E.G'.Murodova

ENGLISH FOR CHEMISTRY STUDENTS

TOSHKENT VILOYATI CHIRCHIQ DAVLAT PEDAGOGIKA UNIVERSITETI

FAKULTETLARARO CHET TILLAR KAFEDRASI

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O'quv uslubiy qo'llanma kimyo yo'nalishi talabalari uchun mo'ljallangan. Ushbu o'quv qo'llanma talabalarga inliz tilini o'z yo'nalishi bilan uyg'unlikda o'rganish uchun yordam beradi. O'quv uslubiy qo'llanma talabalarni nafaqat mashg'ulotlar davomida foydalanishlari uchun balki, ingliz tilini mustaqil o'rganishlarida ham foydalidir.

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Uslubiy qo'llanma tuzilishi 18ta mavzudan iborat. Har bir mavzu talabalarga mavzu haqida umumiy ma'lumot beruvchi ingliz tilidagi ma'lumot, mavzuga aloqador lug'atlar ro'yxati va o'rganilgan ma'lumotlarni takrorlash va mustahkamlash uchun topshiriq va testlardan iborat.

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Introduction

The study of chemistry allows us to understand the natural world, leading to numerous advances in human knowledge and technology. As a result chemistry has become an integral part of our everyday lives, shaping the world we live in and the products that we consume. The ability to communicate effectively is paramount for those who study and work in the field of chemistry. It is essential for chemistry students and professionals to develop English language skills to read scientific literature, write reports, and communicate with their peers in the English speaking world.

This book is designed to provide a comprehensive and accessible guide for chemistry students who seek to improve their English language skills in the context of their chosen field. This structure allows readers to focus on the specific topics that are most relevant to their needs with specific sections for grammar, vocabulary, and pronunciation. It introduces the basic English language skills necessary for studying chemistry and familiarizes readers with scientific vocabulary. As learners move through topics they will explore a variety of chemistry spheres with useful vocabulary its definition and fortifying exercises. The textbook also includes some specialized areas of chemistry such as nuclear chemistry, organic chemistry, polymer chemistry, surface chemistry and forensic chemistry. These chapters provide the diverse applications of chemistry in various industries and fields of research, highlighting the importance of effective communication in English for chemistry professionals All subjects are essential for a well-rounded understanding of chemistry and the textbooks focus on English language ensures that readers can confidently discuss and explain these concepts in professional setting.

It is our hope that this book will serve as a valuable resource for students, educators, professionals providing the tools and proper knowledge necessary for success in the

field of chemistry. As you embark on your journey through the pages of this book you can find useful materials to consolidate your gained knowledge. Not only learners but also teachers of English or chemistry subjects may find it useful while conducting classes with the students who are in this field. The book provides different activities which can be used during lessons in the purpose of making the group more active and interested. The valuable tasks with reliable information support the development of English language skills throughout the course. This book will inspire each reader to continually change themselves, expand their knowledge, and refine their English language skills in the context of chemistry.

In conclusion manual aims to support you with a comprehensive and engaging resource to provide your journey towards mastery of English language within the field of chemistry. It also features supplementary materials that will further enhance your learning experience which include self assessment quizzes, additional exercises, matching tasks all of which are aimed to consolidate your knowledge.

In closing, we would like to express our gratitude to many educators, researchers, and professionals who have contributed their expertise and insights to the development of the book by their materials related to our chosen issue.

Theme 1. Introduction to English for chemists

- Aims of the lesson : to introduce students to each other and the subject
- To make students aware of the objectives and aims of the subject
- To teach learners using new vocabulary about getting introduced like question words and introductory terms

Activity 1. Welcoming guests. Teacher will divide the class into 2 groups and ask them to introduce themselves by mentioning an interesting fact about themselves. Students will be divided list of essential words for introducing themselves and save it for future applications.

Essential Words for Making a Good First Impression in English

Knowing the appropriate words to use while introducing yourself is crucial, especially if you are not a native English speaker or are just beginning to learn English. Making a good first impression and establishing rapport both require a firm grasp of the English language.

You can **introduce yourself in English** using the terms below.

-One of the most crucial parts of any self-introduction is the giver's name. Just introduce yourself by saying, "*Hi, my name is [your name].*"

-A person's occupation is indicated with the phrase "*I work as*" followed by the person's specific job title.

-When asked where you're from, the standard response is "*I'm from [your country/city].*"

-Interests: "*In my free time, I like to [your hobby/activity],*" when describing something you enjoy doing.

-You can talk about your relatives by saying something like, "*I have [number] [siblings/parents/children].*"

-You can talk about your academic credentials by saying something like, "*I have a [degree/diploma in],*" which is shorthand for "*I have a [degree/diploma in] in [area of study].*"

-You can say, "*I speak [language/s],*" to specify the languages you know.

Use these words to introduce yourself in English with confidence and make a fantastic first impression. **Don't forget** to exude assurance and friendliness when interacting with others. To sum up, it's not necessary to struggle through an awkward introduction in English. You can boldly introduce yourself to new people and begin forming connections if you have the appropriate words and a welcoming demeanor.

Activity 2. Guess who is it. Teacher will distribute handouts with pictures of different people to subgroups of the class and instruct them that 1 group will introduce a picture and other shoul find who is it. Each answer will be evaluated and given feedback by teacher.

Activity 3. Asking questions. Initially, teacher will introduce question words to the class by a video and distribute list of them. Students will make a simple question using the words

and accomplish some other task like gap filling or matching

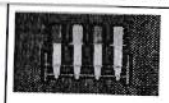
question word	function	example sentence
what	asking for information about something	What is your name?
	asking for repetition or confirmation	What? I can't hear you. You did what?
what...for	asking for a reason, asking why	What did you do that for?
when	asking about time	When did he leave?
where	asking in or at what place or position	Where do they live?
which	asking about choice	Which colour do you want?
who	asking what or which person or people (subject)	Who opened the door?
whom	asking what or which person or people (object)	Whom did you see?
whose	asking about ownership	Whose are these keys?
why	asking for reason, asking what...for	Why do you say that?
why don't	making a suggestion	Why don't I help you?
how	asking about manner	How does this work?
	asking about condition or quality	How was your exam?
how + adj/ adv	asking about extent or degree	see examples below
how far	distance	How far is Pattaya from Bangkok?
how long	length (time or space)	How long will it take?
how many	quantity (countable)	How many cars are there?
how much	quantity (uncountable)	How much money do you have?
how old	age	How old are you?
how come (informal)	asking for reason, asking why	How come I can't see her?

Theme 2 : Laboratory equipment and techniques

- Aims of the lesson : to introduce with the vocabulary of laboratory equipments.
- To make students aware of the usage and consolidate with some activities
- To teach learners modal verbs (should/ shouldn't) using laboratory rules

Activity 1. Introduction of the theme and new vocabulary. Teacher will give general information about laboratory and items which are used during any work and introduce new words with their definition (translate if needed). Students will be distributed names and definitions of new words, they should find their pair and explain their word or phrase to the class.

