Veda International School

Kusugal Road, Hubballi

(ICSE Board)

Grade 9 Subject: Chemistry

Topic: language of chemistry

Exercise

1, What is a symbol? What information does it convey?

Ans: a **symbol** is a short way to represent an **element**. It usually has **one or two letters**.

Example:

- **H** for hydrogen
- **O** for oxygen
- **Na** for sodium

What information does it give?

- The **name of the element**
- Its place in a **chemical formula** (like **H_2O** for water)
- Sometimes, it also shows:
  - **Number of atoms** (with small numbers, like the $_2$ in H_2O)
  - **Charge** or **isotope** (like Na^+ or C-14)

2. what a qualitative and quantitative information is conveyed by a symbol?

Ans: Qualitative Information:

A symbol shows **what** element or substance it is.
Example:

- **H** = Hydrogen
- **O** = Oxygen
  This tells us the **type of element**, not how much.

Quantitative Information:

A symbol can also tell us **how much** of an element is present when used in a formula.
Example:

- In **H_2O**, the **2** means there are **2 hydrogen atoms**.
- In **CO_2**, the **2** means **2 oxygen atoms**

In short:

- **Qualitative = what element**
- **Quantitative = how many atoms**

3, (i) What do you understand by the term chemical formula?
A **chemical formula** shows the **elements** present in a compound and the **number of atoms** of each element.
It is written using **chemical symbols** and **numbers** (subscripts).
Example: H_2O means 2 hydrogen atoms and 1 oxygen atom.

(ii) What qualitative information is given by the formula NH_3?
The formula **NH_3** (ammonia) tells us:

- It is made of **nitrogen (N)** and **hydrogen (H)**.
- There is **1 nitrogen atom** and **3 hydrogen atoms**.
- It is a **compound**, not an element.
- The elements are chemically combined in a **fixed ratio**.

4. What do you understand by the term valency?

Ans: **Valency** is the **combining power of an element**.
It tells us **how many atoms of hydrogen** (or any other element) an atom can combine with or replace in a chemical reaction.

In simple terms:

Valency = **Number of bonds** an atom can form.

Examples:

- **Hydrogen (H)** has valency **1** → it forms 1 bond
- **Oxygen (O)** has valency **2** → it forms 2 bonds
- **Nitrogen (N)** has valency **3**
- **Carbon (C)** has valency **4**

5. (i) What do you understand by the term variable valency?

Variable valency means that **some elements can show more than one valency**.
This happens because they can lose **different numbers of electrons** in different compounds.

Example:

- **Iron (Fe)** has **variable valency**:
  - In **$FeCl_2$**, iron has valency **2**
  - In **$FeCl_3$**, iron has valency **3**

So, iron can have valency **2 or 3** depending on the compound.

(ii) How are the elements having variable valency?

Elements show variable valency because:

1. **They have more than one shell of electrons**
2. They can lose electrons from **more than one energy level (shell)**
3. Usually seen in **transition metals** (like iron, copper, lead, etc.)

More Examples:

- **Copper (Cu):**
  - Cu^{+} (valency 1), Cu^{2+} (valency 2)
- **Tin (Sn):**
  - Sn^{2+} (valency 2), Sn^{4+} (valency 4)

6. Why is the symbol S for sulphur, but Na for sodium and Si for silicon?

Ans: symbol S Because **'S' is the first letter of the word "Sulphur"** – it's straightforward and not shared with any other element.

Symbol Na Because it comes from the **Latin name** of sodium: **"Natrium"**.
So, **Na = Natrium**.

Symbol Si Because the first letter **'S'** is already taken by sulphur, and **'Si'** makes it clear that it's **Silicon**, not Sulphur.

- Some symbols are based on **English names** (like S for sulphur)
- Others are based on **Latin names** (like Na for sodium)
- Symbols are also chosen to **avoid confusion** between elements

7. If the symbol for cobalt is CO, what would be wrong with it?

Ans: The symbol **"CO"** would actually be **incorrect** for cobalt because:

- **"CO"** is the chemical formula for **carbon monoxide**, a compound made of **carbon (C)** and **oxygen (O)**.
- The **correct symbol for cobalt** is **"Co"**, with a capital **C** and a lowercase **o**.

