

UNITS 4, 5, 6 GROUP PRACTICE PROBLEMS-Answers

Unit 4: Chemical Nomenclature

- 1) Classify each compound as either: M = molecular (two nonmetals) I = Ionic (metal + nonmetal)
- a) FeCl₂ **Ionic** b) N₂O **Molecular** c) HBr **Molecular**
d) CO₂ **Molecular** e) BaI₂ **Ionic** d) K₂O **Ionic**

- 2) Complete the following table:

Element	Ion(s)	Oxidation Number(s)	Names
Iron	Fe ²⁺	+2	iron (II) or ferrous
	Fe ³⁺	+3	iron (III) or ferric
Potassium	K ⁺	+1	potassium
Beryllium	Be ²⁺	+2	beryllium
Tin	Sn ²⁺	+2	tin (II) or stannous
	Sn ⁴⁺	+4	tin (IV) or stannic
Cobalt	Co ²⁺	+2	cobalt (II)
	Co ³⁺	+3	cobalt (III)
Oxygen	O ²⁻	-2	oxide
Fluorine	F ⁻	-1	fluoride
Copper	Cu ⁺	+1	copper (I) or cuprous
	Cu ²⁺	+2	copper (II) or cupric

- 3) List 3 common examples of each of the three types of bonding:
- a) Ionic **table salt: NaCl, baking soda: NaHCO₃, rust: Fe₂O₃**
b) Covalent **water: H₂O, carbon dioxide: CO₂, carbon monoxide: CO**
c) Metallic **gold: Au, silver: Ag, platinum: Pt**

- 4) Circle each of the following compounds that is ionically bonded:
CO₂ SiO₂ NaCl HBr CH₄ Rb₂O KF

- 5) Write the chemical formula for each of the following compounds:
- | | |
|---|--|
| potassium sulfate K₂SO₄ | sodium oxide Na₂O |
| aluminum nitride AlN | diphosphorus trioxide P₂O₃ |
| iron(II) perchlorate Fe(ClO₄)₂ | arsenic pentachloride AsCl₅ |
| calcium carbonate CaCO₃ | chromium (III) chloride CrCl₃ |
| carbonic acid H₂CO₃ | hydrobromic acid HBr |
| hypochlorous acid HClO | dihydrogen monoxide H₂O |
| cesium bromide CsBr | barium sulfate BaSO₄ |
| chlorine monoxide ClO | beryllium oxide BeO |
| sulfur difluoride SF₂ | sodium bicarbonate NaHCO₃ |
| tin (II) fluoride SnF₂ | cobalt (III) nitrate Co(NO₃)₃ |
| potassium chlorate KClO₄ | oxygen difluoride OF₂ |
| hydrochloric acid HCl | lithium hydroxide LiOH |
| sulfur dioxide SO₂ | copper (I) sulfide Cu₂S |
| nitrous acid HNO₂ | calcium iodide CaI₂ |

- 6) Which of the following compounds are covalently bonded?
NO₂ PCl₃ NH₃ NaI CaCl₂ Al₂O₃ C₆H₆

- 7) Write the chemical name for each of the following compounds
- | | | | |
|--------------------------------|---------------------------------|--------------------------------|---------------------------------------|
| H ₂ | hydrogen | H ₂ O | water or dihydrogen monoxide |
| CO ₂ | carbon dioxide | NH ₃ | ammonia or nitrogen trihydride |
| SO ₃ | sulfur trioxide | CH ₄ | methane or carbon tetrahydride |
| P ₂ S ₆ | diphosphorus hexasulfide | N ₂ O ₄ | dinitrogen tetroxide |
| C ₂ F ₂ | dicarbon difluoride | HNO ₂ | nitrous acid |
| Cu ₂ S | copper (I) sulfide | SnO ₂ | tin (IV) oxide |
| HBrO ₂ | bromous acid | HF | hydrofluoric acid |
| CrO ₃ | chromium (VI) oxide | Cr ₂ O ₃ | chromium (III) oxide |
| Al ₂ O ₃ | aluminum oxide | SeO ₂ | selenium dioxide |
| SeO ₃ | selenium trioxide | NI ₃ | nitrogen triiodide |
| PCl ₃ | phosphorous trichloride | SF ₂ | sulfur difluoride |

