HW 26 Acids

Oxides are compounds made of two elements one of which is oxygen, e.g., SO_2, SO_3, CO_2, CaO, Fe_2O_3

Many metals and non-metals burn rapidly when heated in oxygen or air, producing their oxides.

There are basic and acidic oxides.

1. When soluble acidic oxides react with water, they form acids. E.g.:

   $SO_3 + H_2O \rightarrow H_2SO_4$

2. When soluble basic oxides react with water, they form bases. E.g.:

   $CaO + H_2O \rightarrow Ca(OH)_2$

   Insoluble oxides cannot react with water, but insoluble basic oxides will react with an acid and produce salt and water, insoluble acidic oxides will react with base and produce salt and water.

Acids can provide H^+ (proton) for reactions with other compounds.

$H_2SO_4 + Zn \rightarrow H_2 + ZnSO_4$

$HCl + Ag\ NO_3 \rightarrow AgCl + HNO_3$

An acid is composed from atoms of hydrogen and a conjugate base. The conjugate base reacts as an independent particle. (SO_4^{2-} , Cl^- , $NO^{3\,-}$ are conjugate bases of sulfuric, hydrochloric, and nitric acids respectively, notice these are polyatomic ions).

Examples of polyatomic ions:

Acetate	$C_2H_3O_2^-$	Sulfite	SO_3^{2-}
Ammonium	NH_4^+	Sulfate	SO_4^{2-}
Carbonate	CO_3^{2-}	Phosphite	PO_3^{3-}
Hypochlorite	ClO^-	Phosphate	PO_4^{3-}
Chlorite	ClO_2^-	Permanganate	MnO_4^-
Perchlorate	ClO_4^-	Iodate	IO_3^-
Nitrite	NO_2^-	Hydrogen carbonate	HCO_3^-
Nitrate	NO_3^-		

Bases can provide OH^- for reactions with other compounds.

$Ca(OH)_2 + HCl \rightarrow CaCl_2 + HOH\ (H_2O)$

Reactions where acids and bases react with each other are called **reactions of neutralization**. In these reactions a salt and water are formed. E.g. below is a neutralization reaction between hydrochloric acid (HCl – acid) and sodium hydroxide (NaOH – base) with formation of salt (sodium chloride, NaCl) and water:

$HCl + NaOH \rightarrow NaCl + H_2O$

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

The solubility table can be useful to answer some questions from the homework (S-soluble, sS – slightly soluble, I – insoluble):

	Bromide Br^-	Carbonate CO_3^{2-}	Chloride Cl^-	Chlorates ClO_3^-	Hydroxide OH^-	Nitrate NO_3^-	Oxide O^{2-}	Phosphate PO_4^{3-}	Sulfate SO_4^{2-}	Dichromate $Cr_2O_7^{2-}$
Aluminium Al^{3+}	S	X	S	S	I	S	I	I	S	I
Ammonium NH_4^+	S	S	S	S	S	S	X	S	S	S
Calcium Ca^{2+}	S	I	S	S	sS	S	sS	I	sS	I
Copper(II) Cu^{2+}	S	I	S	S	I	S	I	I	S	I
Iron(II) Fe^{2+}	S	I	S	S	I	S	I	I	S	I
Iron(III) Fe^{3+}	S	X	S	S	I	S	I	I	sS	I
Magnesium Mg^{2+}	S	I	S	S	I	S	I	I	S	I
Potassium K^+	S	S	S	S	S	S	S	S	S	S
Silver Ag^+	I	I	I	S	X	S	I	I	sS	I
Sodium Na^+	S	S	S	S	S	S	S	S	S	S
Zinc Zn^{2+}	S	I	S	S	I	S	I	I	S	I
	Bromide Br^-	Carbonate CO_3^{2-}	Chloride Cl^-	Chlorates ClO_3^-	Hydroxide OH^-	Nitrate NO_3^-	Oxide O^{2-}	Phosphate PO_4^{3-}	Sulfate SO_4^{2-}	Dichromate $Cr_2O_7^{2-}$

Questions:

1. We have solutions with the following pH: pH of 9, pH of 2, pH of 12, pH of 5, pH of 7. Which of the solution is a strong acid, weak acid, neutral, weak base, strong base.
2. Complete and balance the following reactions: P_2O_5 + H_2O; CuO + HNO_3;

   CuO + H_2O; ZhO + HCl; ZnO + H_2O.

3. Write neutralization reactions between acids and bases that result in the following salts: $Al_2(SO4)_3$, $NiCO_3$, $Fe(NO3)_3$, $Mg_3(PO4)_2$, Li_2SO_4