

REVIEW QUESTIONS

Chapter 3

1. Using only a periodic table, assign charges for each ion below, then complete the table with formulas and names for compounds formed by the combination of each cation and anion.

	Ca <u>2+</u>	K <u>1+</u>	Al <u>3+</u>	NH ₄ <u>1+</u>
S <u>2-</u>	CaS	K ₂ S	Al ₂ S ₃	(NH ₄) ₂ S
	Calcium sulfide	Potassium sulfide	Aluminum sulfide	Ammonium sulfide
Cl <u>1-</u>	CaCl ₂	KCl	AlCl ₃	NH ₄ Cl
	Calcium chloride	Potassium chloride	Aluminum chloride	Ammonium chloride
N <u>3-</u>	Ca ₃ N ₂	K ₃ N	AlN	(NH ₄) ₃ N
	Calcium nitride	Potassium nitride	Aluminum nitride	Ammonium nitride
NO ₂ <u>1-</u>	Ca(NO ₂) ₂	KNO ₂	Al(NO ₂) ₃	NH ₄ NO ₂
	Calcium nitrite	Potassium nitrite	Aluminum nitrite	Ammonium nitrite
SO ₄ <u>2-</u>	CaSO ₄	K ₂ SO ₄	Al ₂ (SO ₄) ₃	(NH ₄) ₂ SO ₄
	Calcium sulfate	Potassium sulfate	Aluminum sulfate	Ammonium sulfate
NO ₃ <u>1-</u>	Ca(NO ₃) ₂	KNO ₃	Al(NO ₃) ₃	NH ₄ NO ₃
	Calcium nitrate	Potassium nitrate	Aluminum nitrate	Ammonium nitrate
CO ₃ <u>2-</u>	CaCO ₃	K ₂ CO ₃	Al ₂ (CO ₃) ₃	(NH ₄) ₂ CO ₃
	Calcium carbonate	Potassium carbonate	Aluminum carbonate	Ammonium carbonate
ClO ₃ <u>1-</u>	Ca(ClO ₃) ₂	KClO ₃	Al(ClO ₃) ₃	NH ₄ ClO ₃
	Calcium chlorate	Potassium chlorate	Aluminum chlorate	Ammonium chlorate
OH <u>1-</u>	Ca(OH) ₂	KOH	Al(OH) ₃	NH ₄ OH
	Calcium hydroxide	Potassium hydroxide	Aluminum hydroxide	Ammonium hydroxide
PO ₄ <u>3-</u>	Ca ₃ (PO ₄) ₂	K ₃ PO ₄	AlPO ₄	(NH ₄) ₃ PO ₄
	Calcium phosphate	Potassium phosphate	Aluminum phosphate	Ammonium phosphate

2. Fill in the missing name or formula for each compound listed below. Fill in column 1 without using any notes, and then fill in column 2 with the use of notes.

	1	2
Barium nitrate	Ba(NO₃)₂	
Ferrous chloride	FeCl₂	
Silver hydroxide	AgOH	
Strontium phosphate	Sr₃(PO₄)₂	
Copper(II) acetate	Cu(C₂H₃O₂)₂	
Zinc nitrite	Zn(NO₂)₂	
Potassium sulfite	K₂SO₃	
Ammonium carbonate	(NH₄)₂CO₃	
Iodine heptafluoride	IF₇	
Bromine trifluoride	BrF₃	
CuClO ₄	copper(I) perchlorate	
Ag ₂ SO ₄	silver sulfate	
N ₂ O ₅	dinitrogen pentoxide	
Hg ₂ I ₂	mercury(I) iodide	
PbO ₂	lead (IV) oxide	
OF ₂	oxygen difluoride	