Common Laboratory Apparatus List

1		A **Pipette**	is a laboratory tool used for transferring small amounts of liquid. It consists of a narrow tube with a tapered tip and a bulb at the other end, which is used to draw up and dispense the liquid.
2		A **Test tube rack**	is a laboratory tool used to hold and organize test tubes during experiments. It can be made of plastic or metal and comes in various sizes to accommodate different numbers of test tubes.
3		A **test tube**	is a cylindrical glass or plastic tube used in laboratories to hold and mix small quantities of liquid. They are various sizes and used in experiments to observe chemical reactions or to store small amounts of liquid.

4		A **beaker**	is a cylindrical glass or plastic container used in laboratories to hold, mix, and heat liquids. It has a flat bottom and a spout for pouring, and often has graduations marked on the side for measuring the volume of the liquid inside.
5		An **alcohol burner**	is a laboratory tool used for heating and sterilizing materials. It consists of a metal or glass container filled with alcohol, with a wick or burner at the top that is ignited to produce a flame.
6		A **syringe**	is a medical instrument used for injecting medication or extracting fluids from the body.
7		A **graduated cylinder**	is a laboratory instrument used for measuring the volume of liquids. It has a narrow cylindrical shape with markings on the side to indicate volume.
8		A **dropper**	is a small tube with a rubber bulb used for dispensing small amounts of liquid.
9		**A Tape**	is a thin strip of material, such as plastic or paper, coated with a sticky substance on one side, used for attaching or binding objects together.
10		A **barometer**	is a scientific instrument used for measuring atmospheric pressure. It is commonly used in weather forecasting.

Activity 2. Fill in the gaps with the words in activity 1. Ask students to work in pairs and fill the gaps with the words.

1. The scientist used a_____ to add a few drops of the chemical to the solution.
2. The chemistry student carefully poured the liquid into the _____ and measured its precise volume.
3. The nurse filled the _____ with the flu vaccine and gently injected it into my arm.
4. The biologist used an _____ to sterilize the scalpel

before making an incision on the specimen, ensuring that no bacteria or other contaminants would affect the results of the experiment.

5. The scientist poured the solution into the ____, carefully measuring the volume using the graduations on the side before heating it on the Bunsen burner.

6. The scientist carefully added a few drops of the solution to the ____, observing the color change as the chemicals reacted with each other.

7. I used the ___ to wrap the gift and secure the wrapping paper in place.

8. The meteorologist used the____ to measure the air pressure and predict the upcoming weather conditions

9. She placed the test tube into the designated slot on the _____, ensuring that it was secure and wouldn't tip over during the experiment.

10. The scientist carefully used the _____ to transfer a precise amount of the solution into the test tube, ensuring accurate results for the experiment.

Activity 3. Write as more rules as you can in 5 minutes. First teacher will explain modal verbs should and shouldn't and give some examples in the form of rules of laboratory. Teacher ask students to work in groups and write as more rules as they can during given time. Students will write rules using explained modal verbs.

Possible examples or answers : Things to Do

1. You should inform the instructor if there is a problem.

2. You should know where to find the first aid kit, the chemical spill kit, the eye wash and the safety shower.

3. You should wash your hands before you leave the lab for the day.

1. You should not eat, drink, chew gum, smoke or apply

cosmetics in the lab

2. You shouldn't put pieces of lab equipment in your mouth. It sounds obvious but you'd be surprised!

3. You shouldn't work with chemicals until you are sure of their safe handling. This includes some awareness of their flammability, reactivity, toxicity, and disposal.

Theme 3: Elements, compounds and molecules

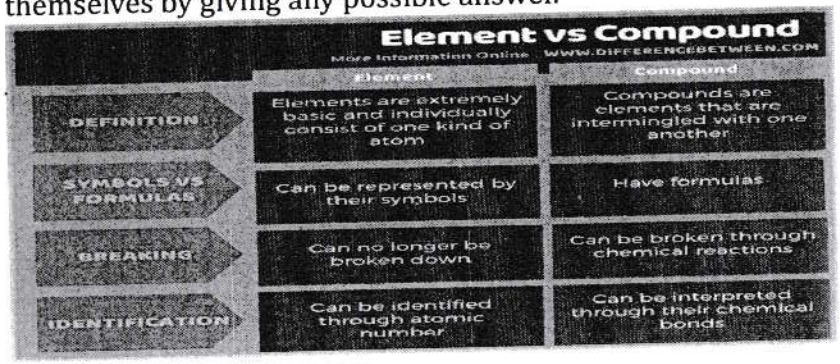
- Aims: to teach learners to differentiate elements, compounds and molecules
- To introduce some examples for chemical elements, molecules and compounds
- To enable students to make conditional sentences

Activity 1. Introduction of elements, molecule and compounds. Teacher will stick some pictures with the name of chemical elements, compounds and molecules. Then ask students to read them and guess the difference.

In order to give clear explanation teacher will use a video about differenciating 3 chemical terms above. Here is the link

Elements	Molecules	Compounds
e.g oxygen (O_2),	phosphorus (P_4),	magnesium oxide (MgO)

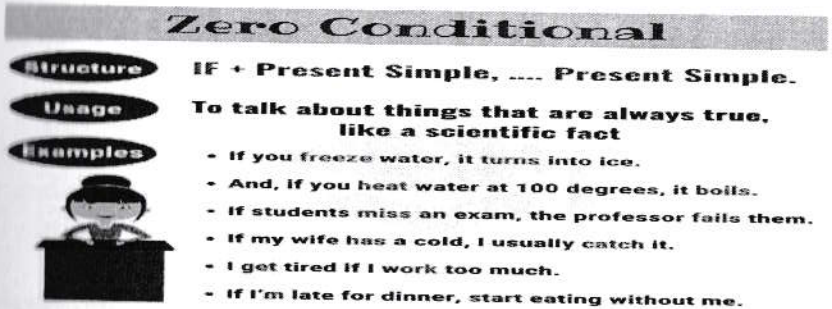
After presenting video teacher will give clear and short explanation of the whole video with some more visual aids and examples and answer the questions if asked. The best way is giving more and more examples and ask students to try themselves by giving any possible answer.



Activity 2. Identify the group. Teacher will divide the class into groups of 5 or 6 and distribute following worksheet them. Students will be given a group of words where elements, molecules and compounds are written in a mixed form they should divide words into 3 groups.

