13 CHAPTER

LABORATORY AND PRACTICAL SKILLS

Student Learning Outcomes

After studying this chapter, students will be able to:

- Explain, with examples, the types of chemical hazards in the lab and suggest safety precautions. (Types of chemical hazards to be identified: flammable or explosive hazards, corrosive hazards, toxic hazards, reactive hazards radiation hazards and asphyxiation hazards)
- Recognize the meaning of different, chemical hazard signs in the lab and [L] on chemicals.
- Recognize the importance of personal protective equipment correctly identifying the types of PPE needed for different lab activities locate the nearest fire extinguisher and emergency shower.
- Show awareness of emergency procedures-in the even to fan emergency in the lab.

INTRODUCTION

LONG QUESTIONS

Q.1 Define chemistry laboratory. What are responsibilities of a student while working in the chemistry laboratory.

OR

What precautionary measures should be adopted by a student while working in the laboratory.

Ans: **CHEMISTRY LABORATORY**

Definition

A Chemistry laboratory is a place where a student is trained to observe the physical and chemical characteristics of substances by following definite procedures.

RESPONSIBILITY OF A STUDENT WHILE WORKING IN THE LABORATORY/ PRECAUTIONS

i. Before starting the laboratory work, a student should get himself **familiarized with the layout of the laboratory** and various fittings provided in the laboratory table as well as the side shelves.
ii. Students are expected **to conduct themselves in a responsible manner** at all times in the lab.
iii. They are advised **not to work alone** in the lab.
iv. Experiments should be performed **in the presence of lab instructor** and other laboratory staff.
v. All **equipments should be checked before use** whether they are working properly according to the requirements of the experiments.
vi. Determine **the potential hazards** related to any equipment or the experiment before beginning any work.
vii. **Appropriate safety precautions** must be observed at all cost.
viii. There must **not be any crowding in the lab** and students should stick to their work places at a safe distance from each other.
ix. **Don't bring any food items** in the lab.
x. **Never taste or smell** any compound or a gas.
xi. If it is necessary to smell a gas it is always advised to **waft the fumes or vapor** towards your nose.
xii. **Warning signs** are displayed when unusual hazards, hazardous materials, hazardous equipment or special conditions are expected.
xiii. Do not pour chemicals down the drains and **do not utilize the sewer for chemical waste** disposal.
xiv. Keep all **sink traps and floor drains clean**.
xv. Laboratory chemical waste can be **disposed of in sewer or trash bin** if they are non-hazardous materials.
xvi. Acids and bases are **first neutralized** followed by sewer disposal.
xvii. **Hazardous waste material** is transported to hazardous waste disposal site.
xviii. **Misuse and mishandling of chemicals** may create serious problems for the laboratory workers.
xix. A laboratory worker must **use the chemicals according to the standard procedures** keeping in view the particular hazards and precautions required for the safe use. For

Q.2 What are chemicals, creating problems for the safety of workers?

Ans: **CHEMICALS, CREATING PROBLEMS FOR THE SAFETY OF WORKERS**

The chemicals which can create problems for the safety of workers are:

- Cleaning agents
- Disinfectants
- Solvents
- Paints
- Compressed gas cylinders
- Mineral acids
- Carcinogenic chemicals etc.

Q.3 How to identify and minimize health and safety problems?

Ans: **TO IDENTIFY AND MINIMIZE HEALTH AND SAFETY PROBLEMS**

Recognizing hazards which are commonly encountered in the laboratory helps to identify and minimize many of the health and safety problems.

Q.4 What are most hazards which we might face while working in the laboratory?

Ans: **HAZARDS WE MIGHT FACE WHILE WORKING IN THE LAB**

Most hazards which we might face while working in the laboratory fall into the following categories.

1. Chemical Hazards in the laboratory
2. Hazard Signs
3. Personal Protective Equipment (PPE) in the Laboratory
4. Location of Fire Extinguisher
5. Emergency Situation in the Lab

SHORT QUESTIONS

Q.1 When are warning signs displayed?

Ans: **DISPLAY OF WARNING SIGNS**

Warning signs are displayed when unusual hazards, hazardous materials, hazardous equipment or special conditions are expected.

Q.2 Define chemistry laboratory.

Ans: **CHEMISTRY LABORATORY**

Definition

A Chemistry laboratory is a place where a student is trained to observe the physical and chemical characteristics of substances by following definite procedures.

Q.3 Give the names of common hazards in the laboratory.

Ans: **HAZARDS WE MIGHT FACE WHILE WORKING IN THE LAB**

Most hazards which we might face while working in the laboratory fall into the following categories.

6. Chemical Hazards in the laboratory
7. Hazard Signs
8. Personal Protective Equipment (PPE) in the Laboratory
9. Location of Fire Extinguisher
10. Emergency Situation in the Lab

MULTIPLE CHOICE QUESTIONS

1 **Safety in the chemistry laboratory is:**

(A) the responsibility of the students only
(B) the responsibility of the professor only
(C) the responsibility of the lab incharge only
(D) a shared responsibility

2 **Accidents often result from:**

(A) making mistakes
(B) failure to use common sense
(C) failure to follow instructions
(D) all of the above

3. **The label "Warning" on a chemical bottle signifies:**
(A) that the chemical can cause less serious injury
(B) that the chemical can cause serious injury
(C) that user should be careful when using chemical
(D) that user should open it only in the presence of a teacher

13.1 CHEMICAL HAZARDS IN THE LABORATORY

LONG QUESTIONS

Q.1 (A) What is meant by chemical hazards? Name the chemical hazards which we might face while working in the laboratory?
(B) Describe flammable and explosive chemical hazards in detail.

