CBC

SYLLABUS–ALIGNED CHEMISTRY

FIRST EDITION
SEPTEMBER 2024

SENIOR 1 & 2

THEME: INTRODUCTION TO CHEMISTRY AND EXPERIMENTAL TECHNIQUES.

TOPIC 1.2: EXPERIMENTAL CHEMISTRY.

SENIOR: 1. **TERM**: 1. **PERIODS**: 12.

COMPETENCY: The learner understands that chemistry is a process of evidence based enquiry involving the collection of evidence about the natural world, the identification of trends and patterns in the evidence and the development of theories that help us explain the evidence.

LEARNING OUTCOMES AND SUGGESTED LEARNING ACTIVITIES

For 5 Learning Outcomes A – F, the learner should be able to:

A **Know laboratory rules and regulations and understand the importance of risk assessment in order to work safely. Know action required in the event of an accident (k)**

- *Research to:*
  - *Examine a list of laboratory rules showing the reasons for each rule;*
  - *Demonstrate ways how to deal with a fire in the laboratory (fire guidelines)*
  - *Demonstrate how a fire extinguisher is used, and produce a set of guidelines of its use.*

INTRODUCTION

Long ago, ancient scientists used few available tools to try their investigations including turning a metal into gold. They wanted to find a way to live forever. They used guesses and ideas to help them discover more new things. Therefore, without experimental chemistry, countless technologies, materials, and innovations that shape our daily lives would have not existed.

Experimental Chemistry refers to a scientific discipline that involves the systematic design, implementation, and analysis of experiments to investigate chemical occurrences, develop new substances and materials, and optimize chemical processes. The term "experimental" originates from the Latin "experiri," meaning "to try" or "to test," and refers to the process of testing hypotheses and theories through hands-on trials and observations.

LABORATORY RULES

Imagine yourself standing on a single highway busy road, waiting to cross. You must look both sides for safety crossing. However, incase you disobey traffic signals and rules; you might be hit by a vehicle.

In comparison therefore, **laboratory rules** refer to a set of guidelines, protocols, and regulations that govern behavior and practices within a scientific laboratory setting to ensure a safe, efficient, and productive working environment. Laboratory rules include:

- Wear appropriate attire such as closed-toe shoes, lab coats, gloves, and safety goggles or glasses for protection from potential hazards.
- Tie back long hair and secure loose jewelry because they can get caught in equipments or catch fire, causing accidents.
- No eating or drinking to prevent ingesting harmful chemicals.
- Handle equipment with care such as burettes, pipettes which are often delicate and expensive so as to prevent breakage.
- Follow instructions and procedures from your facilitator before doing anything in the laboratory so as to ensure safety.
- Properly dispose wastes such as chemicals, substances, broken glassware and other materials in the expected dust bin to ensure a clean and organised lab.
- Work in designated well-ventilated area to prevent overcrowding and reduce the risk of accidents.
- Clean up after experiments to maintain a clean and organized lab.

LABORATORY FIRE GUIDELINES

Laboratory fire guidelines means a set of rules designed to prevent and extinguish fires in laboratory settings. Laboratories often involve hazardous materials, equipment, and experiments, which can cause the risk of fires. *Fire in a laboratory can be caused by;* explosions of flammable materials, electrical malfunctions and improper storage of chemicals.

PROPER PROCEDURES FOLLOWED WHEN FIRE OCCURS IN A LABORATORY.

- Sound the alarm, either by starting the fire alarm or alerting orally.
- Quickly identify the source of the fire such as a chemical spill or an electrical malfunction to determine the best course of action to take next.
- Shut off gas and electricity supplies to prevent fueling the fire. Use a fire extinguisher with PASS method to extinguish the fire.
- Immediately evacuate the lab and ensure that all learners are accounted for and move to a designated safe area.

GUIDELINES OF USING FIRE EXTINGUISHER:

Following the PASS method, the guidelines required include the following:

P – Pull the safety pin/ring to release the lock. (Make sure you have the right type of extinguisher for the fire class.)