Hydrogen (H_2), oxygen (O_2), chlorine (Cl_2), ozon (O_3), sulfur (S_8), water (H_2O), Methane (CH_4), hydrogen (H), magnesium oxide (MgO), oxygen (O), carbon (C), hydrogen (H), **nitrogen** (N_2), Copper (Cu), sodium chloride (NaCl), fluorine (F_2), gold (Au), chlorine (Cl_2), phosphorus (P_4), carbon dioxide (CO_2), bromine (Br_2), iron (Fe), iodine (I_2).

Activity 3. Making compounds using conditional sentences. Teacher will give clear explanation of conditional sentences and introduce them with the fist type by giving understandable examples. Students will create some compounds from learned elements and write the formule with conditional sentences. Teacher will limit the time and require eliciting answers.



1. Possible answers: If we mix hydrogen and oxygen, we get water.

2. If sodium metal and chlorine gas mix under the right conditions, they will form salt

3. If demand for *oxygen* still exceeds supply once these adaptations have occurred, the fetus must further reduce its *oxygen* consumption.

4. If methane is a causal mechanism, the repetition of the negative *carbon* excursions could be accounted for by multiple releases of methane.

5. If sulphur reacts with oxygen, sulphur dioxide gas is produced.

6. If this sulphur dioxide gas combines with water, sulphurous acid is formed which is a weak acid.

Theme 4. Chemical reactions

- **Aims:** to present new vocabulary related to chemical reactions
- To make students acquainted with chemical reactions, their types and special terms
- To review and reinforce learned vocabulary with the help of multiple choice questions

Activity 1. In order to brainstorm teacher will ask some short questions from the class. Students will answer according to their background knowledge. Teacher may give some promts or keywords if needed for the purpose of activating the class.

1. What is chemical reactions?
2. How many types of reactions do you know?
3. What is the difference between a chemical reactions and a physical reactions ?
4. What is an oxidation reaction? Is it exothermic or endothermic?
5. Give one example of oxidation Reaction.

Activity 2. Students will be distributed cards in which there are some new words and their definitions about chemistry and chemical reactions and will give additional obvious definition and an example to those words. They will work in pairs. Others will make notes of words and definitions.

1. **Combination**- When two elements or one element and one compound or two compounds combines to give one single product.
2. **Decomposition**- Splitting of a compound into two or more simple products.
3. **Displacement**- It takes place when a more reactive metal displaces a less reactive metal.
4. **Double displacement**- Reactions in which ions are exchanged between two reactants forming new compounds

are called double displacement reactions.

5. **Precipitation**- The insoluble compound called precipitate forms in this reaction.

6. **Exothermic**- Reactions which produce energy are called exothermic reaction. Most of the decomposition reactions are exothermic.

7. **Endothermic**- Reactions which absorb energy are called endothermic reaction. Most of the combination reactions are endothermic.

8. **Oxidation**- Gain of oxygen or removal of hydrogen or metallic element from a compound is known as oxidation.

9. **Reduction**- Addition of hydrogen or removal of oxygen from a compound is called reduction.

10. **Redox**- A chemical reactions where oxidation and reduction both take place simultaneously are also known as redox reaction. Eg - $NaOH + HCl \Rightarrow NaCl + H_2O$

11. **Rusting**- When iron reacts with oxygen and moisture forms a red substance called rust.

12. **Rancidity**- Oils and fats when get oxidized on exposure to air show a change in taste and smell.

13. **Corrosion**- Metals when attacked by oxygen, water, acids, gases, present in air changes its surface which is called corrosion.

Activity 3. Multiple choice questions. Teacher will distribute multiple choice questions in the form of 2 versions. Students should finish the task in 10 minuts and changen papers in order to check each other. Teacher will elicit answers with the reasons. They will make discussions on indefinite questions.

Version 1

1. The chemical formula of lead sulphate is

(a) Pb_2SO_4

(b) $Pb(SO_4)_2$

(c) $PbSO_4$

(d) $Pb_2(SO_4)_3$

2. Which information is not conveyed by a balanced chemical equation?

(a) Physical states of reactants and products

(b) Symbols and formulae of all the substances involved in a particular reaction

(c) Number of atoms/molecules of the reactants and products formed

(d) Whether a particular reaction is actually feasible or not

3. Chemically rust is

(a) hydrated ferrous oxide

(b) only ferric oxide

(c) hydrated ferric oxide

(d) none of these

4. Both CO_2 and H_2 gases are

(a) heavier than air

(b) colourless

(c) acidic in nature

(d) soluble in water

5. Which of the following gases can be used for storage of fresh sampel of an oil for a long time?

(a) Carbon dioxide or oxygen

(b) Nitrogen or helium

(c) Helium or oxygen

(d) Nitrogen or oxygen

6. The electrolytic decomposition of water gives H_2 and O_2 in the ratio of

(a) 1 : 2 by volume

(b) 2 : 1 by volume

(c) 8 : 1 by mass

(d) 1 : 2 by mass

7. In the decomposition of lead (II) nitrate to give lead (II) oxide, nitrogen dioxide and oxygen gas, the coefficient of nitrogen dioxide (in the balanced equation) is

(a) 1
(b) 2
(c) 3
(d) 4

8. Fatty foods become rancid due to the process of

(a) oxidation
(b) corrosion
(c) reduction
(d) hydrogenation

9. We store silver chloride in a dark coloured bottle because it is

(a) a white solid
(b) undergoes redoc reaction
(c) to avoid action by sunlight
(d) none of the above

10. Silver article turns black when kept in the open for a few days due to formation of

(a) H_2S
(b) AgS
(c) $AgSO_4$
(d) Ag_2S

Version 2

1. When crystals of lead nitrate are heated strongly in a dry test tube

(a) crystals immediately melt
(b) a brown residue is left
(c) white fumes appear in the tube
(d) a yellow residue is left

2. Dilute hydrochloric acid is added to granulated zinc taken in a test tube. The following observations are

recorded. Point out the correct observation.

(a) The surface of metal becomes shining
(b) The reaction mixture turns milky
(c)Odour of a pungent smelling gas recorded
(d) A colourless and odourless gas is evolved

3. When carbon dioxide is passed through lime water,

(a) calcium hydroxide is formed
(b) white precipitate of CaO is formed
(c) lime water turns milky
(d) colour of lime water disappears.

