

Saitechinfo NEET-JEE Academy

The oxidation number (oxidation state) of an atom in a compound is determined using the following rules and methods. These rules are applied systematically to assign oxidation numbers.

Rules for Determining Oxidation Numbers

1. Oxidation Number of Free Elements

- The oxidation number of an atom in its elemental form (e.g., O_2 , N_2 , Fe) is **0**.

2. Oxidation Number of Monoatomic Ions

- For a monoatomic ion, the oxidation number is equal to its charge.
 - Example: Na^+ : +1, Cl^- : -1

3. Oxygen

- Oxygen generally has an oxidation number of **-2** in compounds.
- Exceptions:
 - In peroxides (H_2O_2 , Na_2O_2): **-1**
 - In superoxides (KO_2): **-1/2**
 - In compounds with fluorine (OF_2): **+2**

4. Hydrogen

- Hydrogen has an oxidation number of **+1** in most compounds.
- Exception:
 - In metal hydrides (NaH , LiH): **-1**

5. Fluorine

- Fluorine always has an oxidation number of **-1** in its compounds.

6. Other Halogens (Cl, Br, I)

- Halogens usually have an oxidation number of **-1**, except when they are bonded to oxygen or more electronegative halogens.

7. Neutral Compounds

- The sum of the oxidation numbers of all atoms in a neutral compound is **0**.
 - Example: In H_2O , $2(+1) + (-2) = 0$.

8. Polyatomic Ions

- The sum of the oxidation numbers of all atoms in a polyatomic ion equals the ion's charge.
 - Example: In SO_4^{2-} , $S + 4(-2) = -2$, so $S = +6$.

9. Group-Specific Rules

- Group 1 elements (alkali metals): **+1**
- Group 2 elements (alkaline earth metals): **+2**
- Aluminum (Al): **+3**

10. Electronegativity

- In a covalent bond, the more electronegative atom is assigned a negative oxidation number.
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Steps for Determination

1. Write the Chemical Formula:

- Identify all elements in the compound or ion.

2. Apply the Rules in Order:

- Assign known oxidation numbers based on the rules (e.g., oxygen = -2 , hydrogen = $+1$, etc.).

3. Solve for Unknown Oxidation Numbers:

- Use the sum of oxidation numbers in the compound or ion to determine the unknown oxidation state.

4. Verify Your Results:

- Ensure that the sum of oxidation numbers matches the overall charge of the compound or ion.

Examples

1. Determine the Oxidation Number of Chromium in $Cr_2O_7^{2-}$:

- Oxygen = -2 (7 atoms: $7 \times -2 = -14$)
- Let chromium's oxidation number be x .
- $2x - 14 = -2$
- Solve: $2x = +12 \Rightarrow x = +6$
- Chromium's oxidation number is $+6$.

2. Determine the Oxidation Number of Sulfur in H_2SO_4 :

- Hydrogen = $+1$ (2 atoms: $2 \times +1 = +2$)
- Oxygen = -2 (4 atoms: $4 \times -2 = -8$)
- Let sulfur's oxidation number be x .
- $2(+1) + x + 4(-2) = 0$
- Solve: $+2 + x - 8 = 0 \Rightarrow x = +6$
- Sulfur's oxidation number is $+6$.

3. Determine the Oxidation Number of Carbon in C_2H_6 :

- Hydrogen = $+1$ (6 atoms: $6 \times +1 = +6$)
- Let carbon's oxidation number be x .
- $2x + 6 = 0$
- Solve: $2x = -6 \Rightarrow x = -3$
- Carbon's oxidation number is -3 .

By following these rules and steps, oxidation numbers can be systematically determined for any compound or ion. Let me know if you need additional examples or explanations!