

Salts Exercise

i. Which of the following salts is soluble in water?

- a. Silver chloride (AgCl)
- b. Lead carbonate (PbCO_3)
- c. **Sodium nitrate (NaNO_3)**
- d. Lead chloride (PbCl_2)

ii. What type of ions do bases provide for salt formation?

- a. Negative ions
- b. Positive ions**
- c. Neutral molecules
- d. Complex ions

iii. What is the primary reason salts have high melting points?

- a. Weak van der Waals forces
- b. Strong electrostatic forces**
- c. Hydrogen bonding
- d. Covalent bonding

iv. In what state are salts generally good conductors of electricity?

- a. Solid
- b. Gas
- c. Molten**
- d. Powdered

v. Which of the following is a general solubility rule for chlorides?

- a. All chlorides are insoluble.
- b. All chlorides are soluble.
- c. Chlorides are soluble except lead and silver chlorides.**
- d. Chlorides are soluble except sodium and potassium chlorides.

vi. What happens to the ions in a salt when it is dissolved in water?

- a. They form a gas.
- b. They become fixed in place.
- c. They become mobile.**
- d. They form a solid.

vii. Which of the following methods is used to prepare a salt by titration?

- a. Acid + Metal
- b. Acid + Insoluble Base
- c. Acid + Insoluble Carbonate
- d. Acid + Alkali**

viii. Which of these salts is insoluble in water?

- a. Potassium carbonate (K_2CO_3)
- b. Ammonium nitrate (NH_4NO_3)
- c. Calcium Chloride ($CaCl_2$)
- d. Lead chloride ($PbCl_2$)**

ix. What is formed when an acid reacts with an excess of an insoluble base?

- a. Salt and hydrogen
- b. Salt and water**
- c. Salt and carbon dioxide
- d. Salt and oxygen

x. Which ion is commonly found in soluble nitrates?

- a. NH_4^+
- b. NO_3^-**
- c. Cl^-
- d. CO_3^{2-}

6. Calculate the mass in grams of each of the following samples:

Formula: Mass = moles × molar mass

(a) 1.2 moles of K

- Molar mass of K = 39 g/mol
- Mass = $1.2 \text{ mol} \times 39 \text{ g/mol} = \mathbf{46.8 \text{ g}}$

(b) 75 moles of H₂

- Molar mass of H₂ = $(2 \times 1) = 2 \text{ g/mol}$
- Mass = $75 \text{ mol} \times 2 \text{ g/mol} = \mathbf{150 \text{ g}}$

(c) 0.25 moles of steam (H₂O)

- Molar mass of H₂O = $(2 \times 1) + 16 = 18 \text{ g/mol}$
- Mass = $0.25 \text{ mol} \times 18 \text{ g/mol} = \mathbf{4.5 \text{ g}}$

(d) 1.05 moles of CuSO₄·5H₂O

- Molar mass = Cu (63.5) + S (32) + O₄ (64) + $5 \times [H_2 (2) + O (16)]$
 $= 63.5 + 32 + 64 + 5 \times (18)$
 $= 159.5 + 90 = 249.5 \text{ g/mol}$
- Mass = $1.05 \text{ mol} \times 249.5 \text{ g/mol} = \mathbf{261.975 \text{ g}}$

(e) 0.15 moles of H₂SO₄

- Molar mass = H₂ (2) + S (32) + O₄ (64) = 98 g/mol
- Mass = $0.15 \text{ mol} \times 98 \text{ g/mol} = \mathbf{14.7 \text{ g}}$
-

7. Calculate the number of molecules present in each of the following samples:

Formula: Number of molecules = moles × Avogadro's number (6.022×10^{23})

(a) 2.5 moles of carbon dioxide (CO_2)

- Molecules = $2.5 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol} = \mathbf{1.5055 \times 10^{24}}$
molecules

(b) 3.4 moles of ammonia (NH_3)

