

Chapter	16 Lab Safety and Practical Skills	Class	1 st Year	Subject	Chemistry
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Give Short Answers of the Following Questions

1. What is meant by standardization?

Ans. Determination of exact concentration of a solution by titrating it against a solution of known strength is called standardization.

2. What is the volumetric analysis?

Ans. A quantitative analysis based upon the measurement of volume is called as volumetric analysis.

3. What is Titration?

Ans. The process of determination the exact of volume of solution which reacts completely with the definite volume of another solution.

4. How carbonate (CO_3^{2-}) radicals are identified?

Experiment	Observation	Inference
Take about 2 g of solid carbonate sample in a clean test tube and then add about 5 cm ³ of dilute HCl solution. Pass the gas evolved in the above step through a solution of lime water.	Effervescence takes place during which a gas evolves briskly, that turns lime water milky.	Carbonate (CO_3^{2-}) are indicated ions.
Reactions involved in the above steps $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ $\text{Ca}(\text{OH})_2(\text{aq}) + \text{CO}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$ Lime water (white ppt)		
Confirmatory Test Original solution + MgSO_4	White ppt. of MgSO_3	CO_3^{2-} is confirmed.

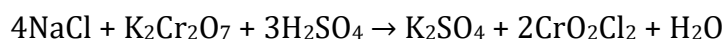
5. How chlorine (Cl^-) radicals are identified?

Experiment	Observation	Inference
Take 2 g of solid sample in a test tube and add 5 cm ³ of distilled water to make the aqueous solution. Add a few drops of dil. HNO_3 solution to acidify the solution of the salt, finally add about 5 cm ³ of aqueous AgNO_3 . Confirmatory Test O.S Silver Nitrate (AgNO_3) solution. Result: Acid Radical = Chloride Cl^-	A thick white precipitate is formed which dissolves in aq NH_3 . In other words, white ppt. (AgCl) soluble in dil. NH_4OH . White ppt. (AgCl) soluble in dil. NH_4OH .	Cl^- ions are indicated. Cl^- is confirmed.

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6. Given the chemistry of Chromyl Chloride test.

Ans. It is confirmatory test of Cl⁻. In this test reddish brown chromyl fumes are evolved when solid salt, solid K₂Cr₂O₇ and Conc. H₂SO₄ are heated together.



7. How Aluminium (Al³⁺) radical is identified?

Ans. Take 4 g of solid sample in a clean test tube. Dissolve it in about 10 cm³ distilled water. Divide this solution into two parts for further tests.

Experiment	Observation	Inference
To one part, add about 5 cm ³ NaOH solution.	A white gelatinous precipitate is formed.	Al ³⁺ ions are indicated.
To the second part of the above solution, add a few drops of aqueous ammonia.	A white precipitate is formed.	Al ³⁺ ions are indicated.
$\text{Al}_{(aq)}^{3+} + 3\text{OH}_{(aq)}^{-} \rightarrow \text{Al}(\text{OH})_{3(s)}$ White ppt		
Confirmatory Test(Lake Test): O.S + few drops of HCl + litmus solution + excess of NH ₄ OH.	A blue lake (blue ppt. in colourless solution) is formed.	Al ³⁺ is confirmed.

8. How calcium (Ca²⁺) radical is identified?

Ans. Take 4 g of solid sample in a clean test tube. Dissolve it in 10 cm³ distilled water.

Make two parts of this solution for further tests:

Experiment	Observation	Inference
To one part, add NaOH solution.	White precipitate is formed which does not dissolve in excess of NaOH solution.	Ca ²⁺ ions are indicated.
To the second part of the above solution, add aqueous ammonia.	Only a slight turbidity appears of No precipitate is formed.	Ca ²⁺ ions are indicated.
$\text{Ca}_{(aq)}^{2+} + 2\text{OH}_{(aq)}^{-} \rightarrow \text{Ca}(\text{OH})_{2(s)}$ White ppt		
Confirmatory Test: O.S NH ₄ Cl + K ₄ [Fe(CN) ₆] Result: Basic Radical + Calcium (Ca ²⁺)	White ppt. of Ca ₂ [Fe(CN) ₆] formed.	Ca ²⁺ is confirmed.

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9. How Ammonium (NH_4^{1+}) radical is identified?

Ans.

Experiment	Observation	Inference
Take 4 g of sample in a clean test tube. Dissolve it in 10 cm ³ distilled water. Add NaOH solution and gently heat it.	Ammonia gas is evolved with a distinct smell. Ammonia gas turns moist red litmus blue.	NH_4^{1+} ions are indicated.
$NH_4^{1+}_{(aq)} + OH^{1-}_{(aq)} \rightarrow NH_{3(g)} + H_2O_{(l)}$		
Confirmatory Test: To the O.S added picric acid solution. Result: Basic Radical = Ammonium NH_4^+	Yellow needle like crystals are obtained.	NH_4^+ is confirmed.

