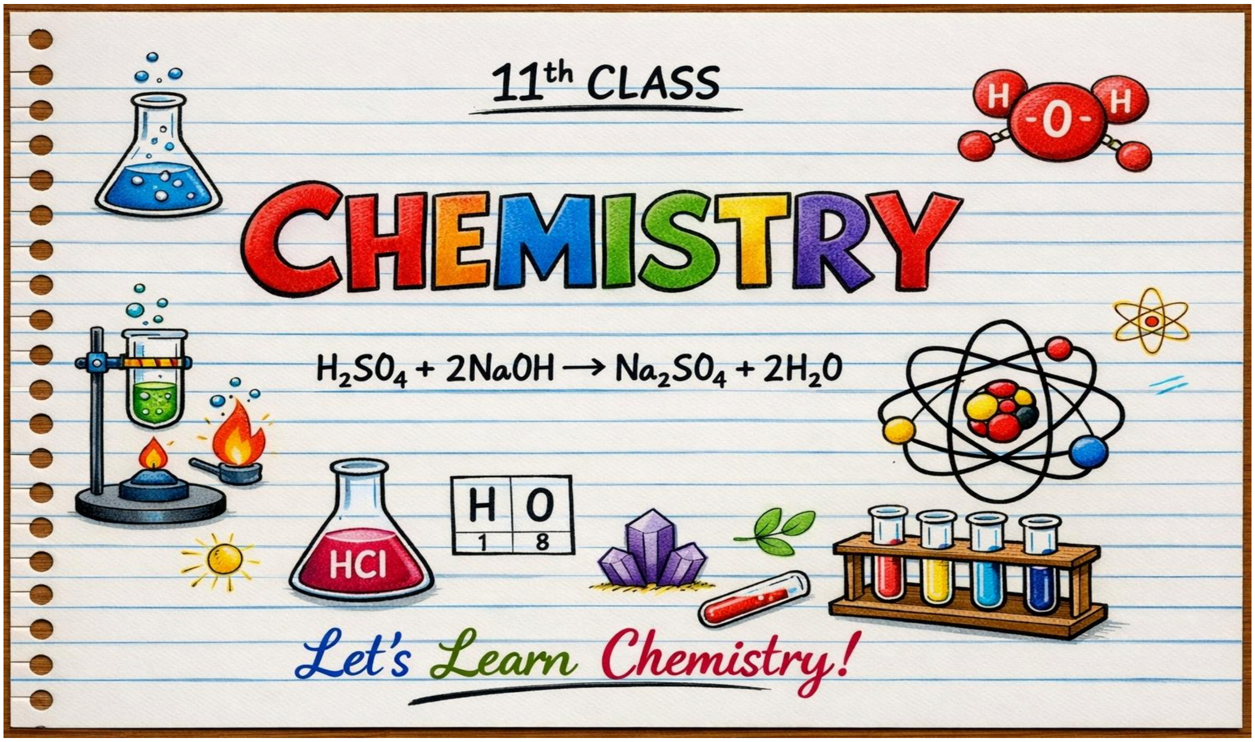

Class: 11th

Subject: Chemistry

Unit 16: LAB SAFETY AND PRACTICAL SKILLS

❖ Important MCQs:

1. The primary purpose of familiarizing with laboratory layout before experiments is to:

(a) Save time only

(b) Locate chemicals easily

(c) Ensure safe and efficient work ✅

(d) Avoid instructor

2. Performing experiments without supervision mainly increases the risk of:

(a) Time wastage

(b) Incorrect results

(c) Accidents and hazards ✅

(d) Chemical shortage

3. Wearing safety goggles in the laboratory primarily protects against:

(a) Heat

(b) Chemical splashes ✅

(c) Noise

(d) Dust only

4. Identifying potential hazards before an experiment helps in:

(a) Completing work quickly

(b) Avoiding unnecessary steps

(c) Taking appropriate safety measures ✅

(d) Reducing cost

5. Crowding in the laboratory should be avoided because it:

(a) Reduces space only

(b) Causes noise

(c) Increases chances of accidents ✅

(d) Slows work

6. The instruction "never taste or smell chemicals" is mainly related to:

(a) Cleanliness

(b) Discipline

(c) Safety from toxic exposure ✅

(d) Lab rules

7. Immediate reporting of accidents or breakage ensures:

(a) Punishment avoidance

(b) Replacement of glassware

(c) Proper handling and safety measures ✅

(d) Record keeping only

8. Seeking instructor's help while handling equipment ensures:

(a) Faster completion

(b) Better marks

(c) Safe and correct usage ✅

(d) Less effort

9. Disposal of chemicals in the drain is prohibited because it:

(a) Blocks pipes

(b) Pollutes environment and damages plumbing ✅

(c) Wastes chemicals

(d) Is time consuming

10. Following warning signs in the lab is essential to:

(a) Maintain discipline

(b) Understand instructions

(c) Prevent accidents and hazards ✅

(d) Impress instructor

11. The most common physical hazard in a laboratory is:

(a) Chemical burns

(b) Slips and falls on wet floor ✅

(c) Gas leakage

(d) Microbial infection

12. Cut-resistant gloves are mainly used to prevent:

(a) Chemical exposure

(b) Heat burns

(c) Cuts and abrasions from glassware ✅

(d) Electrical shock

13. Broken glassware in a laboratory should be disposed in:

(a) Regular bin

(b) Sink

(c) Special container ✅

(d) Open area

14. Chemical hazards in laboratory are mainly related to:

(a) Noise and vibration

(b) Chemicals and their reactions ✅

(c) Light intensity

(d) Temperature only

15. Safe use of chemicals requires:

(a) Random handling

(b) Standard procedures and precautions ✅

(c) Mixing all chemicals

(d) Heating without control

16. Biological hazards include:

(a) Metals and salts

(b) Viruses, bacteria and allergens ✅

(c) Glass and plastics

(d) Heat and light

17. Biological hazards are mainly transferred through:

(a) Machines only

(b) Animals, plants, water and air ✅

(c) Glassware

(d) Electric sources

18. Chemical waste should NOT be disposed in:

(a) Proper containers

(b) Sewers or bins ✅

(c) Treatment plants

(d) Labeled bottles

19. Chemical waste containers must include:

(a) Color only

(b) Type and date of waste ✅

(c) Cost of chemicals

(d) Student name only

20. The main purpose of EPA rules is to ensure:

(a) Lab decoration

(b) Proper waste disposal and environmental safety ✅

(c) Faster experiments

(d) Cost reduction

21. Chemical waste treatment may include:

(a) Freezing only

(b) Neutralization and precipitation ✅

(c) Ignition only

(d) Mixing randomly

22. Ion exchange in waste treatment is used to:

(a) Increase toxicity

(b) Remove unwanted ions ✅

(c) Produce heat

(d) Store chemicals

23. First aid box in laboratory is used for:

(a) Decoration

(b) Emergency treatment of accidents ✅

(c) Chemical storage

(d) Glassware repair

24. Biological hazards mainly include:

(a) Metals

(b) Microbes and allergens ✅

(c) Instruments

(d) Solutions

25. One of the safest practices in laboratory waste management is:

(a) Throwing in drains

(b) Ignoring rules

(c) Proper labeling and storage of waste containers ✅

(d) Mixing all wastes together

26. Volumetric analysis is mainly used to determine:

(a) Density of solutions

(b) Concentration of solutions ✅

(c) Temperature of solutions

(d) Mass of solids

27. The process used in volumetric analysis is called:

(a) Filtration

(b) Crystallization

(c) Titration ✅

(d) Sublimation

28. The substance that shows color change at end point is called:

(a) Solvent

(b) Indicator ✅

(c) Catalyst

(d) Solute

29. The point at which indicator changes color is known as:

(a) Equilibrium point

(b) End point ✅

(c) Initial point

(d) Neutral point

30. In acid-base titration, NaOH solution is usually taken in:

(a) Burette

(b) Conical flask ✅

(c) Pipette

(d) Funnel

31. Phenolphthalein indicator in basic solution gives color:

(a) Colorless

(b) Blue

(c) Pink ✅

(d) Green

32. HCl solution in titration is commonly placed in:

(a) Conical flask

(b) Burette ✅

(c) Beaker only

(d) Pipette

33. Before titration, pipette is rinsed with:

(a) Acid only

(b) Water only

(c) Distilled water then NaOH solution ✅

(d) Alcohol

34. The purpose of removing air bubbles from burette nozzle is to:

(a) Save solution

(b) Ensure accurate measurement ✅

(c) Clean apparatus

(d) Increase speed

35. Initial burette reading is taken using:

(a) Thermometer

(b) Anti-parallax card or white paper ✅

(c) Filter paper

(d) Glass rod

36. White paper under conical flask is used to:

(a) Absorb solution

(b) See color change clearly ✅

(c) Heat solution

(d) Dry flask

37. The process of adding acid dropwise is called:

(a) Rough titration

(b) Gradual titration

(c) Controlled addition in titration ✅

(d) Distillation

38. End point in NaOH-HCl titration with phenolphthalein is:

(a) Blue color

(b) Dark pink

(c) Light pink persists ✅

(d) Colorless solution

39. Concordant readings mean values that:

(a) Are completely different

(b) Vary widely

(c) Agree within small range (±0.1 cm^3) ✅

(d) Are random

40. Repeating titration is necessary to obtain:

(a) Fast results

(b) Concordant and accurate readings ✅

(c) Large volume

(d) High temperature

📘 EXERCISES

Q.1 Four choices are given for each question. Select the correct choice.

I. While taking a reading with a burette, why is it always advisable to read the lower meniscus for colorless liquids and the upper meniscus for colored liquids?

(a) because it is more convenient

(b) because colorless liquids have more surface tension than colored liquids

(c) because lower meniscus does not exist for colored liquids

(d) because of the parallax effect ✅

II. Why is phenolphthalein indicator more appropriate in titrations involving a strong acid and a strong base?

(a) because it is itself weakly acidic

(b) because the pH at equivalence point matches its colour change range ✅

(c) because the solution at end of titration is acidic

(d) because the solution at end of titration is basic

III. Which cation gives a white gelatinous precipitate upon addition of aqueous ammonia?

(a) Cr^{3+}

(b) Cr^{2+}

(c) Zn^{2+}

(d) Al^{3+} ✅

IV. Addition of NH_4OH to an aqueous solution gives a green precipitate which turns brown on standing. Which ion is indicated?

(a) Cu^{2+}

(b) Cr^{3+}

(c) Fe^{2+} ✅

(d) Fe^{3+}

V. On dry heating, a colorless odorless gas that turns lime water milky indicates:

(a) Chloride ion (Cl^-)

(b) Sulfate ion (SO_4^{2-})

(c) Carbonate ion (CO_3^{2-}) ✅

(d) Nitrate ion (NO_3^-)

VI. The chromyl chloride test is a confirmatory test for:

(a) Bromide ions (Br^-)

(b) Iodide ions (I^-)

(c) Chloride ions (Cl^-) ✅

(d) Sulfate ions (SO_4^{2-})

VII. The brown ring test is a confirmatory test for:

(a) Chloride (Cl^-)

(b) Nitrate (NO_3^-) ✅

(c) Sulfate (SO_4^{2-})

(d) Carbonate (CO_3^{2-})

Q.2 Short-Answer Questions

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

Methyl orange is used in strong acid–weak base titrations, where the end point lies in the acidic pH range.

b. Why is phenolphthalein suitable for weak acid–strong base titration but not for strong acid–weak base titration?

