

2.5 Lewis Diagrams

Name: _____ Class: _____ Date: _____

Total: 10 marks

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: $\text{O} = \text{C} = \text{O}$, 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
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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]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **2.5 Lewis Diagrams** lesson on the **Learn** page;
- read the **Lewis Diagrams** section of the AP Chemistry handout on the **Know** page.

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 N₂: $2(5) = 10$ valence electrons; a **triple** bond between the N atoms, leaving one lone pair on each N.