BATNA2 University
Faculty of Natural and Life Sciences (L1)
Academic year 2023-2024

PW 1: Safety, chemistry equipment and preparation of solutions

❖ Objectives

At the end of this practical work, the student will be able to:

- **Recognize** the safety instructions to follow in a chemistry laboratory.
- **Identify** the risks of chemical products.
- **List** the different glassware and their uses.
- **Prepare** solutions from solids or liquids.

I- Safety and equipment in chemistry laboratory

I-1- Safety instructions to follow in Chemistry practical work

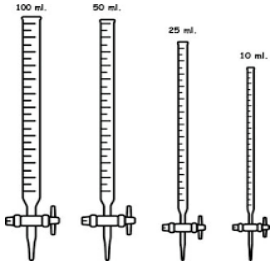
- wear your personal safety equipment (protective glasses/goggles, lab coats, gloves etc.) correctly and keep it in shape.
- Tie your hair if it is long.
- Leave the passages free.
- Work in a stable position.
-Use clean and functional lab material
-Wash your hands before and after manipulations.
-Using mobile phones is strictly forbidden.
-Eating and drinking is not allowed in the laboratory.
-Use proper storage containers closed and labelled with their contents.
- Respect the safety instructions given by the teacher **for all practical work**.

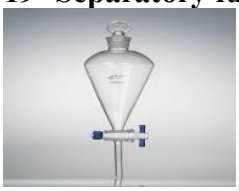
I-2- Pictograms (risks of chemicals)

Symbol	Pictogram Name	General Meaning
	**Explosive**	These chemicals can explode.
	**Flammable**	These chemicals burn or can release gases that burn.
	**Oxidizing**	These chemicals give off oxygen and can make a fire spread.

	**Corrosive**	These chemicals cause permanent damage to skin or eyes. These chemicals destroy metals.
	**Acute toxicity or toxic**	These chemicals are poisons that quickly cause sickness or death. A toxin may attack one or more parts of the body, such as the liver, kidneys, nerves, lungs, skin, eyes, or bone.
	**Hazardous to the environment**	These chemicals are dangerous if they get into rivers, lakes or oceans
	**Health hazard/Hazardous to the ozone layer**	These chemicals cause health problems. Usually less toxic than Acute toxicity pictogram. This pictogram is also used for chemicals that can destroy the ozone layer.
	**Serious health hazard**	These chemicals cause serious health problems. Some problems show up immediately, but some may show up much later.

I-3- Laboratory equipment's

1-Test tube 	**2- Test tube holder** 	**3- Test tube stand** 	**4- Beaker** 
5- Erlenmeyer flask 	**6- Volumetric flask** 	**7- Graduated cylinder** 	**8- Graduated pipette** 
9- Burette 	**10- Burette clamp** 	**11- Funnel** 	**12- Petri dish** 

13- Glass rod 	**14- Wash Bottle** 	**15- Spatula** 	**16-Round-bottom flasks** 
17- Glass Condenser 	**18- Filter paper** 	**19- Separatory funnel** 	**20- Watch glass**
21- Mortar and pestle 	**22-Analytical balance** 	**23- Magnetic Stirrer** 	**24- Pipet bulbs** 

25-A rotary evaporator (Rotavap) 

1- **A test tube**, is a common piece of laboratory glassware consisting of glass or clear plastic tubing, open at the top and closed at the bottom, used for chemical test.
2- **A test tube holder** is used to hold hot test tubes.
3- **Test tube stand** is used to hold several test tubes together.
4- **Beakers** are used as containers. They are available in a variety of sizes.
5- **Erlenmeyer flasks** are often used in chemistry reactions, particularly in titrations. As with beakers, the volume markings should not be considered accurate.
6- **Volumetric flasks** are used to measure and store solutions with a high degree of accuracy. These flasks generally possess a marking near the top that indicates the level at which the volume of the liquid is equal to the volume written on the flask. These devices are often used when solutions containing dissolved solids of known concentration are needed.
7- **Graduated cylinders** are used to measure and transfer liquids with a moderate degree of accuracy.
8- **A graduated pipette**, it is used for accurately measure and transfer a volume of liquid from one container to another.
9- **Burettes** are devices used typically in analytical, quantitative chemistry applications for measuring liquid solution. Burettes are used heavily in titration experiments.