10. How Chromium radical (Cr^{3+}) is identified?

Ans. Add 4 g samples in a clean test tube. Dissolve it in 10 cm³ distilled water. Make two parts of the above solution for further tests.

Experiment	Observation	Inference
To one part, add NaOH solution.	A green precipitate appears which turns into green solution when excess of NaOH is added	Cr^{3+} ions are indicated.
To the second part of the above solution, add aqueous ammonia.	A green precipitate appears which is insoluble in excess of aqueous ammonia.	Cr^{3+} ions are indicated.
$Cr^{3+}_{(aq)} + 3OH^{-}_{(aq)} \rightarrow Cr(OH)_3s$ Green ppt		
Confirmatory Test: O.S + Na_3PO_4	Pale green ppt. of $CrPO_4$ formed.	Cr^{3+} is confirmed.

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11. For which type of titration, methyl orange is used as an indicator?

Ans. Methyl orange is used as an indicator in strong acid-weak base titrations.

Methyl orange changes colour in the pH range of 3.1 to 4.4, making it ideal for titrations where the equivalence point is acidic, as is the case when a strong acid (e.g., HCl) is titrated against a weak base (e.g., NH_4OH).

12. Explain why phenolphthalein is a suitable indicator for the titration of a weak acid with a strong base but not for the titration of a strong acid with a weak base.

Ans. Phenolphthalein is suitable for weak acid-strong base titrations because the equivalence point ($\text{pH} \approx 8.5$), which falls within phenolphthalein's colour change range ($\text{pH } 8.2-10$).

It is not suitable for strong acid-weak base titrations because the equivalence point is acidic ($\text{pH} < 7$), outside phenolphthalein's range, so it would not show a clear endpoint.

13. Explain why different indicators change colour over different pH ranges.

Ans. Different indicators change colour over different pH ranges because each has a unique acid-base equilibrium and changes structure (and thus colour) at a specific pH range where its conjugate acid and base forms are present in comparable amounts.

Examples:

1. Phenolphthalein:

- Colour change range: $\text{pH } 8.2 - 10$
- Colour: Colourless in acid, pink in base

2. Methyl Orange:

- Colour change range: $\text{pH } 8.2 - 10$
- Colour: Red in acid, yellow in base

14. It is always advisable to use dilute solutions while performing experiments in volumetric analysis? Give a reason.

Ans. Yes, it is advisable to use dilute solutions in volumetric analysis because they reduce the risk of large heat changes and allow for more precise volume measurements, minimizing errors and improving the accuracy of the titration results.

15. White precipitates are formed when Ca^{2+} , Al^{3+} and Zn^{2+} all react separately with NaOH solution. How will you detect which basic radical is present?

Ans. To distinguish between Ca^{2+} , Al^{3+} and Zn^{2+} ions when all form white precipitates with NaOH, excess can be used:

1. Add excess NaOH to each white precipitate formed:

- $\text{Ca}(\text{OH})_2$: Insoluble in excess NaOH $\rightarrow$ White ppt remains
- $\text{Al}(\text{OH})_3$: Dissolves in excess NaOH forming a colorless solution
- $\text{Zn}(\text{OH})_2$: Dissolves in excess NaOH forming a colorless solution

2. Differentiate Al^{3+} and Zn^{2+} using ammonium hydroxide (NH_4OH):

- $\text{Al}(\text{OH})_3$: Insoluble in excess $\text{NH}_4\text{OH} \rightarrow$ White ppt remains
- $\text{Zn}(\text{OH})_2$: Soluble in excess NH_4OH - Colorless solution forms

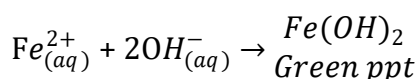
16. How Fe^{2+} can be distinguish from Fe^{3+} chemically?

Ans. Identification of Iron (II) radical (Fe^{2+})

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Take 4 g sample in a clean test tube. Dissolve it in 10 cm³ of distilled water. Make two portions of the solution for further tests.

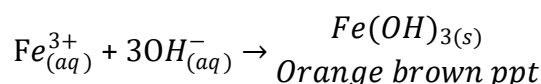
Experiment	Observation	Inference
To one portion, add NaOH solution.	A green precipitate is formed which is turned into orange brown precipitate after some time.	Fe ²⁺ ions are indicated.
To the second portion of the above, add aqueous ammonia.	A while gelatinous precipitate of Fe(OH) ₂ is formed which quickly oxidizes to form red brown precipitate of Fe(OH) ₃ .	Fe ²⁺ ions are indicated.