4. When a magnesium ribbon is burnt in air, the ash formed is

(a) black
(b) white
(c) yellow
(d) pink

5. In which of the following, heat energy will be evolved?

(a) Electrolysis of water
(b) Dissolution of NH4Cl in water
(c) Burning of L.P.G.
(d)Decomposition of AgBr in sunlight

6. Rancidity can be prevented by

(a) adding antioxidants
(b) storing food away from light
(c) keeping food in refrigerator
(d) all of these

7. The reaction of H_2 gas with oxygen gas to form water is an example of

(a) combination reaction
(b) redox reaction
(c) exothermic reaction
(d) all of these reactions

8. The reaction in which two compound exchange their ions to form two new compounds is called

(a) displacement reaction
(b) combination reaction
(c) double displacement reaction
(d) redox reaction

9. On immersing an iron nail in $CuSO_4$ solution for few minutes, you will observe

(a) no reaction takes place
(b) the colour of solution fades away
(c)the surface of iron nails acquire black coating
(d) the colour of solution changes to green

10. An element X on exposure to moist air turns reddish-brown and a new compound Y is formed. The substance X and Y are

(a) X = Fe, Y = Fe_2O_3
(b) X = Ag, Y = Ag_2S
(c) X = Cu, Y = CuO
(d) X = Al, Y = Al_2O_3

Theme 5. Acids and bases

- **Aims :** to present new vocabulary related to acids and bases
- To make students acquainted with the difference between acids and bases, their types and special terms
- To review and reinforce learned vocabulary with the help of multiple choice questions

Activity 1. Presenting new theme with the video and general information about the topic

Teacher will show the video about acids and bases, and their difference. Then give more facts about items to make them obvious for class

Here is the links for videos: https://www.youtube.com/watch?v=mnbS56HQbaU

https://www.youtube.com/watch?v=FM2MpMbV0rw

More information about issues and differentiation:

Acids We are familiar with some acids – citrus fruits, tomatoes and vinegar are acidic and mostly taste sour. Because strong acids can damage cells, our stomach needs a special lining to protect it from the hydrochloric acid that helps to digest our food. Acids react with most metals including magnesium to create hydrogen gas and a salt – there are lots of different types of salts in chemistry. They also react with a group of substances called carbonates to produce carbon dioxide gas, salt and water.

Bases A corrosive substance is one that will damage or destroy other substances with which it comes into contact by means of a chemical reaction. Bases feel slippery to touch. This is because they can change the structure of proteins. A strong base can cause severe chemical burns because it starts to damage the proteins in your skin. Basic substances are used in many cleaning products.

An acid is a substance that produces hydrogen

(H^+) ions when it is added to water. A hydrogen ion is just the proton and no electron. If we look at the formulas of different acids, we can see that they all contain at least one H (hydrogen) – for example:

- HCl – hydrochloric acid
- H_2SO_4 – sulfuric acid
- HNO_3 – nitric acid.

When we put a molecule of acid into water, it breaks apart. The science term for this is that it dissociates. For example hydrochloric acid (HCl) dissociates into hydrogen ions (H^+) and chloride anions (Cl^-). **The chemical difference between acids and bases is that acids produce hydrogen ions and bases accept hydrogen ions.** A base is a substance that neutralises acids. When bases are added to water, they split to form hydroxide ions, written as OH^-. We call a base that has been added to water an alkaline solution. If we look at some formulas for bases, we can see that they all contain hydroxide (OH^-) ions – for example:

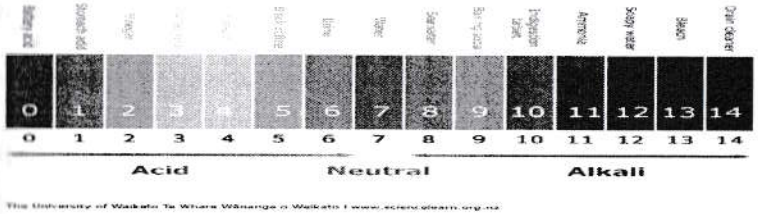
- NaOH – sodium hydroxide (caustic soda)
- NH_4OH – solution of ammonia in water
- $Ca(OH)_2$ – calcium hydroxide (builders' lime)

If an acid and a base are added together, they react to form water (H_2O) and a salt. An example you might be familiar with is brushing your teeth. The acid created from the bacteria on your teeth reacts with the base in your toothpaste. This reaction is called neutralisation.

Identifying and measuring acids and bases

A pH meter measures how acidic or basic a solution is. When we test a substance with a pH meter, we get a number from 0–14. This is a pH scale, and it can be used to compare substances. It is important to know that this scale is logarithmic. This means that a decrease in the pH scale of 1 can result in an increase of 10 times the concentration of hydrogen ions. Acids have a pH below 7. The more H^+ ions, the more acidic it is and

the lower the pH will be. Bases have a pH above 7. pH 7 is said to be neutral – this means there is a balance of H^+ and OH^- ions. Sometimes, the pH value can be less than 0 for very strong acids or greater than 14 for very strong bases.



Activity 2. Find the right group. Teacher will give some example for both acids and bases. Students will work in pairs and divide words into 2 groups according to their special features. Each answer will be elicited with proof.

Hydrochloric acid, sulphuric acid, nitric acid, lactic acid, hydrobromic acid, potassium hydroxide, sodium hydroxide, calcium hydroxide, lithium hydroxide, cesium hydroxide.

Acids	Bases
e.g: nitric acid	

Activity 3. Review. Do multiple choice questions. Teacher will divide tests in the form of handouts to each student in order to check their understanding the theme. Students will work individually and check themselves.

Q1. Which one of the following is the strongest acid?

a) $CH_2ClCOOH$
b) CH_3COOH
c) $CHCl_2COOH$
d) CCl_3COOH

Correct Answer. (d) CCl_3COOH

Q2. Lime water is-

a) CaO

b) $Ca(OH)_2$

c) $CaCO_3$

d) $CaCl_2$

Correct Answer. (b) $Ca(OH)_2$

Q3. The chemical formula of caustic potash is–

a) NaOH

b) $Ca(OH)_2$

c) NH_4OH

d) KOH

Correct Answer. (d) KOH

Q4. Bleaching powder gives the smell of chlorine because it-

a) is unstable.

b) gives chlorine on exposure to the atmosphere.

c) is a mixture of chlorine and slaked lime.

d) contains an excess of chlorine.

Correct Answer. (d) contains an excess of chlorine.

Q5. Arrange these acids in order of increasing strength. Given solutions with the same initial concentration of each acid, which would have the highest percent ionization?

acid A: pKa = 1.52

acid B: pKa = 6.93

acid C: pKa = 3.86

Answer. Acids are listed in ascending order of strength: acid B < acid C < acid A. Acid A has the highest percent of ionisation given the same initial concentration of each acid because it is the strongest acid.

Q6. Arrange these bases in order of increasing strength:

Given solutions with the same initial concentration of each base, which would have the highest percent ionization?

base A: pKb = 13.10

base B: pKb = 8.74

base C: pKb = 11.87

Answer. Bases are listed in ascending order of strength: base A < base C < base B. Since base A is the weakest base, it has the highest percent of ionisation in solutions with the same initial concentration of each base.

Q7. (a) Write the name given to bases that are highly soluble in water. Give an example.

(b) How is tooth decay related to pH? How can it be prevented?