- Molecules = $3.4 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol} = \mathbf{2.0475 \times 10^{24}}$
molecules

(c) 1.09 moles of benzene (C_6H_6)

- Molecules = $1.09 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol} = \mathbf{6.564 \times 10^{23}}$
molecules

(d) 0.01 moles of acetic acid (CH_3COOH)

- Molecules = $0.01 \text{ mol} \times 6.022 \times 10^{23} \text{ molecules/mol} = \mathbf{6.022 \times 10^{21}}$
molecules
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8. Decide whether or not each of the following is an example of an empirical formula:

- Empirical Formula:** The simplest whole-number ratio of atoms of each element in a compound.

(a) Al_2Cl_3

- Ratio is 2:3. It is the simplest whole-number ratio. **Yes.**

(b) Hg_2Cl_2

- Ratio is 2:2, which can be simplified to 1:1. The empirical formula should be HgCl . **No.**

(c) NaCl

- Ratio is 1:1. It is the simplest whole-number ratio. **Yes.**

(d) C₇H₅O

- Ratio is 7:5:1. It cannot be simplified further. **Yes.**
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9. TNT contains 7 C-atoms, 5 H-atoms, 3 N-atoms and 6 O-atoms. Write its empirical formula.

- The ratio of C:H:N:O is 7:5:3:6.
- This ratio cannot be simplified further as 7,5,3,6 have no common divisor.
- Empirical Formula: **C₇H₅N₃O₆**
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10. A molecule contains four phosphorus atoms and ten oxygen atoms. Write the empirical formula. Also determine the molar mass.

- The ratio of P:O is 4:10, which can be simplified by dividing by 2.
- Simplified ratio is 2:5.
- Empirical Formula: **P₂O₅**
- Molar Mass = $(2 \times 31) + (5 \times 16) = 62 + 80 = \mathbf{142 \text{ g/mol}}$
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11. Calculate the molar masses and write the empirical formulas.

(a) Indigo (C₁₆H₁₀N₂O₂)

- Molar Mass = $(16 \times 12) + (10 \times 1) + (2 \times 14) + (2 \times 16) = 192 + 10 + 28 + 32 = \mathbf{262 \text{ g/mol}}$
- Empirical Formula: The ratio 16:10:2:2 can be simplified by dividing by 2. **C₈H₅NO**

(b) Indoxyl (C_8H_7ON)

- Molar Mass = $(8 \times 12) + (7 \times 1) + 16 + 14 = 96 + 7 + 16 + 14 = 133 \text{ g/mol}$
- Empirical Formula: The ratio 8:7:1:1 cannot be simplified. C_8H_7NO

12. Identify the substance that has a formula mass of 133.5 amu.

- (a) $MgCl_2$: $24 + (2 \times 35.5) = 95 \text{ amu}$
- (b) S_2Cl_2 : $(2 \times 32) + (2 \times 35.5) = 64 + 71 = 135 \text{ amu}$
- (c) BCl_3 : $11 + (3 \times 35.5) = 11 + 106.5 = 117.5 \text{ amu}$
- (d) $AlCl_3$: $27 + (3 \times 35.5) = 27 + 106.5 = 133.5 \text{ amu}$
- Answer: (d) $AlCl_3$

13. Calculate the number of atoms in each of the following samples:

(a) 3.4 moles of nitrogen atoms

- Number of atoms = moles \times Avogadro's number
- Atoms = $3.4 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms/mol} = 2.047 \times 10^{24} \text{ atoms}$

(b) 23g of Na

- Moles of Na = mass / molar mass = $23 \text{ g} / 23 \text{ g/mol} = 1 \text{ mole}$
- Atoms = $1 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms/mol} = 6.022 \times 10^{23} \text{ atoms}$

(c) 5g of H atoms

- Moles of H = mass / molar mass = $5 \text{ g} / 1 \text{ g/mol} = 5 \text{ moles}$
- Atoms = $5 \text{ mol} \times 6.022 \times 10^{23} \text{ atoms/mol} = 3.011 \times 10^{24} \text{ atoms}$