Ans:

(A) CHEMICAL HAZARDS IN THE LABORATORY

Definition

The substances that can be harmful to health if inhaled or ingested are called chemical hazards in the laboratory.

Names of Chemical Hazards in the Laboratory

1. Flammable and Explosive Chemical Hazards
2. Corossive Hazard
3. Toxic Chemical Hazards
4. Reactive Chemical Hazards
5. Radiation Hazards
6. Asphyxiation Hazards

(B) FLAMMABLE AND EXPLOSIVE CHEMICAL HAZARDS

Precautions to work in the Laboratory

- To start working in the laboratory requires great care, responsible behaviour and good attention.
- It is important to exercise extreme caution while working with delicate instruments, hazardous chemicals and open flames.
- If flammable and explosive chemicals are not handled in a safe and compliant manner, they can cause acute health problems.

Problems due to careless working

These problems may include burns, eye injuries, lung disease and suffocation.

EXPLOSIVE CHEMICALS

Definition

Chemicals that cause a sudden release of pressure, gas and heat when they experience sudden shock are called explosive chemicals.

Examples

Chemicals which are expected to explode are:

- Picric acid,
- 2.4-di-nitrophenyl hydrazine
- Benzoyl peroxide
- Nitrocellulose etc.

Precaution

If you ever come across any chemical that you suspect to explode, do not attempt to move the container to avoid shock.

Hazards due to explosives

Explosives can cause damage to people, windows, tables etc.

FLAMMABLE CHEMICALS OR MIXTURES

Definition

Flammable chemicals or mixtures are those which have a flashpoint around room temperature.

Examples

Flammable compounds are

- Ethers
- Methylated spirit
- Benzene
- Acetone
- Petrol etc.

Precaution to use hazardous chemical

Avoid using a chemical that is hazardous. Look for its alternative.

Safety instruction to use potentially dangerous chemicals

If you must use a potentially dangerous chemical, you must follow the underlying safety instructions.

(i) Obtain prior approval from your teacher.
(ii) Always use smallest quantity of the chemicals
(iii) Always conduct experiment in fume hood.
(iv) Remove all other chemicals and apparatus around you.
(v) Inform other people working with you.
(vi) Always wear safety spectacles, gloves and lab coat.
(vii) Alway keep flammable compounds away from heat source.
(viii) Pour the flammable liquid very carefully.
(ix) Properly dispose off any hazardous waste.
(x) Do not store flammable liquid in refrigerator.

Q.2 What are corrosive hazards or corrosive chemicals in the laboratory? What are safety precautions regarding corrosive hazards while working in the laboratory?

Ans: **CORROSIVE HAZARDS OR CHEMICAL HAZARDS**

Definition

The chemicals that are corrosive to skin or animal tissues are called corrosive hazards or corrosive chemicals.

Hazards

Corrosive chemicals attack living tissues when they come in contact with them.

Physical states

(i) They can be in the form of solids, liquids or gases.
(ii) Such chemicals attack skin, eyes and respiratory tract and in the intestine as well.

SAFETY PRECAUTIONS/MEASURES

(i) Wear splash goggles and use face shield

Whenever you work with corrosive chemicals, wear splash goggles instead of safety glasses and use a face shield.

(ii) **Fume cupboard**

Corrosive chemicals must be used in a fume cupboard to avoid breathing corrosive vapours.

(iii) Add acid slowly

While mixing concentrated acids with water, always add acid slowly to water and not vice versa.

(iv) Eye wash and emergency shower

Ensure eye wash and emergency shower is available.

(v) Wash the affected area

Wash the affected area with soap and water

(vi) Medical attention

Seek medical attention in case of emergency.

Examples

Corrosive chemicals are:

- Mineral acids including HF
- Caustic alkalies
- Acetic acid (glacial) etc.

Q.3 What are toxic chemical hazards in the laboratory? What are safety precautions regarding toxic chemical hazards while working in the laboratory?

Ans:

TOXIC CHEMICAL HAZARDS

Definition

A toxic chemical is a poisonous material which is capable of causing serious health problems.

Examples

- Mercury
- Benzene
- Chlorine
- Pesticides
- Ammonia
- Hydrogen cyanide.

SAFETY INSTRUCTIONS

The following safety instructions may be ensured in case you intend to work with toxic chemicals.

(i) Wear gloves, masks or other protective devices.
(ii) Keep the work area well ventilated.
(iii) Keep the toxic chemicals in original container.
(iv) Do not work alone.
(v) Wash your hands with soap and water after you finished.
(vi) Always work in fume hood because toxic vapours can be formed during an experiment
(vii) Seek immediate medical and if you think you may have exposed to poisonous substance.