Chemical symbols are case-sensitive. Using the wrong case can completely change the meaning:

- **"Co"** = cobalt (element)
- **"CO"** = carbon monoxide (compound)

So, writing **CO** instead of **Co** would be confusing and scientifically incorrect.

8. Complete the following statements by selecting a proper word or words.

A. The formula of a compound represents

Ans: a molecule,

B. The correct formula of aluminum oxide is

Ans: Al_2O_3.

C. The valency of nitrogen in a nitrogen dioxide NO2 is

Ans: 4.

9. State the valency and formula of the following

Name	Formula	Valency
Ammonium	NH_4^+	1
Calcium	Ca^{2+}	2
Ferric *(Iron III)*	Fe^{3+}	3
Zincate	ZnO_2^{2-}	2
Oxide	O^{2-}	2
Nitride	N^{3-}	3
Hydroxide	OH^-	1
Cupric *(Copper II)*	Cu^{2+}	2
Stannic *(Tin IV)*	Sn^{4+}	4
Barium	Ba^{2+}	2

10. (i) **What do you understand by trivial names of a compound?**
A: Trivial names are the common or traditional names given to chemical compounds. These names are not based on the IUPAC (International Union of Pure and Applied Chemistry) rules but are widely used for convenience. For example, **water** is the trivial name for **dihydrogen monoxide (H_2O)**.

(ii) Give the chemical names of three compounds and also state their trivial names.

1. **Chemical name:** Sodium chloride | **Trivial name:** Common salt
2. **Chemical name:** Calcium carbonate | **Trivial name:** Limestone or marble
3. **Chemical name:** Dihydrogen monoxide | **Trivial name:** Water

11. What do you understand by the term chemical equation? Why should a chemical equation always be balanced?
A: A **chemical equation** is a symbolic representation of a chemical reaction. It shows the reactants and products with their chemical formulas.
Balanced chemical equations ensure that the number of atoms of each element is the same on both sides, which reflects the **law of conservation of mass**—matter cannot be created or destroyed in a chemical reaction

12. **Explain the term valency and variable valency.**

- **Valency** is the combining capacity of an element, determined by the number of electrons an atom can lose, gain, or share to achieve a full outer shell.
- **Variable valency** refers to elements (mainly transition metals) that can exhibit more than one valency.

b. How are the elements with variable valency named?
Elements with variable valency are named using Roman numerals in brackets after the element's name to indicate its valency.
Example:

- Iron(II)- for Fe+2
- Iron (III) for Fe +3

13. **Give the formula and valency of the following:**

Compound	Formula	Valency
Aluminate	AlO_2^-	1
Chromate	CrO_4^{2-}	2
Aluminum	Al^{3+}	3
Cupric (Copper II)	Cu^{2+}	2

14. Write the formulae of the following salts:

1. Zinc carbonate – **$ZnCO_3$**
2. Ammonium sulfate – **$(NH_4)_2SO_4$**
3. Lead hydroxide – **$Pb(OH)_2$**
4. Barium chloride – **$BaCl_2$**
5. Sodium nitrate – **$NaNO_3$**
6. Potassium dichromate – **$K_2Cr_2O_7$**
7. Potassium zincate – **K_2ZnO_2**
8. Calcium bicarbonate – **$Ca(HCO_3)_2$**
9. Magnesium nitride – **Mg_3N_2**
10. Silver chloride – **AgCl**

15. Give the names of the following:

1. $Na_2Fe(CN)_6$ -Sodium hexacyanoferrate(II)
2. HClO- Hypochlorous acid
3. $CaSiO_3$- Calcium metasilicate
4. H_2SO_4 – Sulfuric acid
5. $K_2Cr_2O_7$ – Potassium dichromate
6. HNO_3 – Nitric acid
7. $Mn_3(BO_3)_2$ – Manganese(II) borate
8. H_2CO_3 – Carbonic acid