14. Calculate the mass of the following:

Formula: Mass = (Number of particles / Avogadro's number) × Molar Mass

(a) 3.24×10^{18} atoms of iron (Fe)

- Moles of Fe = $(3.24 \times 10^{18}) / (6.022 \times 10^{23}) = 5.38 \times 10^{-6}$ mol
- Molar mass of Fe = 56 g/mol
- Mass = 5.38×10^{-6} mol × 56 g/mol = **3.01×10^{-4} g**

(b) 2×10^{19} molecules of nitrogen gas (N₂)

- Moles of N₂ = $(2 \times 10^{19}) / (6.022 \times 10^{23}) = 3.32 \times 10^{-5}$ mol
- Molar mass of N₂ = 28 g/mol
- Mass = 3.32×10^{-5} mol × 28 g/mol = **9.30×10^{-4} g**

(c) 1×10^{20} molecules of water (H₂O)

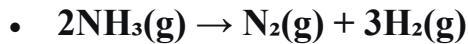
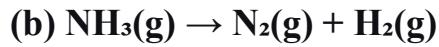
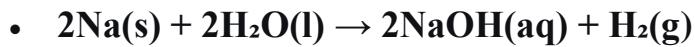
- Moles of H₂O = $(1 \times 10^{20}) / (6.022 \times 10^{23}) = 1.66 \times 10^{-4}$ mol
- Molar mass of H₂O = 18 g/mol
- Mass = 1.66×10^{-4} mol × 18 g/mol = **2.99×10^{-3} g**

(d) 3×10^8 atoms of Al

- Moles of Al = $(3 \times 10^8) / (6.022 \times 10^{23}) = 4.98 \times 10^{-16}$ mol
- Molar mass of Al = 27 g/mol
- Mass = 4.98×10^{-16} mol × 27 g/mol = **1.35×10^{-14} g**

15. Balance the following chemical equations

(a) Na(s) + H₂O(l) → NaOH(aq) + H₂(g)



16. Potassium is a Group 1 element...

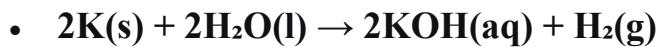
(a) Predict the formula of potassium oxide and potassium nitride.

- Potassium Oxide: K is +1, O is -2. Formula is K_2O .
- Potassium Nitride: K is +1, Nitride ion is N^{3-} . Formula is K_3N .

(b) Show that 1.28×10^{-2} mole of K were added to the water.

- Mass of K = 0.5 g
- Molar mass of K = 39 g/mol
- Moles of K = mass / molar mass = $0.5 \text{ g} / 39 \text{ g/mol} = 0.0128 \text{ mol}$ or $1.28 \times 10^{-2} \text{ mol}$

(c) Balance the chemical equation.



(d) Transform the balanced chemical equation into an ionic equation.

- First, write all soluble strong electrolytes as ions: $2\text{K(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{K}^+(\text{aq}) + 2\text{OH}^-(\text{aq}) + \text{H}_2\text{(g)}$
- Cancel spectator ions (there are none to cancel in this case).
- The ionic equation is: $2\text{K(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{K}^+(\text{aq}) + 2\text{OH}^-(\text{aq}) + \text{H}_2\text{(g)}$

(e) Calculate the number of atoms present in the sample of K.

- Moles of K = 1.28×10^{-2} mol
- Number of atoms = moles × Avogadro's number
- Atoms = $(1.28 \times 10^{-2}$ mol) × $(6.022 \times 10^{23}$ atoms/mol) = **7.71×10^{21} atoms**

(f) Predict the period number of potassium in the periodic table.

- Potassium (K) has an atomic number of 19.
- Electronic configuration: 2, 8, 8, 1. It has 4 electron shells.
- Therefore, it is in **Period 4**.