Q.4 What are reactive chemical hazards in the laboratory? What are safety precautions regarding reactive chemical hazards?

Ans:

REACTIVE CHEMICAL HAZARDS

Definition

Hazards due to reactive chemicals are called reactive chemical hazards.

Importance

The reactivity property of chemicals is vital for the production of many chemicals, pharmaceutical and food products which are in our daily use.

Hazards

When chemical reactions are not properly performed, they may cause

- Fires
- Explosions as they may evolve dangerous gases.
- These reactions may result to an extreme damage to life and property.

Examples

Reactive chemicals are:

- Calcium hydride
- Sodium
- Lithium
- Azides
- Picric acid

- $AIC1_3$
- Benzoyl peroxide etc.

Safety Instructions

(i) Handle reactive chemicals with utmost care. Segregate these from other chemicals while storage.
(ii) Appropriate measures should be taken before performing reactions with reactive chemicals. Utilize shield and heavy gloves.
(iii) Minimize the quantity required for experiment.
(iv) Glass equipment must be shielded by wrapping with tape.
(v) After use carefully dispose off every dangerous material.

Q.5 What are radiation hazards in the laboratory? What are safety precautions regarding radiation hazards?

Ans: **RADIATION HAZARDS**

Definition

Hazards due to radiations are called radiation hazards.

Following are the radiation hazards:

(i) High dose of radiation

When a person is exposed to a high dose of radiation
It can damage the functioning of tissues and organs and can cause vomiting, radiation burns, hair loss and radiation syndrome.

(ii) Aplha and beta particle

Radioactive materials that emit alpha and beta particles inflict-extreme damage when inhaled or injected.

(iii) Gamma rays

Gamma rays cause external injuries.

(iv) Medical x-rays

Medical x-rays produce ionizing radiation which can affect living tissues.

Safety instructions

1. Keep radioactive sources shielded.
2. Avoid prolonged exposures to the radiation.
3. Stay inside as walls and ceilings can protect you from radiation fall out.
4. Never operate equipment that produces radiation without sufficient training.
5. Wear protective clothing, wear face mask.
6. Avoid contact of the material with bare skin.
7. Monitor exposure to radiation using badges etc.

Q.6 What are asphyxiation hazards in the laboratory? What are safety precautions regarding these hazards?

Ans: **ASPHYXIATION HAZARDS**

Definition

It is a type of hazard in which a gas or vapour can cause unconscience or death through suffocation.

OR

Chemicals that can cause suffocation, are known as chemical asphyxiants.

Significance

A **sufficient level of oxygen** is essential for normal breathing. If this level falls, it can create very dangerous situation. The exposed person has no warning and cannot realize that oxygen level has become low.

Symptoms of low oxygen level

If the level of oxygen decreases a person can feel rapid breathing, rapid heart rate, nausea and convulsions.

Examples

Chemical asphyxiants are

- Hydrogen cyanide
- Carbon monoxide
- Nitrogen
- Argon
- Helium
- Methane
- Carbon dioxide etc.

SAFETY INSTRUCTIONS

(i) Store and use asphyxiant chemicals in well-ventilated areas with plenty of air.
(ii) Wear a full lab coat, wear glasses and standard gloves, long trousers and closed-toed shoes.
(iii) Dispose off the waste strictly according to the instructions.
(iv) If exposed to such chemicals wash the exposed part with running water and seek medical attention.
(v) When such a chemical is inhaled, remove the patient from the contaminated area and call appropriately trained person.

EXERCISE

1. Why flammable liquids are not stored in refrigerator?

Ans: **STORAGE OF FLAMMABLE LIQUIDS**

Flammable liquids are not stored in refrigerator because turning of the compressor on or the internal light, can create sparks. It can ignite the flammable vapors released by the liquid which can cause fire or explosion.

2. Can you wear contact lenses in the lab?

Ans: **WEARING CONTACT LENSES**

Yes, we can wear contact lenses in the lab but in case of corrosive chemicals, extreme heat, or infectious agents, wear the safety goggles over contact lenses.

3. Under what circumstances explosive chemicals are likely to explode?

Ans: **EXPLOSION OF EXPLOSIVE CHEMICALS**

Explosive chemicals are likely to explode under following circumstances:

- sudden increase in heat,
- increase in pressure
- shock
- friction
- or all these factors

It causes a rapid chemical reaction that releases a large amount of hot gas and generate a powerful explosion.

4. How will you dispose off acid and alkali waste after the experiment is finished?

Ans: **TO DISPOSE OFF ACID AND ALKALI**

i. Neutralize the solution by carefully adding the opposite chemical i.e. acid to base or base to acid until the pH reaches a near-neutral level.
ii. Then dilute it with large amounts of water and then pour down in the drain.

SHORT QUESTIONS

Q.1 What are corrosive hazards or corrosive chemicals in the laboratory?

Ans: **CORROSIVE HAZARDS OR CHEMICAL HAZARDS**

Definition

The chemicals that are corrosive to skin or animal tissues are called corrosive hazards or corrosive chemicals.

Hazards

Corrosive chemicals attack living tissues when they come in contact with them.