9. Na_2CrO_4 – Sodium chromate
10. HNO_2 – Nitrous acid
11. $Al_2(SO_4)_3$ → Aluminum sulfate
12. $Mg(HCO_3)_2$ → Magnesium bicarbonate
13. $NH_4)_2S$ → Ammonium sulfide
14. $KMnO_4$ → Potassium permanganate
15. $KClO_3$ → Potassium chlorate
16. Na_2PbO_2 → Sodium plumbite
17. KClO → Potassium hypochlorite
18. $CuSO_4$ → Copper(II) sulfate
19. $Pb(NO_3)_2$ → Lead(II) nitrate

16. Write the formula and balance the following equations

(a) Zinc + Dilute Sulfuric Acid → Zinc Sulfate + Hydrogen

Word equation: Zinc + Sulfuric acid → Zinc sulfate + Hydrogen

Formula: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

(b) Ammonium Sulfate + Calcium Hydroxide → Calcium Sulfate + Ammonia + Water

Word equation: Ammonium sulfate + Calcium hydroxide → Calcium sulfate + Ammonia + Water

Formula: $(NH_4)_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + NH_3 + H_2O$

Balanced: $(NH_4)_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2NH_3 + 2H_2O$

(c) Lead Oxide + Hydrochloric Acid → Lead Chloride + Water + Chlorine

Word equation: Lead oxide + Hydrochloric acid → Lead chloride + Water + Chlorine

Assuming **PbO_2** is the oxide reacting (oxidizing agent):

Formula: $PbO_2 + HCl \rightarrow PbCl_2 + H_2O + Cl_2$

Balanced: $PbO_2 + 4HCl \rightarrow PbCl_2 + 2H_2O + Cl_2$

17. Balance the Following Equations

(a) $Na + H_2O \rightarrow NaOH + H_2$

Balanced:
$2Na + 2H_2O \rightarrow 2NaOH + H_2$

(b) $Na_2O_2 + H_2O \rightarrow NaOH + O_2$

Balanced:
$2Na_2O_2 + 2H_2O \rightarrow 4NaOH + O_2$

(c) $NaNO_3$ (on heating) → $NaNO_2 + O_2$

Balanced:
$2NaNO_3 \rightarrow 2NaNO_2 + O_2$

(d) $Cu(NO_3)_2$ (on heating) → $CuO + NO_2 + O_2$

Balanced:
$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$

(e) $Hg(NO_3)_2$ (on heating) → $Hg + NO_2 + O_2$

Balanced:
$2Hg(NO_3)_2 \rightarrow 2Hg + 4NO_2 + O_2$

18. **What is a chemical formula? What are the rules for writing the formula correctly?**

Chemical Formula: A chemical formula shows the elements in a compound and the number of atoms of each element. It represents how atoms combine in fixed ratios to form a chemical compound.

Examples:

- Water → H_2O (2 hydrogen atoms, 1 oxygen atom)
- Carbon dioxide → CO_2 (1 carbon atom, 2 oxygen atoms)

Rules for Writing a Chemical Formula:

1. **Know the symbols and valencies** of the elements or ions.
2. **Write the symbol** of the positive ion (called the *basic radical*) first, then the negative ion (called the *acid radical*).
3. **Balance the valencies**: Use the "criss-cross" method to balance charges.
4. **Do not write charges** in the final formula.
5. If a radical has more than one atom and needs a subscript, **use brackets**.
6. **Simplify subscripts** if possible (e.g., don't write H_2O_2 unless it's actually hydrogen peroxide).

