2 Practice

Now apply the methods above.

2.1 State where valence electrons are located in an atom. [1]

2.2 A metal atom loses electrons. State the sign of the ion it forms. [1]

2.3 Write the neutral formula from Mg^{2+} and Cl^{-}. [2]

2.4 How many Cl^{-} ions balance one Al^{3+} ion? [1]

3 Exam-style questions

3.1 Valence electrons are found in the [1]

- **A** nucleus
- **B** innermost shell
- **C** outermost shell
- **D** neutrons

3.2 The neutral formula from Ca^{2+} and Cl^{-} is [1]

- **A** CaCl
- **B** $CaCl_2$
- **C** Ca_2Cl
- **D** $CaCl_3$

3.3 Consider aluminium (Al^{3+}) and oxide (O^{2-}).

(a) Write the neutral ionic formula. [2]

(b) State the method you used to balance the charges. [1]

3.4 A metal M forms M^{2+} and a nonmetal X forms X^{-}.

(a) Write the formula of the compound they make. [1]

(b) State whether M is more likely a metal or a nonmetal, and why. [2]

4 Go further

You are ready for more on this subtopic:

- work through the interactive **1.8 Valence Electrons and Ionic Compounds** lesson on the **Learn** page;
- read the **Atomic Structure and Properties** section of the AP Chemistry handout on the **Know** page for the full explanation and worked diagrams.

Solutions

2.1 In the outermost shell.

2.2 Positive (a cation).

2.3 $MgCl_2$ (one 2+ needs two 1−).

2.4 Three.

3.1 C —the outermost shell.

3.2 B —$CaCl_2$.

3.3 (a) Al_2O_3. (b) Criss-cross the charge magnitudes into subscripts (so total + equals total −).

3.4 (a) MX_2. (b) A metal —metals lose electrons to form positive cations like M^{2+}.