

ANALYSIS OF ANIONS

The classification of anions is based on their reactions with two ions: Ag^+ and Ba^{2+} . Reagents used for anion classification are: 0.1M AgNO_3 and 0.1M $\text{Ba}(\text{NO}_3)_2$

Classification of anions

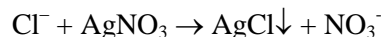
Group	Anions	Reaction with:	
		AgNO_3	$\text{Ba}(\text{NO}_3)_2$
I	Cl^- , Br^- , I^- , SCN^-	white or yellow precipitate	no precipitate
II			
III	CO_3^{2-} ,	white precipitate	white precipitate
IV	HPO_4^{2-}	color precipitate	white precipitate
V	NO_3^-	no precipitate	no precipitate
VI	SO_4^{2-}	no precipitate	white precipitate

GROUP I ANIONS

Group I: anions: Cl^- , Br^- , I^- , SCN^- (chloride, bromide, iodide, thiocyanate)

1. Reactions with the group reagents

1° Put 2-3 drops of each of group I anions into separate test tubes. To each tube add 2-3 drops of AgNO_3 solution. Precipitates will form in all tubes.



Observe the color of these precipitates.

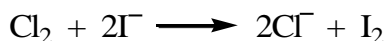
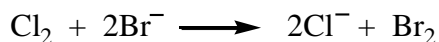
2° Add a few drops of $\text{Ba}(\text{NO}_3)_2$ solution to the test tubes prepared as before. Precipitates will not form.

2. Characteristic reactions

2.1. Reactions with chlorine water

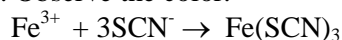
To the 4 tubes with group I anions add a pipette of chlorine water (an aqueous solution of chlorine) and 2-3 ml of chloroform (chloroform does not mix with water and goes down because it is heavier than water). Shake the contents of a test tube energetically. Observe the color of the chloroform layers.

Chlorine oxidizes bromide and iodide ions to free bromine and iodine (redox reaction), well soluble in apolar organic solvents:



2.2. Reaction with FeCl₃

Add a few drops of FeCl₃ to a few drops of group I anions in separate tubes. This reaction is characteristic for SCN⁻ (thiocyanate) ions. Observe the color.

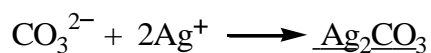


GROUP III ANIONS

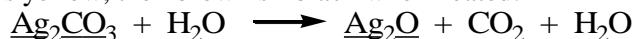
Group III anion: CO₃²⁻ (carbonate)

1. Reactions with group reagents

1° Put 2-3 drops of CO₃²⁻ into a test tube and add a few drops of AgNO₃. Observe the color of the precipitate.



This white precipitate turns yellow, then brownish-black when heated:



2° Put 2-3 drops of CO₃²⁻ into a test tube and add a few drops of Ba(NO₃)₂. Observe the color of the precipitate.

2. Characteristic reactions

2.1. Reaction of CO₃²⁻ anion with strong acids

Add 2M HNO₃ drop by drop to 2-3 ml of CO₃²⁻ solution and observe bubbles of CO₂:

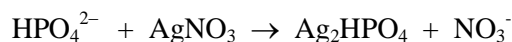


GROUP IV ANIONS

Group IV anion: HPO₄²⁻ (phosphate)

1. Reactions with group reagents

1° Put 2-3 drops of HPO₄²⁻ into a test tube and add a few drops of AgNO₃. Observe the color of the precipitate.

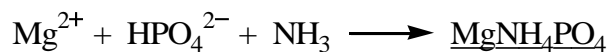


2° Put 2-3 drops of HPO₄²⁻ into a test tube and add a few drops of Ba(NO₃)₂. Observe the color of the precipitate.

2. Characteristic reactions

2.1. Reaction of HPO₄²⁻ ion with magnesia mixture

Prepare the magnesia mixture (an aqueous solution of MgCl₂, NH₃ and NH₄Cl) mixing 5 drops of each. Add a few drops of HPO₄²⁻ solution. Observe the color of the precipitate.



GROUP V ANIONS

Group V anion: NO_3^- (nitrate)

1. Reactions with group reagents

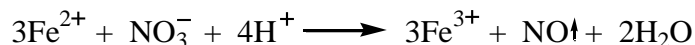
1° Put 2-3 drops of NO_3^- into a test tube and add a few drops of AgNO_3 .

2° Put 2-3 drops of NO_3^- into a test tube and add a few drops of $\text{Ba}(\text{NO}_3)_2$.

2. Characteristic reactions

2.1. Reaction of nitrate ion with FeSO_4 (“ring” reaction)

Put a few crystals of FeSO_4 into a test tube and add about 1 ml of distilled water. Shake the contents of the test tube. Add an equal amount of NO_3^- solution. Shake again and carefully add concentrated H_2SO_4 . Do not shake the tube. Brown ring of complex ion $\text{Fe}(\text{NO})^{2+}$ appears on the border between two solutions:



GROUP VI ANIONS

Group VI anion: SO_4^{2-} (sulfate)

1. Reactions with group reagents

1° Put 2-3 drops of SO_4^{2-} into a test tube and add a few drops of AgNO_3 . Reaction does not occur.

2° Put 2-3 drops of SO_4^{2-} into a test tube and add a few drops of $\text{Ba}(\text{NO}_3)_2$. Observe the color of the precipitate.