19, Write the chemical names of the following compounds:

1. **$Ca_3(PO_4)_2$ – Calcium phosphate**
2. **K_2CO_3 – Potassium carbonate**
3. **K_2MnO_4 – Potassium manganate**
4. **$Mn_3(BO_3)_2$ – Manganese(II) borate**
5. **$Mg(HCO_3)_2$ – Magnesium bicarbonate**
6. **$Na_2Fe(CN)_6$ – Sodium ferrocyanide**
7. **$Ba(ClO_3)_2$ – Barium chlorate**
8. **Ag_2SO_3 – Silver sulphite**
9. **$Pb(CH_3COO)_2$ – Lead(II) acetate**
10. **Na_2SiO_3 – Sodium metasilicate**

21. Write the chemical formulas of the following compounds:

1. Barium sulphate → $BaSO_4$
2. Bismuth nitrate → $Bi(NO_3)_3$
3. Calcium bromide → $CaBr_2$
4. Chromium sulphate → $Cr_2(SO_4)_3$
5. Ferrous sulphide → FeS
6. Calcium silicate → Ca_2SiO_4
7. Potassium ferrocyanide → $K_4Fe(CN)_6$
8. Stannic oxide (tin(IV) oxide) → SnO_2
9. Sodium zincate → Na_2ZnO_2
10. Magnesium phosphate → $Mg_3(PO_4)_2$
11. Stannic phosphate → $Sn_3(PO_4)_4$
12. Sodium thiosulphate → $Na_2S_2O_3$
13. Nickel bisulphate → $Ni(HSO_4)_2$
14. Potassium manganate → K_2MnO_4

22. What do you understand by the following?

a. Acid radical:
It is the negatively charged part of a compound that comes from an acid. For example, SO_4^{2-} (sulphate), NO_3^- (nitrate), Cl^- (chloride).

b. Basic radical:
It is the positively charged part of a compound that comes from a base. For example, Na^+ (sodium), Ca^{2+} (calcium), NH_4^+ (ammonium).

23. **$CaCO_3 + 2HCl$ (dilute) → $CaCl_2 + H_2O + CO_2\uparrow$**

Information Provided:

1. **Reactants and Products:**
   - Reactants: Calcium carbonate ($CaCO_3$) and dilute hydrochloric acid (HCl)
   - Products: Calcium chloride ($CaCl_2$), water (H_2O), and carbon dioxide gas (CO_2)
2. **Reactant and Product Ratios:**
   - 1 mole of $CaCO_3$ reacts with 2 moles of HCl
   - Produces 1 mole each of $CaCl_2$, H_2O, and CO_2
3. **Gas Evolution:**
   - CO_2 is released as a gas (indicated by the upward arrow ↑)
4. **Type of Reaction:**
   - This is an **acid-carbonate** reaction (a type of double displacement followed by decomposition)

Information Not Conveyed:

1. **Reaction Conditions:**
   - No specific temperature, pressure, or concentration details are given (other than "dilute" HCl)
2. **Physical States of All Substances:**
   - While "dilute" and the gas (↑) imply some physical states, not all are specified:

- $CaCO_3$ is a solid, HCl is aqueous, $CaCl_2$ is aqueous, H_2O is liquid, CO_2 is gas — but this is inferred

3. **Reaction Rate or Time:**
   - The equation doesn't say how fast the reaction occurs or how long it takes
4. **Energy Changes:**
   - No information on whether the reaction is exothermic or endothermic
5. **Observable Changes:**
   - Effervescence (bubbling due to CO_2) is not mentioned
6. **Reaction Mechanism:**
   - No details on the step-by-step process of bond breaking/forming
7. **Masses or Volumes:**
   - No numerical quantities (grams, liters, etc.) are provided

24. write the balanced equations for the following

1. 3Mg+N2→Mg3N2
2. 3Fe+4H2O⇌Fe3O4+4H2
3. C6H12O6+6O2→6CO2+6H2O
4. 2Al+3H2O→Al2O3+3H2
5. Zn+2KOH→K2ZnO2+H2O
6. Fe2O3+3C→2Fe+3CO
7. 3CuO+2NH3→3Cu+3H2+N2
8. Pb3O4→3PbO+21O2
9. 2ZnS+3O2→2ZnO+2SO2
10. H2SO4+S→SO2+H2O
11. 2HNO3+S→H2SO4+2NO2
12. MnO2+4HCl→MnCl2+2H2O+Cl2
13. Pb3O4+8HCl→3PbCl2+4H2O+Cl2
14. Ca(HCO3)2+2HNO3→Ca(NO3)2+2H2O+2CO2
15. 2Al+2NaOH+6H2O→2NaAlO2+3H2
16. 2H2SO4+C→2H2O+2SO2+CO2