Physical states

(i) They can be in the form of solids, liquids or gases.
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Ans: **TO DISPOSE OFF ACID AND ALKALI**

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Then dilute it with large amounts of water and then pour down in the drain.

Q.3 What are asphyxiation hazards in the laboratory? What are safety precautions regarding these hazards?

Ans: **ASPHYXIATION HAZARDS**

Definition

It is a type of hazard in which a gas or vapour can cause unconscience or death through suffocation.

OR

Chemicals that can cause suffocation, are known as chemical asphyxiants.

Significance

A **sufficient level of oxygen** is essential for normal breathing. If this level falls, it can create very dangerous situation. The exposed person has no warning and cannot realize that oxygen level has become low.

MULTIPLE CHOICE QUESTIONS

1 The label "Corrosive" on a chemical bottle indicates:
(A) that the material is an oxidizing agent
(B) that the material can degrade rapidly upon exposure
(C) that the contact destroys living tissue
(D) that the chemical can explode

2. Example of highly toxic chemical:
(A) Ethanol
(B) Acetic acid
(C) Potassium cyanide
(D) Potassium permanganate

3. An example of toxic chemical is:
(A) Chlorine
(B) Pesticides
(C) Ammonia
(D) All of these

13.2 HAZARD SIGNS

LONG QUESTIONS

Q.1 What are hazard signs in the laboratory? What is their significance?

Ans: **RADIATION HAZARDS**

Definition

Hazard signs in a laboratory are symbols that indicate the presence of a hazardous substance or material.

Significance

These signs help to identify potential risks to people and the environment.

Need to practice rigorous rules in chemistry laboratory

- A chemistry laboratory is a strict area where rigorous rules must be practiced to avoid a chance of a deadly accident.
- A dangerous situation may arise not only for the individuals working there but for the whole area.
- In a laboratory there are several hazardous materials sensitive equipments and specified areas for specific tasks.

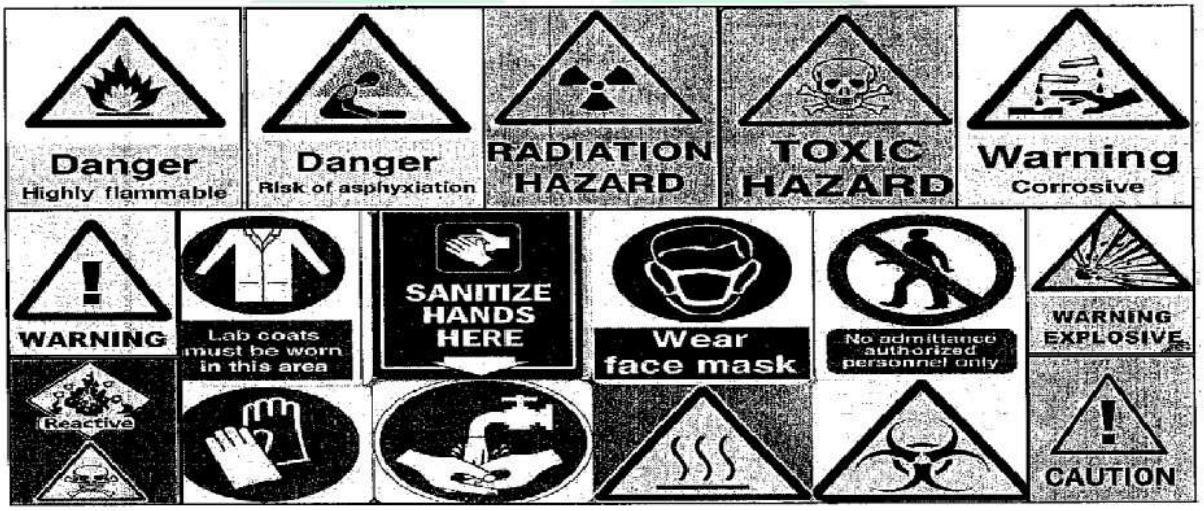
Posting of signs and symbols

Proper warning signs ought to be posted on these areas to ensure that every person entering there must understand and act accordingly to maintain laboratory safety.

Several signs and symbols are posted in different areas of the lab and bottles containing hazardous chemicals.

Significance of hazard signs

These signs indicate that specific precautions must be observed according to the requirement sign posted there. If you see such signs, you must be alert and take extra care to maintain safety in that area.



EXERCISE

1. What does warning sign "caution" convey the message?

Ans: **MESSAGE FROM WARNING SIGNS**

These signs indicate that specific precautions must be observed according to the requirement sign posted there. If you see such signs, you must be alert and take extra care to maintain safety in that area.

2. Name some explosive chemicals.

Ans: **SOME EXPLOSIVE CHEMICALS**

Chemicals which are expected to explode are:

- Picric acid,
- 2,4-di-nitrophenyl hydrazine
- Benzoyl peroxide
- Nitrocellulose etc.

SHORT QUESTIONS

Q.1 What are hazard signs in the laboratory? What is their significance?

Ans: **RADIATION HAZARDS**

Definition

Hazard signs in a laboratory are symbols that indicate the presence of a hazardous substance or material.