(c) Why does bee sting cause pain and irritation? Rubbing of baking soda on the sting area gives relief. How?

Answer. (a) Alkali, such as NaOH (Sodium hydroxide).

(b) A lower pH in the mouth promotes the growth of bad bacteria, which eventually leads to tooth decay.

It is preventable by avoiding foods that cause acidity.

(c) It is caused by formic acid. Formic acid is neutralised by sodium hydrogen carbonate (baking soda), giving relief.

Q8. Methyl orange is-

(a) Pink in acidic medium, yellow in basic medium

(b) Yellow in acidic medium, pink in basic medium

(c) Colourless in acidic medium, pink in basic medium

(d)Pink in acidic medium colourless in basic medium

9. "Sodium hydrogen carbonate is a basic salt". Justify the statement. How is it converted into washing soda? Explain.

Answer. Sodium hydrogen carbonate is a salt formed by the reaction of sodium hydroxide (a strong base) and carbonic acid (weak acid). It is a basic salt. Heating and crystallisation are used to convert it to washing soda. $2NaHCO_3 \rightarrow Na_2CO_3 \rightarrow CO_2 + H_2O$.

Q10. What are the conjugate bases of the Bronsted acids HF, H_2SO_4, and HCO_3^-?

Answer. The conjugate bases for the Bronsted acids are F^-, HSO_4^-, and CO_3^{2-}.

Q11. Why do 1 M HCl solutions have a higher concentration of H^+ ions than 1M CH_3COOH solution?

Answer. HCl is more strong than CH_3COOH. There is complete dissociation of HCl, which produces more H^+ ions than CH_3COOH, a weak acid. The concentration is determined by the presence of H^+ ions. As a result, 1 M HCL has a greater concentration than 1 M CH_3COOH.

Q12. How is the concentration of hydroxide ions(OH^-) affected when excess base is dissolved in a solution of sodium hydroxide?

Answer. When a base is dissolved in a sodium hydroxide solution, the concentration of OH^- ions per unit volume in the solution increases.

Q12. Give Arrhenius's definition of an acid and a base.

Answer. Acids are defined by Arrhenius as substances that release H^+ ions when dissolved in water.

Bases are substances that, when dissolved in water, release OH^- ions.

Activity 4. Practice Questions on Acids and Bases. Do class discussion on given questions. Students will share answers and facts on the issue with each other.

Q2. How is the concentration of hydronium (H_3O^+) ions affected when a solution of an acid is diluted?

Q3. Why does dry HCl gas not change the color of the dry litmus paper?

Q4. A white powder is added while baking bread and cakes to make them soft and fluffy. Write the name of the powder. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking.

Q5. (a) Identify the compound of calcium which is yellowish-white powder and is used for disinfecting drinking water. Write its chemical name and formula. How is it manufactured? Write the chemical equation for the reaction involved. Also, list two other uses of the compound.

Theme 6. Kinetics.

- Aims: to teach learners to use vocabulary related to the topic
- To introduce some examples for chemical types and metods of kinetics
- To enable students to work with kinetic methods and formulas by consolidating the theme.

Activity 1. A) Introducing new subject matter using power point presentation. Teacher will explain main points by clear examples using visual aids. Students will make some notes during explanation.

Chemical kinetics is the study of reaction rates, the changes in the concentrations of reactants and products with time. With a discussion of chemical kinetics, the reaction rates or the changes in the concentrations of reactants and products with time are studied.

In kinetic methods, measurement of the analytical signal is made under dynamic conditions in which the concentrations of reactants and products are changing as a function of time. Generally, in analytical chemistry many methods of analysis are based on the equilibrium state of the selected reaction.

Three types of kinetic methods are discussed in this chapter: chemical kinetic methods, radiochemical methods, and flow injection methods. Chemical kinetic methods use the rate of a chemical reaction and either its integrated or differential rate law

B) Presenting new vocabulary. Teacher will distribute piece of paper in which new words are written. Students will stick them on the board by giving understandable definition for each word.

kinetics	the science concerned with the forces that cause motion
equilibrium	a stable situation in which forces cancel one another
acid-base equilibrium	the normal equilibrium between acids and alkalis in the body
physiology	the science dealing with the functioning of organisms
aqueous	similar to or containing or dissolved in water
thermodynamics	physics concerned with heat and other forms of energy
stoichiometry	(chemistry) the relation between the quantities of substances that take part in a reaction or form a compound (typically a ratio of whole integers)
nomenclature	a system of words used to name things in a discipline
molarity	concentration measured by molecular weight of a substance
mole	a small congenital pigmented spot on the skin
thermochemistry	the branch of chemistry that studies the relation between chemical action and the amount of heat absorbed or generated
alkali	any of various water-soluble compounds capable of turning litmus blue and reacting with an acid to form a salt and water
litmus	a coloring material that turns red in acid solutions
lichen	a plant occurring in crusty patches on tree trunks or rocks
lichen	a plant occurring in crusty patches on tree trunks or rocks

Activity 2. Answer questions. Teacher will divide the class in groups of 5 or 6. And give questions to each group one by one. Other groups also may add their additional answer. Teacher will mark each answer and elicit winning group at the end.

Q.1. What is the difference between average rate, initial rate, and instantaneous rate?

Q.2. Ozone decomposes to oxygen according to the equation 2O3(g)⟶3O2(g)2O3(□)⟶3O2(□). Write the equation that relates the rate expressions for this reaction in terms of the disappearance of O_3 and the formation of oxygen.

Q.3. In the nuclear industry, chlorine trifluoride is used to prepare uranium hexafluoride, a volatile compound of uranium used in the separation of uranium isotopes. Chlorine trifluoride is prepared by the reaction Cl2(g)+3F2(g)⟶2ClF3(g) Cl2(□)+3F2(□)⟶2ClF3(□). Write the equation that relates the rate expressions for this reaction in terms of the disappearance of Cl_2 and F_2 and the formation of ClF_3.

Q.4. A study of the rate of dimerization of C_4H_6 gave the data shown in the table:

2C4H6⟶C8H122C4H6⟶C8H12

Time (s)	0	1600	3200	4800	6200
$[C_4H_6]$ (*M*)	1.00×10^{-2}	5.04×10^{-3}	3.37×10^{-3}	2.53×10^{-3}	2.08×10^{-3}

a. Determine the average rate of dimerization between 0 s and 1600 s, and between 1600 s and 3200 s.

b. Estimate the instantaneous rate of dimerization at 3200 s from a graph of time versus $[C_4H_6]$. What are the units of this rate?

c. Determine the average rate of formation of C_8H_{12} at 1600 s and the instantaneous rate of formation at 3200 s from the rates found in parts (a) and (b).