10- **Burette clamp** is scientific equipment which used specifically to hold and secure a burette on a stand to be more convenient for the experiment.

11- **The funnel** is a tube that is wide at the top and narrow at the bottom. It is used to direct liquid or powder into a small opening. It can be used for filtration by adding filter paper.

12- **A petri dish** is a small dish shaped like a cylinder, used for cultivating microorganisms.

13- **A glass rod** is a piece of laboratory equipment used to mix chemicals and liquids for laboratory purposes. They are usually made of solid glass, thick and long, with rounded ends.

14- **A wash bottle** is a squeeze bottle with a nozzle, used to rinse various pieces of laboratory glassware, such as test tubes and round bottom flasks. Wash bottles are sealed with a screw-top lid.

15- **Laboratory spatula** made of stainless steel, used for measuring solids, moving objects and scraping materials from beaker

16- **Round-bottom flasks** (also called round-bottomed flasks or RB flasks) are types of flasks having spherical bottoms used as laboratory glassware, mostly for chemical or biochemical work.

17- **Condenser** is a glass device used for condensation (changing the physical state of a substance from its gaseous state to its liquid state). In chemistry laboratory, condensers are used in the extraction of essential oils

18- **Filter paper** is a semi-permeable paper used in science labs to remove solids from liquids.

19- **A separation funnel** is a piece of laboratory glassware used in liquid-liquid extractions to separate (partition) the components of a mixture into 2 immiscible solvent phases of different densities.

20- **A watch glass** is a circular concave piece of glass used in chemistry to hold solids while being weighed and as a cover for a beaker.

21- **Mortar and pestle** are used since ancient times to prepare ingredients or substances by crushing them into a fine paste or powder in the laboratory

22- **Analytical balance** is a highly sensitive laboratory instrument used in chemical analysis to measure the mass of chemicals and objects accurately and precisely up to 0.0001 grams.

23- **A magnetic stirrer** or a **magnetic mixer** is a laboratory device that employs a rotating magnetic field to cause a stir bar immersed in a liquid to spin very quickly, thus stirring it. It is used in chemistry and biology as a convenient way to stir small volumes of solutions.

24- **Pipet bulbs** or rubber bulbs, are used in chemistry laboratories, by placing them on top of a pipette. It serves as a vacuum source for filling reagents.

25- **A rotary evaporator** (sometimes abbreviated to rotavap) is a piece of equipment primarily used to remove solvent from a sample through "evaporation under reduced pressure". The presence of reduced pressure in the apparatus causes the solvent to boil at a lower temperature than normal.

II- Preparing solutions (Theoretical part)

Principle: Preparation of solution from solid and liquid.

II-1- Definition of a solution: A solution is a homogeneous mixture of one or more **solutes** dissolved in a **solvent**. Many different kinds of solutions exist. For example, a solute and solvent can be a gas, a liquid or a solid.

solvent: the substance in which a solute dissolve to produce a homogeneous mixture (is presented in the greatest amount).

solute: the substance that dissolves in a solvent to produce a homogeneous mixture

II-2- Concentration of a species in solution

A- Molar concentration (Molarity) C or C_M

The molar concentration of a chemical species in solution is the amount of solute material present per liter of solution. It is expressed in mol/L. **C = n (solute) / V (solution).** (n in **mol** and V in **L**)

The Number of moles **n** is expressed in **moles**: **n = m / M**. (**m** is the mass in **g**, **M** is the molar mass in **g/mol**

B- The mass concentration Cm

The mass concentration of a chemical species in solution is the mass of solute present per liter of solution. It is expressed in **g/L**. **Cm= m (solute)/V(solution). (m** in **g** and **V** in **L).**