3. For each compound shown below, determine if the name or formula is incorrect, and write the correct form in the space provided:

a) Ag_2S	Disilver sulfide	<u>Silver sulfide</u>
b) MgOH	Magnesium hydroxide	<u>Mg(OH)_2</u>
c) $\text{Ca(NO}_3)_2$	Calcium (II) nitrate	<u>Calcium nitrate</u>
d) SnO_2	Tin (II) oxide	<u>Tin (IV) oxide</u>
e) PbS	Lead sulfide	<u>Lead (II) sulfide</u>
f) ZnCl_2	Zinc dichloride	<u>Zinc chloride</u>
g) SO_2	Sodium dioxide	<u>Sulfur dioxide</u>
h) CaSO_4	Calcium sulfide	<u>Calcium sulfate</u>
i) Ba_2O	Barium oxide	<u>BaO</u>
j) Cu_2O	Copper (II) oxide	<u>Copper (I) oxide</u>

4. Balance the following equations by providing the missing coefficients:

- a) $1 \text{ NH}_4\text{NO}_3 \rightarrow 1 \text{ N}_2\text{O} + 2 \text{ H}_2\text{O}$
- b) $1 \text{ Mg}_3\text{N}_2 + 6 \text{ H}_2\text{O} \rightarrow 3 \text{ Mg(OH)}_2 + 2 \text{ NH}_3$
- c) $1 \text{ NCl}_3 + 3 \text{ H}_2\text{O} \rightarrow 1 \text{ NH}_3 + 3 \text{ HOCl}$
- d) $2 \text{ C}_5\text{H}_{10}\text{O}_2 + 13 \text{ O}_2 \rightarrow 10 \text{ CO}_2 + 10 \text{ H}_2\text{O}$
- e) $1 \text{ (NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow 1 \text{ N}_2 + 1 \text{ Cr}_2\text{O}_3 + 4 \text{ H}_2\text{O}$
- f) $1 \text{ PCl}_5 + 4 \text{ H}_2\text{O} \rightarrow 1 \text{ H}_3\text{PO}_4 + 5 \text{ HCl}$

5. Write a balanced equation for each reaction described below. Include state designations:

- a) When an aqueous solution of potassium dichromate is added to an aqueous solution of lead(II) nitrate, solid lead(II) dichromate and aqueous potassium nitrate are formed.



- b) When chlorine gas is bubbled through an aqueous solution of potassium bromide, bromine gas and aqueous potassium chloride are formed.



- c) When zinc metal is reacted with aqueous nitric acid, the reaction produces nitrogen gas, water and aqueous zinc nitrate.



6. What mass of chlorine is present in 12.2 g of $PbCl_2$?

$$12.2 \text{ g } PbCl_2 \times \frac{1 \text{ mol}}{278.1 \text{ g}} \times \frac{2 \text{ Cl}}{1 PbCl_2} \times \frac{35.45 \text{ g}}{1 \text{ mol}} = 3.11 \text{ g}$$

7. How many atoms of oxygen are present in 2.15 g of $Ca_3(PO_4)_2$?

$$2.15 \text{ g } Ca_3(PO_4)_2 \times \frac{1 \text{ mol}}{310.18 \text{ g}} \times \frac{8 \text{ O}}{1 Ca_3(PO_4)_2} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = 3.34 \times 10^{22} \text{ O atoms}$$

8. What is the percent composition of caffeine (C₈H₁₀N₄O₂)?

molar mass = 194.22 g/mol

$$\begin{aligned} \% \text{ C} &= \frac{8 \times 12.01}{194.22} \times 100 = 49.47\% & \% \text{ N} &= \frac{4 \times 14.01}{194.22} \times 100 = 28.85\% \\ \% \text{ H} &= \frac{10 \times 1.01}{194.22} \times 100 = 5.20\% & \% \text{ O} &= \frac{2 \times 16.00}{194.22} \times 100 = 16.48\% \end{aligned}$$