Q.5. A study of the rate of the reaction represented as 2A⟶B2□⟶□ gave the following data:

Time (s)	0.0	5.0	10.0	15.0	20.0	25.0	35.0
[A] (M)	1.00	0.952	0.625	0.465	0.370	0.308	0.230

a. Determine the average rate of disappearance of *A* between 0.0 s and 10.0 s, and between 10.0 s and 20.0 s.

b. Estimate the instantaneous rate of disappearance of *A* at 15.0 s from a graph of time versus [*A*]. What are the units of this rate?

c. Use the rates found in parts (a) and (b) to determine the average rate of formation of *B* between 0.00 s and 10.0 s, and the instantaneous rate of formation of *B* at 15.0 s.

Q.6. Rate Laws How do the rate of a reaction and its rate constant differ?

The rate of a reaction or reaction rate is the change in the concentration of either the reactant or the product over a period of time. If the concentrations change, the rate also changes.

Theme 7. Nuclear chemistry.

- Aims: to teach learners to use vocabulary related to the topic
- To introduce some differences between nuclear reactions and chemical reactions
- To enable students to define nuclear chemistry

Activity 1. A) Introduction of the theme. Teacher will begin the class by asking simple questions about nuclear chemistry in order to brainstorm learners. Then give full information and facts about the topic using visual aids.

Nuclear chemistry deals with nuclear reactions, or reactions that happen inside atoms. Nuclear chemists may be found in different areas of research, including nuclear imaging (in medicine) or nuclear engineering (in power generation). Nuclear chemists conduct basic, applied, or theoretical research. They often work in laboratories and may be responsible for operating, maintaining, and repairing state-of-the-art instrumentation. They are also responsible for maintaining sample preparation supplies and equipment and ensuring the safe use and disposal of samples and other materials used in the lab.

Typical work duties of a nuclear chemist include:

- Conducting laboratory research in industrial, nonprofit institution, government, or academic laboratories
- Developing mathematical models and computer simulations of nuclear phenomena
- Teaching classes and mentoring student researchers in a university setting
- Developing methods for simulating, monitoring, and dismantling nuclear weapons and for monitoring treaty compliance

- Developing nuclear power sources for public utilities, submarines, or satellites and other spacecraft
- Developing medical imaging and therapeutic treatments using radioactive materials

B) Match the terms on the left with the correct definition on the right. Students will match words with their definitions.

a. critical mass

1. attractive force that acts between nucleons at very short distances

b. strong nuclear force

2. the minimum mass of a fissionable isotope in which a nuclear chain reaction can occur

c. fusion reaction

3. joining of two lighter nuclei to form a heavier nuclei

Activity 2. Determine whether the following statements are true or false. Teacher will distribute sentences to the class. Students will work in pairs and decide if the sentences are tue or false and label with T (true) or F (false)

a. The strong nuclear force that causes protons and neutrons in the nucleus to attract each other is not quite as strong as the electric repulsion between protons.

b. The attraction caused by the strong nuclear force occurs over a very short distance.

c. Protons in a nucleus both repel and attract each other, while neutrons only attract.

d. In stable nuclei, the attractions between the particles are stronger than the repulsions.

e. A nucleus with more than 83 protons is unstable and undergoes radioactive decay.

Activity 3. Answer the following questions. Teacher divide the class into groups and distribute the same questionnaire for all. After limited time (ex: 5min) groups will bring out answers

and teacher will define winning group.

1. The splitting of the nucleus into lighter nuclei is called_____.

2. When light mass nuclei combine to form a heavier, more stable nucleus this is called_____.

3. Do current nuclear power plants "harvest" energy from fusion or fission reactions? Why?

4. List two examples of fission reactions:

5. List two examples of fusion reactions:

6. List four types of nuclear waste:

Theme 8. Organic chemistry

- Aims: to teach learners to recall and use common organic chemistry vocabulary
- To introduce some common organic compounds based on their functional groups
- To enable students to name organic compounds based on their structure

Activity 1. Brainstorming organic chemistry. Teacher will start the class by asking the students what they already know about organic chemistry. On the board write " Organic chemistry " and ask students to write one word related to the topic. Everyone should write a word.

Organic chemistry is the study of the structure, properties, composition, reactions, and preparation of carbon-containing compounds. Most organic compounds contain carbon and hydrogen, but they may also include any number of other elements (e.g., nitrogen, oxygen, halogens, phosphorus, silicon, sulfur).Organic chemistry is a highly creative science that allows chemists to create and explore molecules and compounds. Organic chemists spend much of their time developing new compounds and finding better ways of synthesizing existing ones. Organic compounds are all around us. Many modern materials are at least partially composed of organic compounds. They're central to economic growth, and are foundational to the fields of biochemistry, biotechnology, and medicine. Examples of where you can find organic compounds include agrichemicals, coatings, cosmetics, detergent, dyestuff, food, fuel, petrochemicals, pharmaceuticals, plastics, and rubber.

Biotechnology

Virtually all biotechnology ("biotech") products are the result of organic chemistry. Biotech involves using living organisms and bioprocesses to create or modify products for

a specific use. For example, a biotech company might produce seeds for crops that are disease-resistant, or plants that are drought-resistant.

Common employment areas in biotechnology include: Health care, Crop production and agriculture, Nonfood uses of crops, Consumer products (e.g., biodegradable plastics, vegetable oil), Environmental sector, Biofuels

Activity 2. Draw the structural formulas for the following compounds. Teacher will give worksheets for each pair. Students will write structures for compounds. They will check answers on the blackboard.

1) 1-pentene
2) 2-methyl-3-heptyne
3) 3-ethyl-4,5-dimethylpentane
4) 2-ethyl-1-pentanol
5) m-bromophenol
6) 3,3,6,6-tetraethyl-4-octyne
7) 4-methylhexanoic acid
8) 2,3-dichloro-4-ethyl-2-hexene
9) 2,4-dinitrotoluene
10) 3-ethyl-2,3-dimethyl-2-pentanol
11) 5-chloro-4-methyl-3-heptanone
12) 3-phenyl-1-propyne

Activity 3. How many carbon atoms are in each compound? Students wiil write the number of the carbon atoms in compounds

a. Methane ___
b. Ethane ___
c. Ethane ___
d. Pentane ___
e. Propene ___
f. Hexane ___
g. Ethyne ___
h. Propane ___
i. Heptane ___
j. Octane ___
k. Decane ___
l. Buyne ___

m.Butane___
n.Propyne___
o.Butane___

Activity 4. Multiple choice questions. Students do the choices according to their gained knowledge in the purpose of consolidating the theme.