Phenolphthalein changes colour in the basic pH range (about 8.2–10). In weak acid–strong base titration, the equivalence point is basic, so it is suitable. In strong acid–weak base titration, the equivalence point is acidic, so phenolphthalein does not change colour at the correct end point.

c. Why do different indicators change colour over different pH ranges?

Different indicators are weak acids or bases with different structures, so they ionize at different pH levels. This causes each indicator to show colour change in a specific pH range.

d. Why is it advisable to use dilute solutions in volumetric analysis?

Dilute solutions reduce the risk of side reactions and make titration more controlled and accurate, giving a sharper and more precise end point.

e. How will you detect which basic radical is present when Ca^{2+}, Al^{3+}, and Zn^{2+} all give white precipitates with NaOH?

They can be distinguished using excess NaOH and NH_4OH:

- Ca^{2+}: white precipitate insoluble in excess NaOH
- Al^{3+}: white precipitate soluble in excess NaOH (forms clear solution)
- Zn^{2+}: white precipitate soluble in excess NaOH and also in excess NH_4OH

This difference in solubility helps identify the specific ion.

f. How Fe^{2+} can be distinguished from Fe^{3+} chemically?

Fe^{2+} gives a green precipitate with NaOH which turns brown slowly, while Fe^{3+} gives a reddish-brown precipitate directly. Also, Fe^{3+} gives a blood-red complex with thiocyanate ion (SCN^-), which Fe^{2+} does not.

g. Why does Ca^{2+} not give precipitate with aqueous ammonia?

Because Ca^{2+} forms soluble hydroxide in dilute NH_4OH, and aqueous ammonia is a weak base, so it cannot produce sufficient OH^- ions to form a precipitate of $Ca(OH)_2$.

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

By performing acid-base titration using NaOH of known concentration and phenolphthalein indicator. The volume of NaOH used at the end point helps calculate the concentration of acetic acid.

i. What precautions should be observed while diluting a concentrated acid?

Concentrated acid should always be added slowly into water, not water into acid, with continuous stirring to avoid heat splashing and accidents.

j. Why does an aqueous solution of Na_2CO_3 behave like a base?

Na_2CO_3 is a salt of a strong base (NaOH) and weak acid (H_2CO_3). It undergoes hydrolysis in water producing OH^- ions, making the solution basic.

k. If an aqueous solution of NaOH is kept in an open container, what changes occur with time?

It absorbs carbon dioxide (CO_2) from air and slowly converts into sodium carbonate (Na_2CO_3), decreasing its strength as a base.

DESCRIPTIVE QUESTIONS

🌟 Q.3 Describe common types of Chemistry laboratory hazards with two examples in each case.

Chemistry laboratory hazards are conditions or situations in the lab that can cause harm to students, staff, or the environment. These hazards are mainly classified into three types:

1. Physical Hazards

Physical hazards are related to accidents caused by equipment, glassware, or working conditions in the laboratory.

Examples:

- Slipping or falling on a wet floor in the laboratory
- Cuts or injuries caused by broken glassware

2. Chemical Hazards

Chemical hazards arise due to the harmful effects of chemicals used in experiments. These substances may be toxic, corrosive, or reactive.

Examples:

- Burns caused by strong acids like hydrochloric acid (HCl) or sulfuric acid (H_2SO_4)
- Poisoning or irritation due to toxic gases such as ammonia or chlorine

3. Biological Hazards

Biological hazards are caused by living organisms or harmful biological materials that can affect health.

Examples:

- Infection caused by bacteria present in contaminated samples
- Allergic reactions caused by fungi, microbes, or biological substances

🌟 Q.4 What are common accidents in the Chemistry lab? How are they managed in first aid treatment?

Common accidents in a chemistry laboratory occur due to careless handling of chemicals, glassware, or equipment. These accidents must be treated immediately using proper first aid to reduce damage.