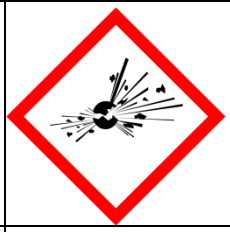
A – Aim the nozzle at the base of the fire while keeping the extinguisher between you and the fire.

S – Squeeze the handle to release the extinguishing agent. Use short, sweeping motions to cover the entire area.

S – Sweep the nozzle back and forth to the entire area of the fire. Continue sweeping until the fire is no longer burning.

PHYSICAL MATERIAL HAZARD SYMBOLS IN THE LABORATORY

Physical material hazard symbols in the laboratory are graphical representations that show and identify potential dangers associated with chemicals and other materials. *They play a crucial role in risk assessment by providing a visual warning that identifies potential risks.* Some common symbols used in chemistry laboratories include;

NAME OF SYMBOL AND INDICATION	SYMBOL	NAME OF SYMBOL AND INDICATION	SYMBOL
Explosive material. *(Presence of explosive or highly reactive substance)*		**Corrosive substance.** (*Indicates substances that can cause burns or damage to skin and eyes)*	
Flammable material. *(Presence of combustible material that can catch fire easily e.g. fuel)*		**Toxic substance.** (*Indicates materials that can be harmful if ingested, inhaled, or absorbed through the skin.)*	
Glassware hazard. *(Presence of broken glasses)*		**No open flame.** *(Do not use an open flame in this area.)*	

THE IMPORTANCE OF RISK ASSESSMENT

Risk assessment refers to the process of assigning a level of risk or priority to a specific hazard or bad situation, based on its likelihood and potential impact. *Risk assessment is essential in laboratories because it helps:*

- To identify potential hazards and take preventive measures to mitigate.
- To priotise the most critical risks and allocate resources accordingly.
- To reduce the likelihood of accidents and injuries.
- To enhance safety culture by advising everyone to take ownership of safety.

B Know and use laboratory equipment (such as burettes, pipettes, measuring cylinders, thermometers, the Bunsen burner, and balance) appropriately for measuring time, temperature, mass, and volume (s, k)

• *Plan and carry out an investigation using measuring cylinders, separating funnel, a thermometer, Bunsen burner and balance to mix 5g of sand and 200 cm^3 water, separating them and recording detailed observations and measurements. You should:*

- *Plan by selecting techniques, apparatus and materials.*
- *Make predictions based on prior knowledge and propose a hypothesis.*
- *Record observations and measurements in a table.*
- *Interpret observations and report results.*
- *Compare observations and results with other groups.*
- *Discuss and develop explanations.*

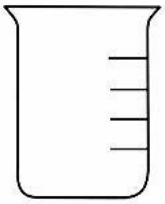
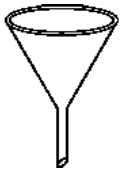
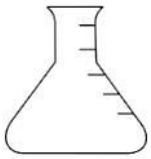
LABORATORY EQUIPMENT

Laboratory equipment refers to the various tools, instruments and apparatus used in scientific laboratories to conduct experiments. These equipments are designed to help learners or facilitators to collect data and perform various procedures with accuracy, precision and safety.

Examples of chemistry laboratory equipment include:

KNOWING THE EQUIPMENT		HOW TO USE THE EQUIPMENT
BURETTE 	-Is a long, graduated tube with a stopcock at the bottom, used in titration experiments to determine the volume of a solution required. - Available in various sizes such as 50 mL.	-The burette is tied to a retort stand and filled with a liquid via a filter funnel. -The liquid is adjusted to the zero mark. *(Not a mandatory)* -The stopcock is opened to allow the liquid flow into a container. -The volume is read from the graduated markings via a lower meniscus and the results are recorded to 2 decimal places such as 23.50 mL and 3.00 mL.