1. Which organic compound is a saturated hydrocarbon?
A) ethyne C) ethene
B) ethanol D) ethane

2. Which formula represents a hydrocarbon?
A) CH3CH2CH2CHO
B) CH3CH2CH2CH3
C) CH3CH2CH2COOH
D) CH3CH2COOCH3

3.In saturated hydrocarbons, carbon atoms are bonded to each other by
A) single covalent bonds, only
B) double covalent bonds, only
C) alternating single and double covalent bonds
D) alternating double and triple covalent bonds

4. What is the general formula for the members of the alkane series?
A) CnH2n
B) CnH2n–2
C) CnH2n+2
D) CnH2n–6

5. In which group could the hydrocarbons all belong to the same alkene series?
A) C2H2, C2H4, C2H6
B) C2H2, C2H4, C4H8
C) C2H2, C2H6, C3H6
D) C2H4, C3H6, C4H8

6. A molecule of butane and a molecule of 2- butene both have the same total number of

A) carbon atoms
B) single bonds
C) hydrogen atoms
D) double bonds

7. A double carbon-carbon bond is found in a molecule of

A) pentane
B) pentyne
C) pentene
D) pentanol

8. The multiple covalent bond in a molecule of 1-butene is a

A) double covalent bond that has 6 shared electrons
B) double covalent bond that has 4 shared electrons
C) triple covalent bond that has 6 shared electrons
D) triple covalent bond that has 4 shared electrons

9. What is the correct formula for butene?

A) C4H4
B) C4H8
C) C4H6
D) C4H10

10. Which general formula represents the homologous series of hydrocarbons that includes the compound l-heptyne?

A) CnH2n-6
B) CnH2n
C) CnH2n-2
D) CnH2n+2

11. Which compound is an unsaturated hydrocarbon?

A) hexanal
B) hexanoic acid
C) hexane
D) hexyne

12. What is the name of a compound that has the molecular formula C6H6?

A) butane
B) benzene
B) butene
D) butyne

13. Two substances have different physical and chemical properties. Both substances have molecules that contain two carbon atoms, one oxygen atom, and six hydrogen atoms. These two substances must be

A) isomers of each other
B) isotopes of each other
C) the same compound
D)the same hydrocarbon

14. The three isomers of pentane have different

A) formula masses
B) molecular formulas
C) empirical formulas
D) structural formulas

Theme 9 : Polymer chemistry

- Aims: to teach learners to recall and use common polymer chemistry vocabulary
- To introduce benefits, importance and usage of polymer chemistry in everyday life
- To enable students to define difference between monomers and polymers

Polymer chemistry is a sub-discipline of chemistry that focuses on the structures of chemicals, chemical synthesis, and chemical and physical properties of polymers and macromolecules. The principles and methods used within polymer chemistry are also applicable through a wide range of other chemistry sub-disciplines like organic chemistry, analytical chemistry, and physical chemistry. Many materials have polymeric structures, from fully inorganic metals and ceramics to DNA and other biological molecules. However, polymer chemistry is typically related to synthetic and organic compositions. Synthetic polymers are ubiquitous in commercial materials and products in everyday use, such as plastics, and rubbers, and are major components of composite materials. Polymer chemistry can also be included in the broader fields of polymer science or even nanotechnology, both of which can be described as encompassing polymer physics and polymer engineering

Activity 1. Brainstorming questions. Teacher will ask some questions after explanation of polymer chemistry , its usage, principles and methods using the power point presentation. Students may use hints while answering questions if needed.

1. What are monomers and polymers? Give suitable examples.

Hints: Monomers are reactive molecules from which polymer are derived.

2. Define the term polymerization.

Hints: The process of formation of polymers from respective monomers is termed as polymerization.

3. What do you mean by copolymer and give two examples?

Hints: The polymer obtained from more than one different monomer is called copolymers and the process is known as copolymerization. For examples Buna-S is a copolymer of 1,3-butadiene and styrene. Bakelite is a copolymer of phenol and formaldehyde.

4. How are polymers are classified on the basis of their structure?

Hints: On the basis of structure polymers are classified as-

1) Linear polymer: These polymers consist of long and straight chain.

2) Branched chain polymers: These polymers contain linear chain having some branches

3) Cross linked or Network polymers: These polymers have some cross-links between various linear chains.

5. Is –[-CH2=CH(C6H5)-]n – a homoplymer or copolymer? Write the name of monomer.

Hints: It is a homopolymer and the monomer is styrene, C6H5CH=CH2

6. Give one example of a) addition polymer, b) condensation polymer, c) copolymer

Hints: a) Polyethene, b) Dacron, c) Bakelite

7. Differentiate the following pair of polymers based on the property mentioned against each. 1) Novolac and Bakelite (structure) 2) Buna-s and Terylene (intermolecular force)

Hints: Bakelite is obtained from phenol and formaldehyde.

Activity 2. Consolidation of the theme. Teacher will hand out worksheet for divided groups of the class. Students will work in teams and fulfill the tasks. At the end answers will be elicited and groups will be scored by teacher.

1.This question is about sports trainers.

When anybody jumps or runs, their legs and feet have to take pressure of up to seven times normal body weight. This can be very harmful to bones, joints and muscles. Different polymers are used to make trainers, as they can easily be made to have the right properties. One of the polymers that is used for making the fillings, heels and insoles in trainers is poly(ethene).

a) Give a property that poly(ethene) would need to have if used to make the heel of a pair of trainers.

_____

b) What type of substance is poly(ethene)?

_____

Ethene is used to make poly(ethene).

c) What is the chemical formula for ethene?

_____

d) Draw the structure of an ethene molecule.

_____

e) i) What fraction of the atoms in an ethene molecule are carbon atoms?

_____

ii) What is the ratio of carbon to hydrogen atoms?

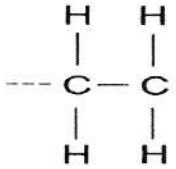
_____

Write your answer in its simplest whole number form.

_____

f) When ethene molecules polymerise, they form a very

long chain polymer. The molecule below shows two carbon and four hydrogen atoms in a chain of poly(ethene). Complete the diagram by drawing 6 more carbon atoms, and 12 more hydrogen atoms.



g) The structure in part f) can be shown as a repeating unit. The repeat unit is shown within a bracket, and the letter 'n' is written outside the bracket. Draw the repeat unit for poly(ethene).

Activity 3. Uses of polymer chemistry. Students should write as many uses of polymer chemistry as they can in 3minutes. After accomplishing they will share ideas and make notes of other benefits that they heard from the group.

e.g. Product made from polymers are all around us: clothing made from synthetic fibers,

polyethylene cups, fiberglass,
nylon bearings, plastic bags,
polymer-based paints, epoxy glue,
polyurethane foam cushion, silicone heart valves,
Teflon-coated cookware.

