

Chapter 13 — Laboratory and Practical Skills

2. Questions for Short Answers**1. Name some corrosive chemicals.**

Ans: Corrosive chemicals are those which attack living tissues when they come in contact with them. They may be solids, liquids or gases, and they attack the skin, the eyes, the respiratory tract and the intestine as well. Examples of corrosive chemicals are the mineral acids including hydrofluoric acid (HF), the caustic alkalies such as sodium hydroxide and potassium hydroxide, and glacial acetic acid.

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

Ans: Explosive chemicals cause a sudden release of pressure, gas and heat when they experience a sudden shock, so the following precautions are adopted: obtain prior approval from your teacher before using such a chemical; always use the smallest quantity of the chemical; always conduct the experiment in a fume hood; remove all other chemicals and apparatus from around you; inform the other people working with you; always wear safety spectacles, gloves and a lab. coat; keep flammable compounds away from any heat source; pour flammable liquids very carefully; dispose off any hazardous waste properly; and do not store flammable liquids in a refrigerator. In addition, if you ever come across a chemical that you suspect may explode, do not attempt to move the container, so that it is not given a shock.

3. What type of damages can reactive chemicals cause?

Ans: The reactivity of chemicals is vital for the production of many other chemicals, pharmaceuticals and food products which are in our daily use. But when chemical reactions are not properly performed, reactive chemicals may cause fires and explosions, as they may evolve dangerous gases. These results may lead to an extreme damage to life and property. Examples of reactive chemicals are calcium hydride, sodium, lithium, azides, picric acid, aluminium chloride (AlCl_3) and benzoyl peroxide.

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

Ans: Two of the safety instructions given for radiation hazards are: (1) keep radioactive sources shielded, that is store the radioactive material at a safe, shielded place; and (2) avoid prolonged exposure to the radiation. Other instructions given in the chapter are: stay inside, as walls and ceilings protect you from radiation fall out; never operate equipment that produces radiation without sufficient training; wear protective clothing and a face mask; avoid contact of the material with bare skin; and monitor exposure to radiation using badges.

5. Which chemicals can cause suffocation?

Ans: The chemicals which can cause suffocation are called asphyxiants. They are gases or vapours which cause unconsciousness or death through suffocation by lowering the level of oxygen in the air. Examples of chemical asphyxiants are hydrogen cyanide, carbon monoxide, nitrogen, argon, helium, methane and carbon dioxide. A sufficient level of oxygen is essential for normal breathing; if this level falls, the exposed person gets no warning and cannot realize that the oxygen level has become low, and he feels rapid breathing, rapid heart rate, nausea and convulsions.

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

Ans: A chemistry laboratory is a strict area where rigorous rules must be practised 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 equipment and specified areas for specific tasks, so proper warning signs ought to be posted on these areas to ensure that every person entering there must understand the hazard and act accordingly to maintain laboratory safety. Similarly, signs are posted on the bottles containing hazardous chemicals so that the person knows the hazardous nature of the chemical before using it and observes the specific precautions required by that sign. If you see such signs, you must be alert and take extra care to maintain safety in that area.

7. How should fire caused by chemicals be handled?

Ans: In case of a fire caused by chemicals the student should not panic. He should stay calm, alert the people in the area to evacuate, and close the doors of the room to confine the fire so that it cannot spread. The fire is then brought under control with the help of a portable fire extinguisher, and for this purpose every student must know the location of the fire extinguisher in the lab. and must have been trained how to handle and apply it. The safety shower provided in the lab. is used if a person

is affected. The emergency staff must be informed and assisted, and for a chemical emergency the safety procedures given in article 13.1 for that particular class of chemical are adopted.

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

Ans: 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. For this purpose, periodic drills should be held with compulsory participation. Students should not only be given lectures but should be involved practically to handle the emergency situations, because knowing a procedure in theory is not the same as being able to carry it out under pressure without panic. A second reason is that during a drill the firefighting and other emergency equipments are checked whether they are in proper working order or not, so that they are reliable when a real emergency occurs. In this way these drills make facing any emergency situation, such as a fire, much easier.

3. Constructed Response Questions

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

Ans: First of all, I will stay calm and will not panic, and I will alert the people in the area to evacuate. Since the fire is due to short circuiting, the electricity supply of the lab. should be switched off at the main switch, and the doors of the room should be closed to confine the fire so that it does not spread. I will then use the portable fire extinguisher placed in the lab. to put down the fire, as I have been trained during the drills how to handle and apply it. If a person has been affected, the emergency shower provided in the lab. is used. Finally, I will call the emergency staff and assist them. Note: the chapter gives the general emergency procedure; the step of switching off the main supply follows from the fact that the fire is electrical.

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

Ans: A fume cupboard (fume hood) is used for every reaction in which a harmful vapour or gas may be released or which may run out of control. According to the chapter: (1) all experiments involving flammable and explosive chemicals must always be conducted in a fume hood; (2) corrosive chemicals must be used in a fume cupboard to avoid breathing the corrosive vapours; and (3) work with toxic chemicals must always be done in a fume hood because toxic vapours can be formed during the experiment. In short, reactions producing flammable, explosive, corrosive or toxic vapours are carried out in a fume cupboard.

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

Ans: Two suggestions are: (1) the personal protective equipment — lab. coat, protective glasses, face shield, apron, boots and hearing protection — should be made available to every student and should be made mandatory before entering the lab., because this equipment reduces exposure to hazardous chemicals and is the first line of defence in an emergency; and (2) periodic emergency drills with compulsory participation should be held, with a training session on the location and handling of the fire extinguisher and the emergency shower, so that every student can face an emergency without panic and the equipment itself is checked for proper working order. Further suggestions from the chapter are: proper warning signs and symbols should be posted on hazardous areas and on chemical bottles; students should not work alone and experiments should be performed in the presence of the lab. instructor; all equipment should be checked before use; and hazardous waste should be disposed off properly, with acids and bases first neutralized before sewer disposal.

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

Ans: Yes. In Fig (13.1) the radiation sign is the yellow sign carrying the trefoil symbol — three black blades arranged around a central circle — with the words RADIATION HAZARD written on it. The asphyxiant sign is the yellow triangular sign with a black border showing a person collapsed under a cloud of escaping gas, with the words "Danger — Risk of asphyxiation" written under it. Both are warning signs, so both use the yellow background with a black symbol, and both tell the person entering that area to be alert and take extra care to maintain safety there.

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

Ans: Chemicals that cause a sudden release of pressure, gas and heat when they experience a sudden shock are called explosive chemicals; picric acid, 2,4-dinitrophenyl hydrazine, benzoyl peroxide and nitrocellulose are examples. Such chemicals store a large amount of chemical energy in unstable bonds, and they need only a small amount of energy to start decomposing. A sudden shock supplies that energy, so the decomposition starts at one point and spreads instantly through the whole sample, releasing gas and heat far faster than they can escape, and the sudden rise of pressure bursts the container — an explosion. This is why the chapter instructs that if you ever come across a chemical that you suspect to explode, you must not attempt to move the container, so that it is not given a shock. Note: the textbook itself states only that these chemicals explode on sudden shock; the reason given above explains that statement and is not written in the chapter.