Identification of Fe (III) radical (Fe²⁺)

Take 2 g FeCl₃ in a clean test tube. Dissolve it in 10 cm³ of distilled water. Make two portions of the solution for further tests.

Experiment	Observation	Inference
To one portion, add NaOH solution.	Orange brown precipitate is formed.	Fe ³⁺ ions are indicated.
To the second portion of the above, add aqueous ammonia.	Orange brown precipitate is formed.	Fe ³⁺ ions are indicated.



17. Why does Ca²⁺ not give precipitate with aqueous ammonia?

Ans. Ca²⁺ does not give a precipitate with aqueous ammonia because calcium hydroxide (Ca(OH)₂), formed by the reaction of Ca²⁺ with ammonia, is sparingly soluble in water. The amount of hydroxide formed is insufficient to exceed the solubility product (K_{sp}) and produce a visible precipitate under normal conditions.

In contrast, other metal ions like Al³⁺ and Zn²⁺ form insoluble hydroxides that precipitate in the presence of ammonia.

18. How will you find out the concentration of acetic acid in vinegar solution?

Ans. To find the concentration of acetic acid (CH₃COOH) in a vinegar solution, we can perform a titration using a strong base (such as NaOH) and an appropriate indicator (such as phenolphthalein).

Procedure:

- 1. Prepare a Sample of Vinegar:** Measure a known volume (e.g., 10 cm³) of the vinegar solution.
- 2. Titration Setup:**

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- Titrant: Prepare a standard solution of NaOH of known concentration (e.g., 0.1 M).
- Indicator: Add a few drops of phenolphthalein (which changes from colorless to pink as the solution goes from acidic to slightly basic).

3. Perform the Titration:

- Slowly add the NaOH solution from the burette to the vinegar solution while stirring.
- End point: The titration is complete when the solution turns light pink (indicating neutralization).

4. Calculate the Concentration of Acetic Acid:

- Use the formula:

$$C_1V_1 = C_2V_2$$

Where:

- C_1 = concentration of acetic acid (required).
- V_1 volume of vinegar used,
- C_2 concentration of NaOH,
- V_2 volume of NaOH used to reach the endpoint.

5. Final Calculation: Solve for C_1 the concentration of acetic acid in vinegar.

Example Calculation:

- If 25 cm³ of NaOH (0.1 M) neutralizes 10 cm³ of vinegar, the calculation would be:

$$C_1 \times 10.0 \text{ cm}^3 = 0.1 \text{ M} \times 25 \text{ cm}^3$$

$$C_1 = 0.1 \times 25.0 / 10 = 0.25 \text{ M}$$

So, the concentration of acetic acid is 0.25 M.

This gives the molarity of acetic acid in the vinegar.

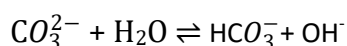
19. What precautions you need to observe while diluting a concentrated acid?

Ans. Precautions to Observe while Diluting a Concentrated Acid:

- Always add acid to water, never water to acid - this prevents splashing due to the exothermic reaction.
- Use protective gear-wear gloves, goggles, and a lab coat to prevent burns and injuries.
- Perform the dilution slowly, while stirring continuously, to control heat release.
- Use heat-resistant glassware - to prevent breakage from the heat generated.
- Work in a well-ventilated area or fume hood- to avoid inhaling harmful vapours.
- Keep neutralizing agents (like baking soda) nearby in case of spills.

20. Why does an aqueous solution of Na₂CO₃ behave like a base?

Ans. An aqueous solution of Na₂CO₃ (sodium carbonate) behaves like a base because the carbonate ion (CO_3^{2-}) undergoes hydrolysis in water:



This reaction produces hydroxide ions (OH^-), which increase the pH of the solution, making it basic in nature. Na₂CO₃ is a salt of a strong base (NaOH) and a weak acid (H₂CO₃), so its solution is basic due to the weak conjugate acid (HCO_3^-) not fully neutralizing OH^- formation.

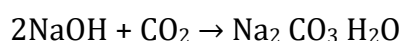
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21. If an aqueous solution of NaOH is kept in an open container, what changes do you expect to take place with the passage of time?

Ans. If an aqueous solution of NaOH is kept in an open container, the following changes occur over time:

1. Absorption of CO₂ from the air:

NaOH reacts with carbon dioxide in the atmosphere:



This reaction forms sodium carbonate Na₂CO₃ and water.

2. Decrease in alkalinity:

As NaOH is gradually converted into Na₂CO₃, the concentration of OH⁻ ions decreases, reducing the solution's basic strength (pH).

3. Formation of precipitates (if concentration is high):

If the solution becomes saturated, precipitates of sodium carbonate hydrate may form. So, by the passage of time the NaOH solution becomes less basic and transforms into a carbonate solution.