1. Chemical Burns (Acid/Base spills on skin)

First Aid Treatment:

- Wash the affected area immediately with plenty of running water for at least 10–15 minutes.
- Remove contaminated clothing carefully.
- Inform the lab instructor and seek medical help if needed.

2. Eye Injuries (Chemical splashes in eyes)

First Aid Treatment:

- Rinse eyes immediately with clean water or eye wash solution for several minutes.
- Do not rub the eyes.
- Get medical attention as soon as possible.

3. Cuts from Broken Glassware

First Aid Treatment:

- Clean the wound with antiseptic solution.
- Apply pressure to stop bleeding using a clean cloth.
- Cover with a sterile bandage and seek medical help if necessary.

4. Inhalation of Toxic Fumes (e.g., chlorine or ammonia gas)

First Aid Treatment:

- Move the person to fresh air immediately.
- Loosen tight clothing to ease breathing.
- If breathing is difficult, seek urgent medical assistance.

5. Skin Contact with Harmful Chemicals

First Aid Treatment:

- Wash the affected area thoroughly with plenty of water.
- Use soap if necessary (except for strong acids immediately).
- Report to the instructor.

🌟 **Q.5 How the following acid radicals are indicated and confirmed in salt analysis?**

In salt analysis, acid radicals (anions) are identified by specific tests which give characteristic observations (indication) and confirmatory results.

i) Carbonate ion (CO_3^{2-})

Indication:

On adding dilute acid, a colorless, odorless gas is evolved which turns lime water milky.

Confirmation:

The gas is carbon dioxide (CO_2). It turns lime water milky due to formation of calcium carbonate ($CaCO_3$), confirming the presence of carbonate ion.

ii) Chloride ion (Cl^-)

Indication:

On adding silver nitrate ($AgNO_3$) solution, a white precipitate is formed.

Confirmation:

The white precipitate dissolves in ammonium hydroxide (NH_4OH), confirming chloride ion.

Chromyl chloride test gives red fumes of chromyl chloride (CrO_2Cl_2), which is a confirmatory test for chloride.

iii) Nitrate ion (NO_3^-)

Indication:

No visible precipitate is formed with common reagents.

Confirmation:

Brown ring test: A brown ring appears at the junction of two layers ($FeSO_4$ and concentrated H_2SO_4), confirming nitrate ion.

iv) Sulfate ion (SO_4^{2-})

Indication:

On adding barium chloride ($BaCl_2$) solution, a white precipitate is formed.

Confirmation:

The white precipitate of barium sulfate ($BaSO_4$) is insoluble in dilute acids, confirming sulfate ion.

Q.6 How the following basic radicals are indicated and confirmed in salt analysis?

Basic radicals (cations) are identified by characteristic precipitates and their behaviour with reagents like NaOH and NH_4OH.

i) Cu^{2+} (Copper ion)

Indication:

With NaOH, a blue precipitate of copper hydroxide is formed.

Confirmation:

The blue precipitate is insoluble in excess NaOH but dissolves in excess NH_4OH, forming a deep blue solution (tetraammine copper complex), confirming Cu^{2+}.

ii) Al^{3+} (Aluminium ion)

Indication:

With NaOH, a white gelatinous precipitate of aluminium hydroxide is formed.

Confirmation:

The precipitate dissolves in excess NaOH but is insoluble in NH_4OH, confirming Al^{3+}.

iii) Fe^{3+} (Ferric ion)

Indication:

With NaOH or NH_4OH, a reddish-brown precipitate of ferric hydroxide is formed.

Confirmation:

The precipitate is insoluble in excess reagents, confirming Fe^{3+}.

It also gives a blood-red colour with thiocyanate ion (SCN^-), which is a confirmatory test.

iv) Zn^{2+} (Zinc ion)

Indication:

With NaOH or NH_4OH, a white precipitate of zinc hydroxide is formed.

Confirmation:

The precipitate dissolves in excess NaOH and also in excess NH_4OH, forming a colorless solution, confirming Zn^{2+}.