Significance

These signs help to identify potential risks to people and the environment.

Q.2 What does warning sign "caution" convey the message?

Ans: **MESSAGE FROM WARNING SIGNS**

These signs indicate that specific precautions must be observed according to the requirement sign posted there. If you see such signs, you must be alert and take extra care to maintain safety in that area.

3. Write down the names of some explosive chemicals.

Ans: **SOME EXPLOSIVE CHEMICALS**

Chemicals which are expected to explode are:

- Picric acid,
- 2.4-di-nitrophenyl hydrazine
- Benzoyl peroxide
- Nitrocellulose etc.

MULTIPLE CHOICE QUESTIONS

1. Example of highly corrosive chemical:

(A) Sulphuric acid
(B) Acetic acid
(C) Potassium cyanide
(D) Potassium permanganate

1. Example of highly explosive chemical is:

(A) Picric acid
(B) Acetic acid
(C) Potassium cyanide
(D) Potassium permanganate

13.3 PERSONAL PROTECTIVE EQUIPMENTS (PPE) IN THE LABORATORY

LONG QUESTIONS

Q.1 What are the personal protective equipments in the laboratory? What is their significance?

Ans: **PERSONAL PROTECTIVE EQUIPMENTS**

Definition

Personal protective equipment (PPE) in a lab is specialized clothing or equipment that protects lab workers from hazards.

Significance

Personal protective equipment should be made available to students to face any emergency situation which may arise in the lab. They are also useful to reduce exposures to hazardous chemicals.

Proper protective equipment

Proper protective equipment includes such items as:

Examples

- Lab coat
- Protective glasses
- Face shields

- Apron
- Boots
- Hearing protection.

SHORT QUESTIONS

Q.1 Name some personal protective equipments in the laboratory.

Ans:

PERSONAL PROTECTIVE EQUIPMENTS

Proper protective equipment

Proper protective equipment includes such items as:

Examples

- Lab coat
- Protective glasses
- Face shields
- Apron
- Boots
- Hearing protection.

MULTIPLE CHOICE QUESTIONS

1. Which one is not included in the personal protective Example of highly explosive chemical is:

(A) Lab coat
(B) Apron
(C) Boots
(D) Mobile

13.4 LOCATION OF FIRE EXTINGUISHER

LONG QUESTIONS

Q.1 Describe the location of fire extinguishers in the laboratory? What is their significance?

Ans:

LOCATION OF FIRE EXTINGUISHER

Fire Extinguisher

Chemical laboratories using such materials which are likely to catch fire during experiments must have a portable fire extinguisher.

Significance of fire extinguisher

This equipment can quickly be used to control a small fire if it is applied by a student individually. For this purpose, all students should be well aware the location where this fire extinguisher is placed.

Training session

A training session should be held to train all the students to know how to handle and apply this fire extinguisher to extinguish the fire properly without any panic or harm to anybody.

Facility of a shower

Similarly, the facility of a shower should also be made available in the lab whose location and working must be told to everybody working in the lab. In case of fire or any other emergency students should know how to face that emergency situation.

EXERCISE

Q.1 Should emergency drills be compulsory or optional?

Ans:

EMERGENCY DRILLS

An emergency drill is a practice of an emergency procedure. It is used to test the response of employees, facilities, and systems in an emergency situation. Therefore, emergency drills be compulsory.

SHORT QUESTIONS

Q.1 What is the significance of fire extinguishers in the laboratory?

Ans: **SIGNIFICANCE OF FIRE EXTINGUISHER**

This equipment can quickly be used to control a small fire if it is applied by a student individually. For this purpose, all students should be well aware the location where this fire extinguisher is placed.

Q.2 Should emergency drills be compulsory or optional?

Ans: EMERGENCY DRILLS

An emergency drill is a practice of an emergency procedure. It is used to test the response of employees, facilities, and systems in an emergency situation. Therefore, emergency drills be compulsory.

MULTIPLE CHOICE QUESTIONS

1. What should you do in case of a fire drill in lab?

(A) run to safety shower
(B) climb into the fume cupboard
(C) close gas valves and turn off all equipments
(D) carry chemicals out of the lab

13.5 EMERGENCY SITUATION IN THE LAB

LONG QUESTIONS

Q.1 How to deal with emergency situation in the laboratory?

Ans: **EMERGENCY SITUATION IN THE LAB**

Precautionary Measures

(i) Awareness to take action

Students should make themselves aware of the actions that need to be taken in case of an emergency in a laboratory or if a person is affected.

(ii) Periodic drills

For this purpose periodic drills should be held with compulsory participation.

(iii) Lectures and practical to handle emergency

Students should not only been given lectures but involve them practically to handle the emergency situations.

(iv) Checking of fire fighting and other equipments

During drill firefighting and other equipments must be checked whether they are in proper working order or not.

Safety instruction

The following points should be kept in mind to cope with the emergency situation.

(i) Stay calm and do not panic.
(ii) Alert people in the area to evacuate.
(iii) In case of fire, close doors to confine fire. Use fire extinguisher to put down the fire.
(iv) In case of chemical emergency adopt safety procedures as mentioned article 13.1.
(v) Call and assist emergency staff.