C- Normality N

Normality (or normal concentration) indicates the relationship between the number of gram equivalents **'ne'** of solute and the volume of the solution. There is a relationship between normality and molar concentration:

N= x × C (x is the number of **equivalents).**

D- The mass percentage (mass%)

$\%_{mass} = m_A / m_{total} \times 100$. ($m_A$: mass of constituent A)

E- The relative density d

The relative density of a body is the ratio of its density to the density of a body taken as a reference. For liquids and solids, the reference body is pure water. $d = \rho_{body} / \rho_{water}$

F- The density ρ

whose symbol is ρ (rho), the density is defined mathematically as mass divided by volume.

$\rho = m/V$ (g/ıɲL ou g/cm^3).

II-3- The preparation of solutions by dissolution and dilution.

A- Dissolution: Is the physicochemical process by which a solute is dissolved in a solvent to form a homogeneous mixture called solution. Formally, dissolution is defined as the mixture of two phases with formation of a new homogeneous phase.

B- Dilution: consists of taking a determined volume of an initial solution (**concentrated solution**) and adding a determined volume of distilled water to obtain a final solution of lower concentration (**diluted solution**).

To determine the initial or final volume or concentration of solutions, the following relationship can be used:

$$C_{\text{concentrated solution}} \times V_{\text{concentrated solution}} = C_{\text{diluted solution}} \times V_{\text{diluted solution}}$$

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III- Preparing solutions (Experimental part)

III-1- Dissolution of a chemical species

Material	Products
- Analytical balance, Watch glass, Funnel, Volumetric flask 250ml , Wash Bottle	- NaCl - H_2O

➢ Experimental protocol

-From solid NaCl, prepare with precision, a volume $V_1 = 250$ mL of an aqueous solution of NaCl with molar concentration $C_1 = 4 \times 10^{-2}$ mol./L

- First, calculate the molar mass of NaCl which is the mass of a mole of Na plus the mass of a mole of Cl ($M_{Na}+M_{Cl} = 23 + 35.5 = 58.5$ g/mol) and calculate the mass of NaCl ($n = m_{NaCl} / M_{NaCl}$).

-Weigh out 0.5 g NaCl.

- Place the NaCl in a 250 ml volumetric flask.

- Add a small volume of distilled water to dissolve the salt.

- Fill the flask to the 250 ml line.

- Label the prepared solution.

III-2- Dilution of a concentrated solution

Material	Products
- Volumetric flask 500ml, Wash Bottle, Graduated pipette, pipet-bulbs, Beaker	- Concentrate solution of NaCl - H_2O

➢ Experimental protocol

- From the aqueous NaCl solution with molar concentration $C_1 = 4 \times 10^{-2}$ mol/L, prepare with precision, a volume $V_2 = 500$ mL of an aqueous solution of NaCl with molar concentration $C_2 = 4 \times 10^{-4}$ mol/L

- First, calculate the volume V_1 must be taken from the concentrated solution using the relationship

$$C_1 \times V_1 = C_2 \times V_2$$

- Rinse the beaker with the concentrated solution (NaCl solution).

- Introduce a quantity of NaCl solution into the beaker.

- Using a suitable graduated pipette equipped with a pipet-bulbs, take a volume V_1 of NaCl solution

- Introduce the volume taken into the walls of the volumetric flask.

-Add distillated water using the wash bottle and shake (circular movements).

- Adjust the volume to the mark of the volumetric flask to obtain the V_2 (500ml).

- Label the prepared solution.

❖ Report

The report must contain:

-A cover page according to the model below.

- A detailed response to the questions at the end of the Practical Work session.

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Batna-2 University

Faculty of Natural and Live Sciences

PW on General and Organic Chemistry

Report N=…….

Title:……..

Objectives:

Presented by:

Full name

Group: ……

Directed by:

……..

Note:…… /17

Year 2023-2024