Experiment 3
Identification of a Compound: Chemical Properties

Chemists do experiments for different reasons; some of them may be detection, identification, and separation of chemicals from natural samples or from reaction mixtures, and study of the physical and chemical properties of these substances. We will see some of this work through out this laboratory course.

In this experiment:

- You will perform some chemical reactions, write down your observations, explanations and comments.
- You will be given an UNKNOWN substance, which you have already investigated.
- Your duty, depending on the investigations that you have already made in the lab, will be to find what your unknown substance would be.

in order to know whether you have a chemical reaction or not there are some signals

يدل اذا صارت تفاعل كيميائي

يعني ممكن تخلط اشياء بعضها مايصير اي تفاعل اذا لاحظت اشياء معينة هذا يعني انه صار تفاعل كيميائي

Possible Observations:

You may notice any of the following or any combination of them. Never try to smell the reaction mixture directly. There is away to do that in the lab.

1- ♦ Evolution of a gas, a gaseous substance is one of the products, the reaction between sodium bicarbonate and hydrochloric acid produces water and carbon dioxide gas.

تصاعد غاز

اذا خلطنا اشياء بعضها وطلع عندي غاز صار بعدي انه صار تفاعل كيميائي

Sodium Bicrbonate — base — acid — Carbonic acid

$$NaHCO_{3\,(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2CO_{3\,(g)}$$

water + carbon dioxid

$$H_2CO_{3\,(g)} \rightarrow H_2O_{(g)} + CO_{2\,(g)} \uparrow$$

- **Precipitate formation:** formation of an insoluble substance. The reaction between silver nitrate and sodium chloride is an example.

Sodium nitrate

$$AgNO_{3\,(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} \downarrow + NaNO_{3\,(aq)}$$

white — Silver cloride

It is important to notice the color and the appearance of the precipitate, it may be crystalline or cloudy.

(aq) Aqueous → dissolve in water

- **Heat changes:** Chemical reactions may be exothermic or endothermic.

Exothermic: heat is produced. Here, the container gets warmer. The reaction between sodium hydroxide and hydrochloric acid is exothermic where the temperature of the reaction mixture increases upon the reaction.

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(aq)} + Heat \quad (T \uparrow)$$

increase in temperature — product

Endothermic: heat is absorbed. Here the container gets cold. An example of an endothermic reaction is the reaction between barium hydroxide and ammonium nitrate.

decrease

$$Ba(OH)_2.8H_2O_{(s)} + 2NH_4NO_{3(s)} + Heat \rightarrow Ba(NO_3)_{2\,(aq)} + NH_{3(aq)} + 10H_2O_{(l)}$$

Barium hydroxide

♦ **Color change.** Oxidation-Reduction reaction of potassium permanganate ($KMnO_4$) with potassium sulfite (K_2SO_3) undergoes many color changes as the permanganate (MnO_4^-, violet color) is converted into manganate ($MnO_4^=$, green color) then into hypomanganate (MnO_4^{-3}, blue) and finally into manganese +4 oxidation state with yellow color. The oxidation state of manganese has changed from +7 to +6 then + 5 respectively. Another example is the reaction of iodine (I_2) with potassium iodide (KI).

$$I_{2\,(aq)} + KI_{(aq)} \rightarrow KI_{3\,(aq)}$$

$I_{2\,(aq)}$ is brownish and $KI_{3\,(aq)}$ is colorless. So, this reaction shows a disappearance of the yellowish color of iodine.

♦ **Change in odor**, here, a substance with an odor is produced (or disappeared).

$$NH_4Cl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + NH_4OH_{(g)}$$

(ammonium chloride, sodium hydroxide)

$$NH_4OH_{(aq)} \rightarrow NH_{3(g)}\uparrow + H_2O_{(aq)}$$

$NH_{3\,(g)}$ is the ammonia gas, it has strong odor.

Experimental:

I. Investigation of the chemical properties of the following reagents:

Sodium chloride $NaCl_{(aq)}$

Sodium carbonate $Na_2CO_{3\,(aq)}$

Sodium sulfate $Na_2SO_{4\,(aq)}$

Barium chloride $BaCl_{2\,(aq)}$

Zinc sulfate $ZnSO_{4\,(aq)}$

Ammonium chloride $NH_4Cl_{(aq)}$

The investigation will be done by use of the following test reagents according to the procedure 1, 2, 3 and 4 in your manual. You are required to record your observation and write the possible chemical reaction in each case.

The Test Reagents are:

1. Silver nitrate test reagent, $AgNO_{3\,(aq)}$.
2. Sodium hydroxide test reagent, $NaOH_{(aq)}$.
3. Sulfuric acid test reagent, $H_2SO_{4\,(aq)}$.
4. Barium nitrate test reagent, $Ba(NO_3)_{2\,(aq)}$.

5/5

3. Sulfuric acid test reagent, H_2SO_4 (aq).
4. Barium nitrate test reagent, $Ba(NO_3)_2$ (aq).

II. Identification of an unknown: This is done according to step 5 in your manual.

		$AgNO_3$	NaOH	H_2SO_4	$Ba(NO_3)_2$
1.	NaCl	ppt	X	X	X
2.	Na_2CO_3	X			
3.	Na_2SO_4				
4.	$BaCl_2$				
5.	$ZnSO_4$				
6.	NH_4Cl				
7.	H_2O				
Unknown					

The End