SHORT QUESTIONS

Q.1 What are safety instructions to avoid emergency situation in the laboratory?

Ans: **SAFETY INSTRUCTION**

The following points should be kept in mind to cope with the emergency situation.

(i) Stay calm and do not panic.
(ii) Alert people in the area to evacuate.
(iii) In case of fire, close doors to confine fire. Use fire extinguisher to put down the fire.

(iv) In case of chemical emergency adopt safety procedures as mentioned article 13.1.
(v) Call and assist emergency staff.

MULTIPLE CHOICE QUESTIONS

1. Example of self reactive chemical:
(A) Potassium
(B) Phenol
(C) Picric acid
(D) n-hexane

2. When diluting an acid with water
(A) do it quickly
(B) do not stir the container
(C) always add acid to water
(D) always add water to acid

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

INTRODUCTION

1 D 2 D 3 A

13.1 CHEMICAL HAZARDS IN THE LABORATORY

1 C 2 C 3 D

13.2 HAZARD SIGNS

1 A 2 A

13.3 PERSONAL PROTECTIVE EQUIPMENT (PPE) IN THE LABORATORY)

11 D

13.4 LOCATION OF FIRE EXTINGUISHER

1 C

13.5 EMERGENCY SITUATION IN THE LAB

1 A 2 C

EXERCISE SOLUTION
MULTIPLE CHOICE QUESTIONS

1. Tick () the correct answer.

1 Safety in the chemistry laboratory is:
(A) the responsibility of the students only
(B) the responsibility of the professor only
(C) the responsibility of the lab incharge only
(D) a shared responsibility

2 Accidents often result from:
(A) making mistakes
(B) failure to use common sense
(C) failure to follow instructions
(D) all of the above

3 The label "Warning" on a chemical bottle signifies:
(A) that the chemical can cause less serious injury
(B) that the chemical can cause serious injury
(C) that user should be careful when using chemical
(D) that user should open it only in the presence of a teacher

4 The label "Corrosive" on a chemical bottle indicates:
(A) that the material is an oxidizing agent
(B) that the material can degrade rapidly upon exposure
(C) that the contact destroys living tissue
(D) that the chemical can explode

5. Example of highly toxic chemical:
(A) Ethanol (B) Acetic acid
(C) Potassium cyanide (D) Potassium permanganate

6. Example of self reactive chemical:
(A) Potassium
(B) Phenol
(C) Picric acid
(D) n-hexane

7. When diluting an acid with water
(A) do it quickly
(B) do not stir the container
(C) always add acid to water
(D) always add water to acid

8. What should you do in case of a fire drill in lab?
(A) run to safety shower
(B) climb into the fume cupboard
(C) close gas values and turn off all equipments
(D) carry chemicals out of the lab

ANSWER KEY

1	D	**2**	D	**3**	B	**4**	C	**5**	C
6	A	**7**	C	**8**	C				

QUESTIONS FOR SHORT ANSWERS

2. Questions for Short Answers.

Q.1 Name some corrosive chemicals.

Ans: **CORROSIVE CHEMICALS**

Names of some corrosive chemicals are:

- Mineral acids including HF
- Caustic alkalies
- Acetic acid (glacial) etc.

Q.2 What type of safety precautions are adopted to avoid damage due to explosive chemicals?

Ans: **SAFETY PRECAUTIONS FOR EXPLOSIVE CHEMICALS**

If you ever come across any chemical that you suspect to explode, do not attempt to move the container to avoid shock.

Hazards due to explosives

Explosives can cause damage to people, windows, tables etc.

PRECAUTIONS

i. Avoid using a chemical that is hazardous. Look for its alternative.
ii. Obtain prior approval from your teacher.
iii. Always use smallest quantity of the chemicals
iv. Always conduct experiment in fume hood.
v. Remove all other chemicals and apparatus around you.
vi. Inform other people working with you.
vii. Always wear safety spectacles, gloves and lab coat.
viii. Alway keep flammable compounds away from heat source.
ix. Pour the flammable liquid very carefully.
x. Properly dispose off any hazardous waste.
xi. Do not store flammable liquid in refrigerator.

Q.3 What type of damages can reactive chemicals cause?

Ans: **DAMAGE DUE TO REACTIVE CHEMICALS**

When chemical reactions are not properly performed, they may cause

- Fires
- Explosions as they may evolve dangerous gases.
- These reactions may result to an extreme damage to life and property.

Examples

Reactive chemicals are:

- Calcium hydride
- Na,
- Li,
- Azides
- Picric acid
- $AIC1_3$
- Benzoyl peroxide etc.

Q.4 Indicate two such safety instructions which are required to avoid radiation.

Ans: **SAFETY INSTRUCTIONS TO AVOID RADIATION**

i. Keep radioactive sources shielded.
ii. Avoid prolonged exposures to the radiation.
iii. Stay inside as walls and ceilings can protect you from radiation fall out.
iv. Never operate equipment that produces radiation without sufficient training.
v. Wear protective clothing, wear face mask.

Q.5 Which chemicals can cause suffocation?

