The Chemistry of Oxygen: Basic and Acidic Oxides and the Periodic Table

Name _____

Date _____ **Section** _____

Locker _____ **Instructor**_____

Observations and Data

1. Preparation of oxygen

(a) Write the equation for the reaction by which you prepared oxygen.

(b) Hydrogen peroxide slowly decomposes, even when no $FeCl_3$ is present. Compare the decomposition of H_2O_2 in the presence and absence of $FeCl_3$, MnO_2(s), or yeast.

(i) Does the amount of oxygen that may be obtained when reaction is complete depend on whether $FeCl_3$ is added?

(ii) What is the purpose of adding $FeCl_3$, MnO_2(s), or yeast to the H_2O_2 solution?

(iii) What is the name applied to a substance used as $FeCl_3$ in this reaction?

2. Preparation of the oxides

Describe the changes that occur during the reaction with oxygen of each of the following elements, and note any distinctive characteristics of the products formed. Write a chemical equation for each reaction. (For carbon, phosphorus, and sulfur, the formula of the oxide cannot be determined from charge considerations. The formulas of these oxides are CO_2, P_2O_5, and SO_2.)

(a) Lithium _____

Equation _____

(b) Magnesium _____

Equation _____

(c) Calcium _____

Equation _____

(d) Carbon _____

Equation _____

(e) Phosphorus _____

Equation _____

(f) Sulfur _____

Equation _____

3. Acids and bases from oxides

(a) Prediction of the formulas of the hydrated oxides

Write balanced chemical equations to describe the formation of the hydrated oxides (hydroxides) from the respective oxide, for example, oxide + water → hydroxide compound. For elements that are classified as nonmetals whose oxide and hydroxide reaction product formulas are more difficult to predict, two formulas are given, the first written as a base formula, and the second written as the conventional acid formula. You must balance these equations.

(a) Lithium				
(b) Magnesium				
(c) Calcium				
(d) Carbon	$CO_2(g)$ +	$H_2O \rightarrow$	$CO(OH)_2$	or H_2CO_3
(e) Phosphorus	$P_2O_5(s)$ +	$H_2O \rightarrow$	$PO(OH)_3$	or H_3PO_4
(f) Sulfur	$SO_2(g)$ +	$H_2O \rightarrow$	$SO(OH)_2$	or H_2SO_3
(g) Boron	$B_2O_3(s)$ +	$H_2O \rightarrow$	$B(OH)_3$	or H_3BO_3
(h) Chlorine	$Cl_2O_7(l)$ +	$H_2O \rightarrow$	$ClO_3(OH)$	or $HClO_4$

(b) Summary of experimental results

(i) Write in the first column the periodic table group to which the element belongs.

(ii) In the next two columns write the formulas of the oxides and hydrated oxides [see part 3(a) above for the formulas]. If the hydrated oxide is acidic, write its formula in such a way as to indicate this fact, using the conventional acid formula.

(iii) From your pH measurements or the indicator color, describe the acidic or basic properties of the solutions formed from each oxide compound (or hydroxide, if the oxide was not available and you did not make it yourself).

(iv) Write a chemical equation showing how the hydrated oxide forms H_3O^+ or OH^- in the solution.

Element symbol	Periodic table group	Formula of oxide	Formula of hydrated oxide	Acidic or basic properties	Equation
Li					
Mg					
Ca					
C					
P					
S					
B					
Cl					

Name _____ **Date** _____

Application of Concepts

1. Comment on the acidic or basic character of the oxide of phosphorus, P_2O_5 (which actually exists as molecular P_4O_{10}), as predicted by its position in the periodic table and its classification as a metal or nonmetal.

2. Considering the positions of the elements in the periodic table, write the formulas of three other acidic oxides and three other basic oxides. On the longer line write the equation for the reaction of the oxide with water.

Acidic oxides: _____ _____

_____ _____

_____ _____

Basic oxides: _____ _____

_____ _____

_____ _____

3. What does the term *anhydride* mean?

4. Deduce and write the formulas of the anhydrides of the following.

H_2SO_3: _____ HClO: _____

H_2SO_4: _____ $HClO_3$: _____

$La(OH)_3$: _____ HNO_2: _____

$Sn(OH)_4$: _____ HNO_3: _____

RbOH: _____ H_2CO_3: _____

$Ba(OH)_2$: _____ H_4SiO_4: _____