9. Determine the empirical formula for a compound with the following composition:

62.1% C 5.21% H 12.1% N 20.7% O

$$\text{mol C} = 62.1 \text{ g} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = 5.17 \quad (6) \xrightarrow{\times 2} (12)$$

$$\text{mol H} = 5.21 \text{ g} \times \frac{1 \text{ mol}}{1.01 \text{ g}} = 5.16 \quad (6) \xrightarrow{\times 2} (12)$$

$$\text{mol N} = 12.1 \text{ g} \times \frac{1 \text{ mol}}{14.01 \text{ g}} = 0.864 \quad (1) \xrightarrow{\times 2} (2)$$

$$\text{mol O} = 20.7 \text{ g} \times \frac{1 \text{ mol}}{16.00 \text{ g}} = 1.29 \quad (1.5) \xrightarrow{\times 2} (3)$$

Empirical formula = C₁₂H₁₂N₂O₃

10. Combustion analysis of a 12.01-g sample of an unknown acid—which contains only carbon, hydrogen and oxygen—produced 14.08 g CO₂ and 4.32 g H₂O. Determine the empirical formula for this acid.

$$14.08 \text{ g CO}_2 \times \frac{1 \text{ mol}}{44.01 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} = 0.320 \text{ mol C} = 3.84 \text{ g C}$$

$$4.32 \text{ g H}_2\text{O} \times \frac{1 \text{ mol}}{18.02 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} = 0.480 \text{ mol H} = 0.485 \text{ g H}$$

$$\text{Mass of O} = 12.01 \text{ g} - (3.84 \text{ g} + 0.485 \text{ g}) = 7.685 \text{ g O}$$

$$7.685 \text{ g O} \times \frac{1 \text{ mol}}{16.00 \text{ g}} = 0.480 \text{ mol O}$$

$$\text{mol ratio} = (\text{C}_1\text{H}_{1.5}\text{O}_{1.5})$$

Empirical formula = C₂H₃O₃

11. A phosphorous compound that contains 34.00% phosphorus by mass has the formula X_3P_2 . Identify the element X.

Assuming 100 g of sample,

$$34.00 \text{ g P} \times \frac{1 \text{ mol}}{30.97 \text{ g}} \times \frac{3 \text{ mol X}}{2 \text{ mol P}} = 1.647 \text{ mol X}$$

$$\text{molar mass of X} = \frac{66.00 \text{ g}}{1.647 \text{ mol}} = 40.07 \text{ g/mol} \quad \text{X is calcium (Ca)}$$

12. A 3.41-g sample of a hydrate of copper(II) chloride was heated to drive off the water of hydration. The anhydrous salt was found to have a mass of 2.69 g. Determine the formula for this hydrate.

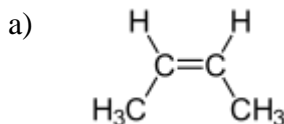
$$\text{mass of water} = 3.41 \text{ g} - 2.69 \text{ g} = 0.72 \text{ g}$$

$$2.69 \text{ g CuCl}_2 \times \frac{1 \text{ mol}}{134.45 \text{ g}} = 0.0200 \text{ mol} \quad (1)$$

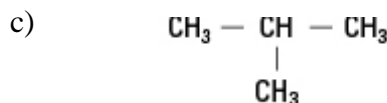
$$0.72 \text{ g H}_2\text{O} \times \frac{1 \text{ mol}}{18.02 \text{ g}} = 0.040 \text{ mol} \quad (2)$$

$$\text{formula of hydrate} = \text{CuCl}_2 \cdot 2 \text{ H}_2\text{O}$$

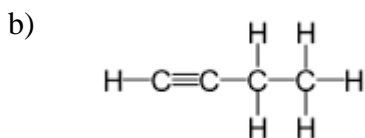
13. Classify each hydrocarbon below as alkane, alkene or alkyne, and write a molecular formula for each:



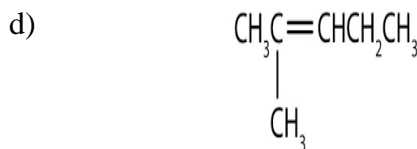
alkene (C₄H₈)



alkane (C₄H₁₀)



Alkyne (C₄H₆)



alkene (C₆H₁₂)