NaCl	sodium chloride	MgCl ₂	magnesium chloride
NO	nitrogen monoxide	NF ₃	nitrogen trifluoride
RbBr	rubidium bromide	N ₂ F ₄	dinitrogen tetrafluoride
CsF	cesium fluoride	AlI ₃	aluminum iodide
HNO ₃	nitric acid	FePO ₄	iron (III) phosphate
NaHSO ₄	sodium hydrogen sulfate	KNO ₃	potassium nitrate
H ₂ SO ₄	sulfuric acid	SiF ₄	silicon tetrafluoride
PtCl ₄	platinum (IV) chloride	NH ₄ Cl	ammonium chloride

- 8) C₈H₁₈ contains a total of **26** atoms, including **8** atoms C and **18** atoms H.
- 9) Al(NO₃)₃ contains a total of 13 atoms, including **3** atoms N, **1** atoms Al, and **9** atoms O.
- 10) (NH₄)₂SO₄ contains a total of **15** atoms.
- 11) One particle of (NH₄)₃PO₄, ammonium phosphate, contains **3** NH₄⁺ ions, **1** PO₄³⁻ ions, **3** atoms N, **12** atoms H, **1** atoms P, **4** atoms O, and **20** total atoms.

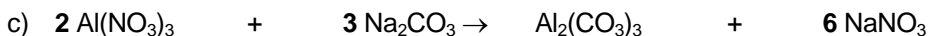
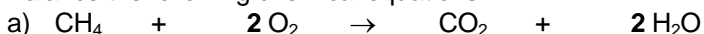
Unit 5: Chemical Formula Relationships

- 12) Determine the formula masses for the following compounds:
- Mg(OH)₂ **58.3 amu**
 - calcium hydroxide **74.1 amu**
 - acetic acid **60.0 amu**
- 13) Perform the following Calculations
- Determine the mass of one mole of CO₂ **44.0 g CO₂**
 - Determine the number of atoms in one molecule of Fe₂O₃ **2 atoms Fe, 3 atoms O = 5 atoms**
 - Determine the number of atoms in one mole of C₆H₁₂O₆
6.02 x 10²³ molecules C₆H₁₂O₆ = 3.61 x 10²⁴ atomsC, 7.22 x 10²⁴ atomsH, 3.61 x 10²⁴ atomsO
 - Determine the mass of 5.240 moles of gold **1032 g Au**
 - Determine the number of moles of nitrogen gas in 85.4 g of nitrogen gas. **3.05 mol N₂**
 - Determine the mass, in grams, of one atom of silver. **1.79 x 10⁻²² g Ag**
 - Determine the mass, in grams, of one molecule of carbon dioxide. **7.31 x 10⁻²³ g CO₂**
- 14) Perform the following Calculations
- Determine the percent composition of ammonium sulfate, (NH₄)₂SO₄.
21% N, 6.1% H, 24.3% S, 48.4% O
 - Determine the percent composition of urea, N₂H₄CO. **46.7% N, 6.7% H, 20.0% C, 26.7% O**
- 15) Each of the compounds listed in question 14 contains nitrogen. They are used as fertilizers. For each of the compounds, which one has the highest percentage of nitrogen? **N₂H₄CO**
- 16) Here is challenge problem on percentage composition.
Chlorine (Cl) is the active ingredient used to purify water in swimming pools. Three brands are available and each cost \$0.50 per liter of water solutions of NaOCl.
- Brand A contains 10 % OCl⁻ by mass, **contains 6.89% Cl or 7% Cl**
 - Brand B contains 7 % chlorine (Cl) by mass, **contains 7% Cl**
 - Brand C contains 14 % NaOCl by mass. **contains 6.68% Cl or 7% Cl**
- Which of the three brands is the best buy? **Following sig figs, they are all the same buy.**
- 17) Write the empirical formula for each of the following compounds.
- C₁₂H₂₂O₁₁, sugar **C₁₂H₂₂O₁₁**
 - C₂H₆O₂, ethylene glycol (antifreeze) **CH₃O**
- 18) From the following empirical formulas and the formula masses for each compound, determine their molecular formulas.
- CH₃; formula mass= 30.0 amu **C₂H₆**
 - CH₂; formula mass= 84.0 amu **C₆H₁₂**
 - C₃H₄O₃ (Vitamin C); formula mass= 176 amu **C₆H₈O₆**

