

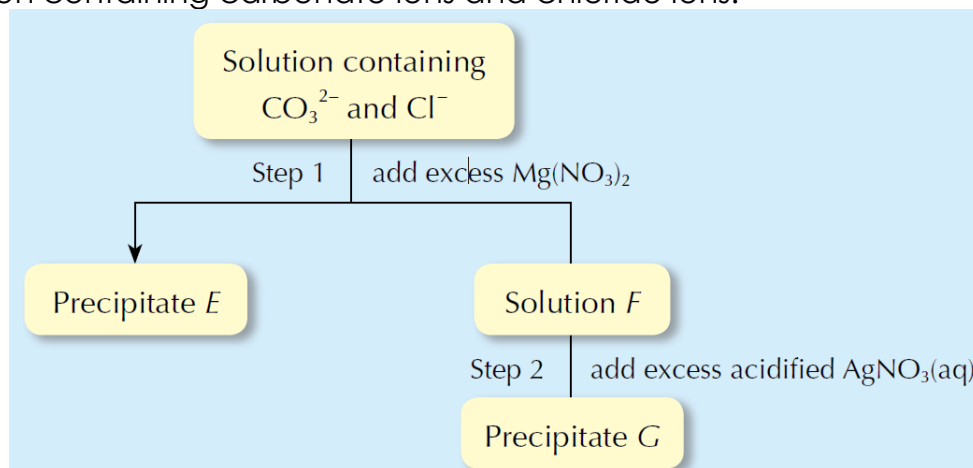
Quiz (Detecting the Presence of Anions)

1. Compound X is a calcium compound containing one of the following anions:
 CO_3^{2-} , SO_3^{2-} , OCl^- , Cl^-

Two tests are performed on X, and the results are tabulated below:

Test	Result
(1) Heat solid X	No observable change
(2) Add dilute hydrochloric acid to X	No observable change

- (a) Deduce from the results of test (1) only, which of the above listed anions is/are not likely to be present in X. Explain your answer by writing a suitable equation.
- (b) Deduce from the results of test (2) only, which of the above listed anions is/are not likely to be present in X. Explain your answer by writing suitable equations.
- (c) By considering the results from the two tests, deduce what compound X is.
2. Suggest a chemical test to distinguish between each of the following pairs of compounds. For each test, state the expected observations.
- (a) Zinc carbonate and zinc chloride
- (b) Sodium hypochlorite and sodium sulphite
- (c) Sodium chloride and sodium iodide
3. The flow chart below outlines the tests used to detect the presence of anions in a solution containing carbonate ions and chloride ions.



- (a) (i) What is precipitate E?
 (ii) Write an ionic equation for the formation of precipitate E in Step 1.
- (b) (i) What is precipitate G?
 (ii) Write an ionic equation for the formation of precipitate G in Step 2.

4. Tests were carried out on salt X. The table below summarizes the results of the tests.

Test	Observation
(1) Appearance of X	White solid
(2) Add dilute hydrochloric acid to X and test any gases given off.	X dissolved to form a colourless solution. A gas with choking smell was detected.
(3) Flame test	Lilac flame
(4) Dissolve X in water and divide the solutions into two equal portions. (i) To the first portion, add a few drops of sodium hydroxide solution and then excess sodium hydroxide solution. (ii) To the second portion, add acidified potassium dichromate solution.	(i) No observable change (ii) The colour of dichromate solution changed from orange to green.

- What does test (1) tell you about X?
- What does test (2) tell you about X?
- What does test (3) tell you about X?
- Explain the observations in test (4)(i).
- What does test (4)(ii) tell you about X?
- Suggest the identity of X.

5. Tests were carried out on salt Y. The table below summarizes the results of the tests.

Test	Observation
(1) Appearance of Y	White solid
(2) Warm Y with sodium hydroxide solution and test any gases given off	A gas with a characteristic pungent smell evolved. The gas turned moist red litmus paper blue.
(3) Flame test	No characteristic flame colour
(4) Add acidified silver nitrate solution	A white precipitate formed.

- What does test (1) tell you about Y?
- What does test (2) tell you about Y?
- Explain the observation in test (3).
- What does test (4) tell you about Y?
- Suggest the identity of Y.

Suggested Answer

1. (a) CO_3^{2-} should not be present because calcium carbonate will decompose on heating.

$$\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$$
 - (b) CO_3^{2-} , SO_3^{2-} and OCl^- should not be present because they will have reaction with hydrochloric acid. Gas bubbles will be liberated.

$$\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$

$$\text{SO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \longrightarrow \text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$

$$2\text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq}) + \text{OCl}^-(\text{aq}) \longrightarrow \text{Cl}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$$
 - (c) The anion present in X is Cl^- . Compound X is calcium chloride.
2. (a) Test with dilute hydrochloric acid. Zinc carbonate gives a colourless gas which can turn limewater milky. There is no observable change for zinc chloride.
 - (b) Test with blue litmus paper. The litmus paper turns white for sodium hypochlorite (solution). There is no observable change for sodium sulphite (solution).
 - (c) Test with acidified silver nitrate solution. Sodium chloride reacts with acidified silver nitrate solution to give a white precipitate while sodium iodide reacts to give a yellow precipitate.
3. (a) (i) Magnesium carbonate
 (ii) $\text{Mg}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \longrightarrow \text{MgCO}_3(\text{s})$
 - (b) (i) Silver chloride
 (ii) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \longrightarrow \text{AgCl}(\text{s})$
4. (a) Both the cation and anion are colourless.
 The compound may contain Group I metal ions, Group II metal ions, aluminium or zinc ions.
 - (b) The compound may contain sulphite ions or hypochlorite ions.
 - (c) The cation may be potassium ion.
 - (d) Potassium ions do not form precipitate with hydroxide ions.
 - (e) The compound contains sulphite ions. It turns acidified potassium dichromate solution from orange to green.
 - (f) Potassium sulphite

5. (a) Both the cation and anion are colourless.
The compound may contain Group I metal ions, Group II metal ions, aluminium or zinc ions.
- (b) The cation may be ammonium ion.
- (c) Ammonium ions do not give a characteristic flame colour in the flame test.
- (d) The anion may be chloride ion.
- (e) Ammonium chloride