AP CHEMISTRY • EXERCISE SHEET

2.5 Lewis Diagrams

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS lone pairs 孤对电子 • valence electrons 价电子 • lewis diagram 路易斯结构 • octet 八隅体

Objective

Build the skills to answer exam questions on **Lewis diagrams** — drawing the shared and lone pairs of a molecule.

You must be able to:

- count total **valence electrons** 价电子 for a molecule or ion
- arrange bonding pairs and **lone pairs** 孤对电子 to satisfy the octet
- use double or triple bonds when needed

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.

Counting valence electrons

Add the valence electrons of every atom; for an **ion**, add one electron per negative charge and subtract one per positive charge. For CO_2: $4 + 2(6) = 16$.

Building the skeleton

Put the least electronegative atom in the centre (usually not H), connect atoms with single bonds, then add lone pairs to complete octets (H needs only 2).

Using multiple bonds

If the central atom is short of an octet, form **double or triple bonds**. For CO_2, each O shares a double bond with C: O = C = O, all octets satisfied, 16 electrons used.

Checking

Count electrons: each bond is 2, each lone pair is 2. The total must equal your valence-electron count, and every atom (except H) should have an octet.

2 Practice

Now apply the methods above.

2.1 Count the total valence electrons in H_2O. [1]

2.2 Count the total valence electrons in NH_3. [1]

2.3 How many lone pairs are on the oxygen in a water molecule? [1]

3 Exam-style questions

3.1 The number of valence electrons to use in the Lewis diagram of NO_3^- is [1]

- **A** 22
- **B** 23
- **C** 24
- **D** 5

3.2 Draw the Lewis diagram of CO_2.

(a) State the total number of valence electrons. [1]

(b) Describe the bonding (single/double/triple) between C and each O. [2]

3.3 For N_2, state the total valence electrons and the bond order (single/double/triple) needed to satisfy both octets. [3]

Solutions

2.1 $2(1) + 6 = 8$.

2.2 $5 + 3(1) = 8$.

2.3 Two lone pairs.

3.1 C — $5 + 3(6) + 1 = 24$ (the +1 for the negative charge).

3.2 (a) 16. (b) Each O forms a **double** bond with C, so all atoms reach an octet.

3.3 N_2: $2(5) = 10$ valence electrons; a **triple** bond between the N atoms, leaving one lone pair on each N.