Ans: **CHEMICALS CAUSING SUFFOCATION**

Chemicals that can cause suffocation, are known as chemical asphyxiants.

Examples

Chemical asphyxiants are

- Hydrogen cyanide
- Carbon monoxide
- Nitrogen
- Argon
- Helium
- Methane
- Carbon dioxide etc.

Q.6 Why signs and symbols are posted on lab and chemical bottles?

Ans: **POSTING OF SIGNS AND SYMBOLS**

Proper warning signs ought to be posted on these areas to ensure that every person entering there must understand and act accordingly to maintain laboratory safety.

Q.7 How fire caused by chemicals should be handled?

Ans: **HANDLING OF FIRE**

i. Fire extinguisher

Fire extinguisher can quickly be used to control a small fire if it is applied by a student individually. For this purpose, all students should be well aware the location where this fire extinguisher is placed.

ii. Facility of a shower

Similarly, the facility of a shower should also be made available in the lab whose location and working must be told to everybody working in the lab. In case of fire or any other emergency students should know how to face that emergency situation.

Q.8 Why emergency drills are important to face emergency situations?

Ans: **EMERGENCY DRILLS**

Emergency drills are important because they help individuals to:

- practice and familiarize themselves with emergency procedures
- respond quickly and calmly in a real emergency by reducing panic
- improve coordination
- identify potential weaknesses in response plans

It ultimately saves lives and minimize damage.

CONSTRUCTED RESPONSE QUESTIONS

3. Constructed Response Questions

Q.1 How will you handle an emergency situation caused by fire due to short circuiting?

Ans: **HANDLING AN EMERGENCY SITUATION**

The fire caused by a short circuit will be handled by the following methods:

- By cutting off the power source
- By evacuating the area
- Extinguish the flames using a fire extinguisher rated for electrical fires
- Label with a "C" or "ABC"
- Never use water on an electrical fire as it can spread the electricity and increase the risk of shock

Q.2 What type of reactions should be carried out in fume cupboard?

Ans: **REACTIONS CARRIED OUT IN FUME CUPBOARD**

The reactions that produce toxic or harmful fumes, vapors, or gases, chemical aerosols should be carried out in a fume cupboard.

Q.3 Put forward at least two suggestions to improve safety in the lab.

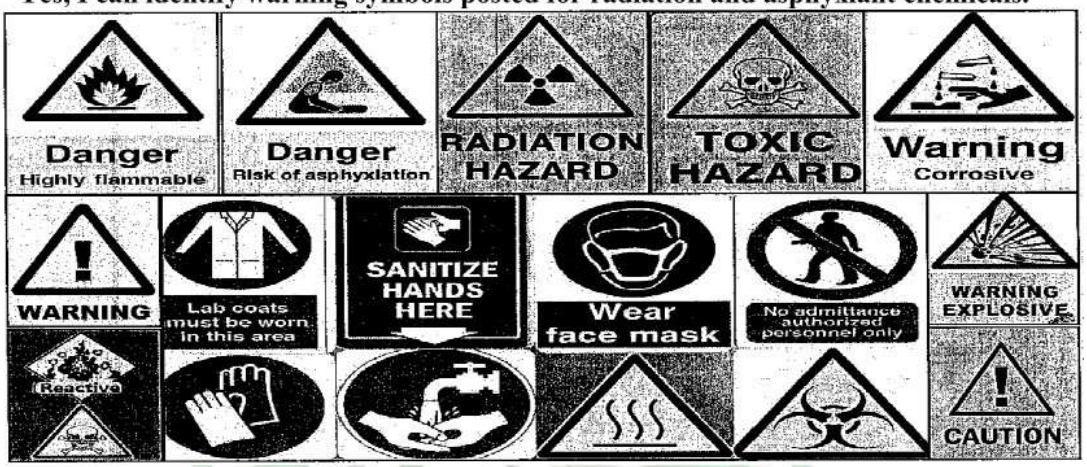
Ans: **SUGGESTIONS TO IMPROVE SAFETY**

(i) No Food or Drink
(ii) Wear Your Proper Lab Attire
(iii) Label Your Work Space
(iv) Don't Work Alone

Q.4 Can you identify warning symbols posted for radiation and asphyxiant chemicals?

Ans: **IDENTIFY SYMBOLS FOR RADIATION AND ASPHYXIANT**

Yes, I can identify warning symbols posted for radiation and asphyxiant chemicals.



Q.5 Why sudden shock can cause some chemicals to explode?

Ans: **EXPLOSION DUE TO SUDDEN SHOCK**

A sudden shock can cause certain chemicals to explode because it starts a chain reaction rapidly, releases a large amount of gas and heat.

DESCRIPTIVE QUESTIONS

4. Descriptive Questions

Q.1 Explain hazards due to explosive and toxic chemicals.

Ans: Answer given on page #

Q.2 Write down five such common safety instructions which are used to avoid all types of hazards.

Ans: Answer given on page #

Q.3 Explain the importance of warning signs and symbols to avoid any accident in the lab.

Ans: Answer given on page #

Q.4 Name some toxic chemicals. Describe the effects of spreading toxic gas in the lab.

Ans: **TOXIC CHEMICAL HAZARDS**

Definition

A toxic chemical is a poisonous material which is capable of causing serious health problems.