- 19) Determine the empirical formula for a compound that contains 18.6 grams of phosphorus and 14.0 grams of nitrogen. **P₃N₅**
- 20) Determine the empirical formula for a compound that contains 35.6% of phosphorus and 64.4% of sulfur. **P₄S₇**
- 21) A compound with a molecular mass of 98.0 g/mole was determined to be 24.49% carbon, 4.08% hydrogen, and 72.43% chlorine.
- Determine the empirical formula of the compound. **CH₂Cl**
 - Determine the molecular formula of the compound. **C₂H₄Cl₂**

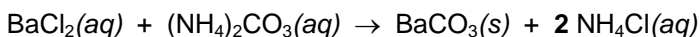
Unit 6: Reactions and Equations

22) Balance the following chemical equations.

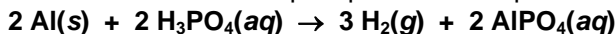


23) According to the following unbalanced reactions:

- Balance the equations
- Determine the amount of reactants and products (in moles)
- Explain the phase labels



aluminum metal reacts with phosphoric acid to produce hydrogen gas and solid aluminum phosphate.



24) Classify the following chemical reactions as:

- | | | |
|--------------------|----------------|--------------------|
| combination | decomposition | single replacement |
| double replacement | neutralization | combustion |
- $\text{Fe}(s) + 2 \text{HCl} = \text{H}_2(g) + \text{FeCl}_2$ **single replacement**
 - $4 \text{NH}_3 + 5 \text{O}_2(g) = 4 \text{NO} + 6 \text{H}_2\text{O}$ **combustion**
 - $\text{C}_2\text{H}_2 + \text{HCl} = \text{C}_2\text{H}_3\text{Cl}$ **combination**
 - $\text{NaBr}(aq) + \text{AgNO}_3(aq) = \text{AgBr}(s) + \text{NaNO}_3(aq)$ **double replacement**
 - $\text{C}_6\text{H}_{12}\text{O}_6 = 2 \text{C}_2\text{H}_5\text{OH} + 2 \text{CO}_2$ **decomposition**
 - $\text{NaOH} + \text{CH}_3\text{COOH} = \text{NaCH}_3\text{COO} + \text{H}_2\text{O}$ **neutralization**

25) Based upon the type of reaction, determine the products. Write the balanced chemical equation.

- Combination: Calcium and bromine combine.
 $\text{Ca}(s) + \text{Br}_2(l) \rightarrow \text{CaBr}_2(s)$
- Decomposition: Water breaks apart by electrolysis.
 $2 \text{H}_2\text{O}(g) \rightarrow 2 \text{H}_2(g) + \text{O}_2(g)$
- Combustion: Natural gas (CH₄) is burned in furnaces.
 $\text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CO}_2(g) + 2 \text{H}_2\text{O}(l)$
- Single Replacement: Chlorine gas is bubbled through an aqueous solution of potassium iodide.
 $\text{Cl}_2(g) + 2 \text{KI}(aq) \rightarrow 2 \text{KCl}(aq) + \text{I}_2(g)$
- Double Replacement: Calcium nitrate and potassium fluoride combine to form a precipitate.
 $\text{Ca}(\text{NO}_3)_2(aq) + 2 \text{KF}(aq) \rightarrow \text{CaF}_2(s) + 2 \text{KNO}_3(aq)$
- Double Replacement – Neutralization: Sodium hydroxide is added to phosphoric acid.
 $3 \text{NaOH}(aq) + \text{H}_3\text{PO}_4(aq) \rightarrow \text{Na}_3\text{PO}_4(aq) + 3 \text{H}_2\text{O}(l)$