25. write the **balanced chemical equations** for each of the word equations you provided:

1. **Calcium hydroxide + ammonium chloride → calcium chloride + water + ammonia**

   Ca(OH)2+2NH4Cl→CaCl2+2H2O+2NH3

   Potassium bicarbonate → potassium carbonate + water + carbon dioxide

   2KHCO3→K2CO3+H2O+CO2

   Potassium bromide + chlorine → potassium chloride + bromine

   2KBr+Cl2→2KCl+Br2

   Iron + chlorine → iron(III) chloride

$2Fe+3Cl2 \rightarrow 2FeCl3$

Calcium + water → calcium hydroxide + hydrogen

$Ca+2H2O \rightarrow Ca(OH)2+H2$

Potassium nitrate → potassium nitrite + oxygen

$2KNO3 \rightarrow 2KNO2+O2$

Iron + hydrochloric acid → iron(II) chloride + hydrogen
(Assuming "iron twice chloride" means **iron(II) chloride**.)

$Fe+2HCl \rightarrow FeCl2+H2Fe + 2HCl$

Nitrogen dioxide + water + oxygen → nitric acid

$4NO2+O2+2H2O \rightarrow 4HNO3$

Lead dioxide (lead(IV) oxide) → lead monoxide + oxygen

$2PbO2 \rightarrow 2PbO+O2$

26. Mark the following statements whether true or false.

1, all elements have a unique valency.- false

2, phosphate is a divalent ion. – false

3, chemical equations are balanced to satisfy the law of conservation of mass. – true

27**.** Give the significance of H_2SO_4 to a chemist.

Sulfuric acid (H_2SO_4) is a **very important industrial chemical**. It's used in:

- **Manufacturing fertilizers** (like ammonium sulfate)
- **Petroleum refining**
- **Chemical synthesis**
- **Batteries** (especially in lead-acid batteries)
- It's often called the "**king of chemicals**" due to its wide application.

28. Differentiate between atomic and molar equation.

- **Atomic Equation** refers to a reaction represented with individual atoms and their counts.
  - E.g., H + O → H_2O *(not balanced or realistic, just conceptual)*
- **Molar Equation** refers to the reaction using **moles** of substances.
  - E.g., $2H_2 + O_2 \rightarrow 2H_2O$ *(balanced molar equation)*

(ii) differentiate between skeleton and balanced equation.

- **Skeleton Equation**: An **unbalanced** chemical equation showing only the formulas of reactants and products.
    - E.g., $H_2 + O_2 \rightarrow H_2O$
- **Balanced Equation**: A chemical equation where the **number of atoms of each element is equal** on both sides.
    - E.g., $2H_2 + O_2 \rightarrow 2H_2O$

29. (i) Why is the correct formula of a substance more valuable to a chemist than the name of the substance?

The **correct chemical formula** gives a chemist **precise information**:

- It shows **which elements** are present and **how many atoms** of each.
- It helps in **calculations** like molar mass and reaction stoichiometry.
- It's **internationally understood**, unlike names which can vary.
- It can suggest **molecular structure** or behavior in reactions.

For example, the name "sugar" is vague, but the formula **$C_6H_{12}O_6$** tells a chemist exactly what molecule is being discussed (glucose).

(ii) What is the significance of the chemical symbol N?

- **N** is the **chemical symbol** for **nitrogen**, an element.
- It represents a nitrogen **atom** with **7 protons**.
- It can appear in compounds like **NH_3** (ammonia), **NO_2** (nitrogen dioxide), etc.