Examples

- Mercury
- Benzene
- Chlorine

- Pesticides
- Ammonia
- Hydrogen cyanide.

EFFECTS OF SPREADING TOXIC GAS IN LAB

Some of these gases are colorless and odorless, making detection difficult. The following are the effects of spreading toxic gas in the lab:

Toxic gases can cause various health effects such as:

respiratory irritation
headaches
chest pain,
dizziness and even death depending on the concentration and duration of exposure,

Common Toxic Gases and Their Effects

(i) Nitrogen Dioxide (NO_2):
It is a reddish-brown gas that irritates the respiratory tract, causing coughing, chest pain, and lung damage. Its high exposure can lead to pulmonary edema and even death.

(ii) Carbon Monoxide (CO):
It is a colorless, odorless gas produced by incomplete combustion. It causes headaches, dizziness, nausea, confusion, and can lead to death by depriving the body of oxygen.

(iii) Sulfur Dioxide (SO_2):
It is a a pungent smelling gas that irritates eyes, nose, and throat, causing coughing, wheezing, and breathing difficulties, particularly for people with respiratory problem like asthma.

(iv) Ozone (O_3):
It is a secondary pollutant that can irritate the lungs, causing chest pain, coughing, and reduced lung function.

(v) Hydrogen Cyanide (HCN):
It is a highly toxic gas with a bitter almond smell; rapidly interferes with cellular respiration, leading to rapid loss of consciousness and can cause death.

(vi) Chlorine (Cl_2):
It is a strong irritant that can damage the respiratory tract, causing coughing, choking, and eye irritation.

Q.5 A student has spilled over a corrosive and explosive chemical due to an accident. Which emergency measures you will take to tackle the situation.

Ans: **MEASURES TO TACKLE THE SITUATION**

If a student has spilled over a corrosive and explosive chemical due to an accident, the following emergency measures will be taken to tackle the situation**:**

i. evacuate the area immediately
ii. alert emergency services
iii. if possible isolate the individual
iv. ventilate the room or area
v. ensure that everyone is at a safe distance away
vi. Immediately call a trained personnel to arrive to handle the situation
vii. do not attempt to clean up the spill yourself
viii. flush the affected area with sufficient amounts of water, if exposed to the chemical
ix. seek medical attention immediately.

INVESTIGATIVE QUESTIONS

5. Investigative Question

Q.1 A few decades ago, a tanker carrying poisonous chlorine gas leaked and the gas spread over a large area in Lahore. The accident killed a few persons as well as animals. Give some concrete proposals to avoid such an accident in future.

Ans:

Following are **some concrete proposals to avoid such an accident in future:**

Provide training to the workers

If a worker must handle chlorine, provide training and supervision on chlorine safety.

Manage protection away from chlorine

Keep all breathing apparatus stored outside the chlorine area.

Prepare an emergency plan

Prepare an emergency plan in place of chlorine emission. Remember to move uphill and upwind.

Do not spray water on leaking chlorine containers

Water and chlorine can create hydrochloric acid and hypochlorous acid.

Take shallow breaths

When entering an equipment area, breathe shallow breaths around the containers until sure a chlorine leak is not present.

Never drop cylinder or knock over it

Move chlorine cylinders with care using a hand truck that has restraint chains to secure the cylinder. Avoid contact between cylinders. Once the cylinder is in place, secure it with chains or trunnions to prevent it from falling.

Check the weight on moving equipment

Do not move filled containers with equipment designed to handle less than two tons.

Connecting of Cylinders

Do not connect more than two cylinders or containers to a common otherwise it may increase the chances for accidental leaks.

Never tamper with a fusible plug

Fusible plugs called melt plugs are activated by temperature, not pressure. If tampered, gas is released and a hazardous reaction can begin.

TERMS TO KNOW

Terms	Definitions
Behaviour for working in the laboratory	Working in the laboratory requires care and responsible behaviour. Hazardous chemicals and open flames if not handled properly can cause health problems
Handling of Chemicals	Chemicals can suddenly explode due to Shock and heat. They require handling them with care.
Safety instructions	Safety instructions should be followed strictly to avoid any damage due to flammable and explosive chemicals.
Corrosive chemicals	Corrosive chemicals affect skin eyes and respiratory tract. To avoid such health problems corrosive chemicals must be handled in fume cupboard
Loss of Carelessness	Chemicals are poisonous and cause; great harm if not handled according to instructions.
Special Care	Some chemicals are so reactive that they require special care in the laboratory
Harm due to Radioactive materials	Radioactive materials can affect living, tissues, and organs and cause other health problems. it is important to avoid longer exposure to radiation to stay healthy
Asphyxiant chemicals	Asphyxiant chemicals are extremely-lethal because they can cause suffocation. They must be used in Well-ventilated places with protected-dress.

Signs and symbols	Signs and symbols should due posted in' lab, and chemical bottles to let the people know their hazardous nature
Personal protection equipment	Personal protection equipment are mandatory before you enter the lab.
location and operation of fire extinguisher and shower	Students shall know the location and operation of fire extinguisher and shower in the lab