PIPETTE 	- Consists of a bulb and a tip, and is used to measure and transfer a specific volume of a liquid. - Available in various sizes, such as 10 mL, 20 mL, and 25 mL.	- A pipette is filled by sucking up the liquid into the bulb upto the marked ring using a mouth or a sucker. - The liquid is then released into a container and the results are recorded to one decimal place such as 25.0mL.
MEASURING CYLINDER 	- Is a graduated glass or plastic, used to measure the volume of a liquid for dilution or mixing. - Available in various sizes, such as (10, 25, 50, 100)mL.	- The liquid is poured into the cylinder. - The volume is read from the markings via a lower meniscus. - The results are recorded to one decimal place such as 25.5 mL and 15.0mL.
THERMOMETER 	- Consists of a bulb and a scale and used to measure temperature in degrees Celsius. - Glass type is mostly used in school chemistry labs.	-The thermometer is fully placed in a solution, making sure the bulb is not attached to the container. -The temperature is read from the scale and recorded to 1 decimal place e.g. 37.5°C and 40.0 °C
BUNSEN BURNER 	- Used for heating solutions or solids. -Consists of a gas supply, a burner, and a flame.	- The burner is lit, and the flame is adjusted to the desired intensity. - There is no numerical record for a Bunsen burner, as it is used for heating purposes only.
BALANCE i)  ii) 	- Consists of a pan and a scale and used to measure the mass of a solid.	- For the digital balance **i)**, the substance is placed on a pan, and the mass is read from the scale and recorded to two decimal places such as (5.23, 6.07, and 12.00) g - For triple beam balance **ii)**, The three riders are adjusted to the total mass of a substance required to be equalised on the pan, mass is recorded to 1 decimal place such as (23.1 and 30.0)g.
ANALOG STOP CLOCK 	-Stopped and started to measure elapsed time. - Consists of a clock face with hour and minute hands, a mechanism to stop and start the clock.	- Set the clock to the desired starting time i.e. 60^{th} point - Start the clock by turning down the starting short handle. - Wait for the clock to count up the desired time e.g. (20.6, 30.9 and 40.0) seconds. - Stop the clock by turning up the starting short handle again. - To reset the clock back to 60^{th} point, turn down the resetting long-curved handle found opposite the starting/stopping short handle.

STOPWATCH 	-Is a handheld timekeeping device used to measure elapsed time with high precision. - Consists of a start/stop button to initiate and halt time measurement, a reset button to return to zero, a display showing minutes, seconds, and hundredths of a second.	- Press the reset button to set the stopwatch to zero (00:00:00). - Press the start button to begin counting up time. - Stop timing by pressing the start button again. Record the time e.g. (20.49, 12.00)s. - Reset the stopwatch by pressing the reset button again. -Where necessary, convert the minutes to seconds.
BEAKER 	- Is a cylindrical, transparent glass or plastic container with a flat bottom and straight sides, used for holding, measuring, mixing, and heating liquids. - Available in various sizes such as 50mL, 100mL.	- Pour a liquid into the beaker. - Either measure the volume, mix with another substance or heat the liquid.
RETORT STAND 	-Is metallic stand with a clamp or holder, used to support and hold laboratory equipment such as burettes, flasks, and test tubes at a desired height.	- Place the equipment into the clamp. - Adjust the stand to a comfortable working height. - Has no numerical values.
FILTER FUNNEL 	- Is a conical-shaped funnel with a stem and a flared mouth, used to guide liquids (sometimes through filter paper) into a given container.	- Place a cone-folded filter paper to the funnel. (Only if used for separations) - Place the funnel in a receiving container. - Pour the liquid into the receiving container via a filter funnel.
CONICAL FLASK 	- Has a conical shape, narrow neck, and flat bottom. - Used for mixing during titrations, heating, and storing chemicals.	- Pour liquids into the flask, or use a pipette to measure and add liquids. - Then, either mix with other liquids or solids, heat with a burner or store in a safe place.
FILTER PAPER 	Is a porous, absorbent paper used for filtering liquids to separate solid particles available in various sizes.	- Cone-fold the filter paper and place in a filter funnel. - Pour the mixture to be filtered onto the paper - Allow the liquid to pass through the paper, leaving the solids behind.
- **Others equipments** include the test tubes, stirrers, spatula, tripod stand, volumetric flasks, syringes, droppers, evaporating dish etc.		

NB: *More emphasis should be put on visual knowing of the equipment and how to practically use them. Drawings may not be necessary.*