30. **What is meant by a chemical equation?**

A **chemical equation** is a symbolic way of showing a **chemical reaction**. It includes:

- **Reactants** (starting materials)
- **Products** (new substances formed)
- The **ratio** of substances involved

Example:
$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

Important information it conveys:

- **Reactants**: Calcium carbonate and hydrochloric acid
- **Products**: Calcium chloride, carbon dioxide, and water
- **Balanced equation**: Shows correct ratios (stoichiometry)
- **Gas evolution**: CO_2 gas is released (bubbling/fizzing)

Important information it fails to explain:

- **Reaction conditions**: Temperature, pressure, whether heat is needed
- **Physical states**: (solid, liquid, gas, aqueous) unless specified
- **Energy changes**: Whether the reaction is exothermic or endothermic
- **Reaction rate**: How fast the reaction occurs

31. Which of the following is most informative?

Options:

- (A) $Na + H_2 \rightarrow NH_3$
- (B) $Na_2 + CH_2 \rightarrow 2\ NH_3$
- (C) $N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g) + 2\ kJ$
- (D) $2\ N_2 + H_2 \rightarrow NH_3$ gas liberation

✓ **Correct Answer: (C)**
Why: It is the most informative because it includes:

- Correct balanced chemical equation
- States of matter (gases)
- Energy change (2 kJ released)

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2. Which of the following is *not* a balanced equation?

Options:

- (A) $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
- (B) $Fe + Cl_2 \rightarrow FeCl_3$
- (C) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$
- (D) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

✓ **Correct Answer: (B)**
Why: $Fe + Cl_2 \rightarrow FeCl_3$ is **not balanced**.
Balanced version: **$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$**

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3. When calcium carbonate is heated, lime and carbon dioxide are formed. This reaction is represented by the chemical equation:

Options:

- (A) $CaCO_3 \rightarrow CaO + CO_2$
- (B) $CaCO_3 + CaO \rightarrow CO_2$
- (C) $CaCO_3 + CO_2 \rightarrow CaO$

✓ **Correct Answer: (A)**
Why: $CaCO_3$ (calcium carbonate) decomposes when heated:
$CaCO_3 \rightarrow CaO + CO_2$

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4. The chemical formula of lead sulphate is:

Options:

- (A) Pb_2SO_4
- (B) $PbSO_4$
- (C) $Pb(SO_4)_2$
- (D) None of these

✓ **Correct Answer: (B)**
Why: Lead(II) has a +2 charge, and sulfate (SO_4) has a -2 charge. So the formula is:
$PbSO_4$

33. Percentage composition of $Na_2H_2O_3 \cdot 5H_2O$

This is **sodium dihydrogen trioxoate pentahydrate** (hydrated sodium hydrogen carbonate).

Step 1: Determine the molar mass of $Na_2H_2O_3 \cdot 5H_2O$

Break it down:

- **Na (Sodium)**: 2 × 22.99 = 45.98 g/mol
- **H (Hydrogen)**: 2 × 1.008 = 2.016 g/mol
- **O (Oxygen)**: 3 × 16.00 = 48.00 g/mol
- **$5H_2O$ (water of crystallization)**: 5 × (2 × 1.008 + 16.00) = 5 × 18.016 = 90.08 g/mol

Total molar mass = 45.98 + 2.016 + 48.00 + 90.08 = **186.08 g/mol**

Now calculate the percentage composition:

- %Na = (45.98 / 186.08) × 100 ≈ **24.71%**
- %H = (2.016 + 10.08) / 186.08 × 100 ≈ **6.52%**
- %O = (48 + 80) / 186.08 × 100 ≈ **68.76%**

34. Which compound has the highest percentage of nitrogen?

Compare the nitrogen content in:

1. **Ferriferrocyanide**: $Fe_4[Fe(CN)_6]_3$
2. **Aluminium nitrate**: $Al(NO_3)_3$
3. **Ammonium dichromate**: $(NH_4)_2Cr_2O_7$

