Exercise walk-through

Lewis Diagrams ▪ 2.5

eXercise

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

Method — 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: $4 + 2(6) = 16$.

Method — 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).

Method — 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.

Method — 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.

Practice 2.1 ▪ 1 mark

Count the total valence electrons in H_2O.

Solution 2.1

Method: Checking

Worked steps

$2(1) + 6 = 8$ B1.

Practice 2.2 ▪ 1 mark

Count the total valence electrons in NH_3.

Solution 2.2

Method: Checking

Worked steps

$5 + 3(1) = 8$ B1.

Practice 2.3 ▪ 1 mark

How many lone pairs are on the oxygen in a water molecule?

Solution 2.3

Method: Building the skeleton

Worked steps

Two lone pairs B1.

Exam-style 3.1 ▪ 1 mark

The number of valence electrons to use in the Lewis diagram of NO_3^- is

A 22

B 23

C 24

D 5

Solution 3.1

Method: Counting valence electrons

A 22

B 23

C 24 ✓

D 5

Worked steps

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

Exam-style 3.2 ▪ 1 mark

Draw the Lewis diagram of CO_2.
(a) State the total number of valence electrons.
(b) Describe the bonding (single/double/triple) between C and each O.

Solution 3.2

Method: Using multiple bonds

Worked steps

(a) 16 B1. (b) Each O forms a **double** bond with C, so all atoms reach an octet M1 A1.

Exam-style 3.3 ▪ 3 marks

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

Solution 3.3

Method: Using multiple bonds

Worked steps

N_2: $2(5) = 10$ valence electrons (M1); a **triple** bond between the N atoms (M1), leaving one lone pair on each N (A1).