Molar masses:

(1) Ferriferrocyanide

- CN = 26 g/mol (12 + 14), and 6 × 3 = 18 CN groups
- So total nitrogen = 18 × 14 = 252 g/mol of N
- Molar mass = Approx 4×55.8 + 3×(55.8 + 6×26) = approx 4×55.8 + 3×(55.8 + 156) ≈ 223.2 + 3×211.8 ≈ **858.6 g/mol**
- %N = (252 / 858.6) × 100 ≈ **29.36%**

(2) Aluminium nitrate: $Al(NO_3)_3$

- 3 N atoms → 3×14 = 42 g
- Molar mass = 26.98 + 3×(14 + 48) = 26.98 + 3×62 = **213.98 g/mol**
- %N = (42 / 213.98) × 100 ≈ **19.63%**

(3) Ammonium dichromate: $(NH_4)_2Cr_2O_7$

- 2 N atoms = 28 g
- Molar mass = 2×18.04 + 2×52 + 7×16 = 36.08 + 104 + 112 = **252.08 g/mol**
- %N = (28 / 252.08) × 100 ≈ **11.11%**

✓ **Highest nitrogen %: Ferriferrocyanide**

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34. Calculate the mass of nitrogen in 1000 kg of urea ($CO(NH_2)_2$)

Molar mass of urea = 12 (C) + 16 (O) + 2×(14 + 2×1.008) = 12 + 16 + 2×(14 + 2.016) = 12 + 16 + 2×18.016 = **60.03 g/mol**

Nitrogen in urea: 2 atoms → 2×14 = 28 g

% Nitrogen = (28 / 60.03) × 100 ≈ **46.65%**

Mass of nitrogen in 1000 kg of urea:

= 46.65% of 1000 kg
= 0.4665 × 1000 = **466.5 kg**

Corrected to nearest kg = 467 kg

38. Calculate the total percentage of oxygen in magnesium nitrate crystals

Formula: $Mg(NO_3)_2 \cdot 6H_2O$

Break down the molecular formula:

- Mg = 24
- $(NO_3)_2$:
  - N = 14 × 2 = 28
  - O = 16 × 6 = 96
- $6H_2O$:
  - H = 1 × 2 × 6 = 12
  - O = 16 × 6 = 96

Total molar mass: = 24 (Mg) + 28 (N) + 96 (O from NO_3) + 12 (H from water) + 96 (O from water)
= **24 + 28 + 96 + 12 + 96 = 256 g/mol**

Total oxygen mass = 96 (from NO_3) + 96 (from water) = 192 g

Percentage of oxygen = (192 / 256) × 100 = 75.0%

39. Mass of nitrogen supplied by 5 kg of urea $CO(NH_2)_2$

Molecular formula breakdown:

- C = 12
- O = 16
- N = 14 × 2 = 28
- H = 1 × 4 = 4

Molar mass of urea = 12 + 16 + 28 + 4 = 60 g/mol

Nitrogen content = 28 g per 60 g urea

So in 5000 g urea: **Mass of nitrogen = (28 / 60) × 5000 = 2333.3 g = 2.33 kg**

40. Percentage of nitrogen in ammonium nitrate NH_4NO_3

Breakdown:

- N = 14 × 2 = 28
- H = 1 × 4 = 4
- O = 16 × 3 = 48

Molar mass = 28 + 4 + 48 = 80 g/mol

Percentage of nitrogen = (28 / 80) × 100 = 35.0%

41. Percentage of boron in borax $Na_2B_4O_7 \cdot 10H_2O$

Breakdown:

- Na = 23 × 2 = 46
- B = 11 × 4 = 44
- O = 16 × 7 = 112
- $10H_2O$:
    - H = 1 × 2 × 10 = 20
    - O = 16 × 10 = 160

Total molar mass = 46 + 44 + 112 + 20 + 160 = 382 g/mol

Percentage of boron = (44 / 382) × 100 = 11.5%