Theme 10: Surface chemistry

- Aims: to teach learners to recall and use common surface chemistry vocabulary
- To introduce the class applications of surface chemistry in everyday life and industry
- To enable students to define and explain the basic concepts of surface chemistry

Activity 1. Introduction to surface chemistry. Teacher will begin the class by asking students if they know what surface chemistry is and what they know about it. Introduce the topic by showing a power point presentation that defines surface chemistry and its basic concepts like surface tension, adsorption and surface energy. Students will make notes during the presentation and ask questions if there is any misunderstanding. Teacher will give list of vocabulary with definitions.

1. **Adsorption.** This phenomenon of attracting and retaining the molecules of a substance by a solid (or a liquid) on its surface resulting into a higher concentration of the molecules on the surface
2. **Adsorbate** The substance that is adsorbed
3. **Adsorbent.** and the substance which adsorbs is called
4. **Desorption** is a process of removing an adsorbed substance from a surface on which it is adsorbed.
5. **Absorption** is different from adsorption. In absorption, the substance is uniformly distributed throughout the body of a solid or a liquid.
6. **Physical adsorption is** when the adsorbate is held on the surface by weak van der Waals forces. This type of adsorption can be reversed by heating or decreasing the pressure.
7. **Chemical adsorption** or **chemisorption** when the forces holding the adsorbate on the surface are of the magnitude of chemical bond forces. This type of adsorption is irreversible.

Activity 2. Answer the questions. Teacher will ask some most asked questions in order to chech learners understanding new theme and vocabulary. Students will answer questions by rising hand and share ideas by this way.

Question 1.What is meant by surface chemistry ?

Answer: Surface chemistry is the study of phenomena that occurs at the interface of two surfaces.

Question 2. What is the enthalpy of adsorption in physisorption?

Answer: 20-40 KJ/mol is the enthalpy of adsorption in physisorption.

Question 3. What is the enthalpy of adsorption in chemisorption?

Answer: The enthalpy of adsorption in chemisorption is 40-400 KJ/mol

Question 4. What is meant by adsorbate?

Answer: The molecule that is adsorbed to the surface of an adsorbent is called adsorbate.

Question 5. What is meant by adsorbent?

Answer: The compound that takes up the adsorbate on its surface is called adsorbent

Activity 3. Multiple choice questions. Teacher will distribute list of questions for individual work. Students answer questions and submit it to the teacher. At the end of the task class will check answers in the form of discussion by giving evidence for each key.

Q1. Choose an example of homogeneous catalysis.

a.) Ostwald's process
b.) Lead chamber process
c.) Haber's process
d.) Contact process

Q2. Which of the following statement is incorrect?

a.) Enzymes are in colloidal state

b.) Enzymes are catalysts
c.) Enzymes can catalyze any reaction
d.) Urease is an enzyme

Q3. The magnitude of ___ decreases in the presence of a catalyst.
a.) activation energy
b.) dissociation energy
c.) energy barrier
d.) intermolecular forces

Q4. Rate of physisorption increases with:
a.) decrease in temperature
b.) increase in temperature
c.) decrease in pressure
d.) decrease in surface area

Q5. Which type of metals form effective catalysts?
a.) Alkali metals
b.) Transition metals
c.) Alkaline earth metals
d.) Radioactive metals

Q6. Why zeolites are good shape-selective catalysts?

Q7. Define catalysis.....

Q8. What are the two steps to proceed with the enzyme catalysed reactions?

Q9. What are associated colloids? Give an example.....

Q10. What is the activation of an adsorbent? How can it be achieved?

Theme 11. Chemistry of food and beverages

- **Aims:** To enable students to understand the basic concepts and vocabulary of the topic
- to review key vocabulary related to chemistry of food and beverages
- To introduce how to read nd interpret food labels using chemical terminology

Activity 1. Introduction to chemistry of food and beverages. Teacher will ask students about their favourite food and beverage items and how they think chemistry plays a role in the taste and quality of these items. Teacher will introduce the topic using power point presentation with pictures of common food and beverage items. Define key vocabulary such as:

Calcium - an element necessary for building strong bones.
Calorie - a unit of heat; a measure of the energy in food.
Carbohydrates - a group of nutrients that provide energy; sugars and starches.
Chemistry - the branch of science that deals with the structure and properties of matter.
Cholesterol - a waxy substance found in human tissues.
Contamination the mixing of unwanted materials in an experiment.
Deficiency - lack of a needed amount.
Diabetes - a disease in which the body cannot process sugar efficiently, ew!!!!!!!
Fats - a group of nutrients that provide energy and building blocks for development of body systems.
Food - provides us with important chemicals called nutrients, yummy!!!!
Food label - a panel of nutritional information found on food packaging.

Food pyramid - a visual representation of U.S.D.A. recommendations for healthy food choices.

Fructose - a sugar found naturally in fruits.

Glucose - a sugar found in fruits and vegetables; the sugar broken down to yield energy in your cells.

Insulin - a protein hormone that enables the body to use sugar.

Lactosea - sugar found in milk.

Minerals - substances that work with vitamins, necessary for growth and development.

Nutrient - a chemical found in food that helps keep an organism alive and active.

Nutrition - the science or study of proper balanced diets to promote health, especially in humans.

Obesity - the condition of having an excess amount of body fat.

Proteins - a group of nutrients that provide energy and building blocks for growth and repair of body tissues; found in meats and vegetables.

Activity 2. Matching words with definitions. Students will be distributed handouts and they will match words with definitions according to Activity 1.

1	diabetes	A. a simple carbohydrate that tastes sweet and provides quick energy
2	calorie	B. a group of nutrients that provide energy and building blocks for growth and repair of body tissues; found in meats and vegetables
3	cholesterol	C. to smell like garbage!!!!
4	fats	D. a waxy substance found in human tissues
5	obesity	E. a sugar found in fruits and vegetables; the sugar is broken down to yield energy in your cells

6	carbohydrates	F. the mixing of unwanted materials in an experiment
7	calcium	G. lack of a needed amount
8	deficiency	H. a disease in which the body cannot process sugar efficiently
9	lactose	I. the condition of having an excess amount of body fat
10	Food pyramid	G. a unit of heat; a measure of the energy in food
11	proteins	H. provides us with important chemicals called nutrients, yummy!!!!
12	glucose	I.a group of nutrients that provide energy and building blocks for development of some body systems
13	food label	J. a sugar found in milk
14	sugar	K. a panel of nutritional information found on food packaging
15	food	L. an element necessary for building strong bones
16	gobble	M. a visual representation of U.S.D.A. recommendations for healthy food choices
17	contamination	N. a group of nutrients that provide energy; sugars and starches

Activity 3. Writing task. Teacher will assign short writing task. Students will write short paragraph about their favourite food or beverage and describe the chemistry behind its taste and texture. After accomplishing the task students will read their texts one by one. While writing students will use new vocabulary of the theme.

e.g : My favourite food is... I like it because..... It is useful for.... It is consisted of....

Theme 12: Historical developments in chemistry

- **Aims:** To enable students to understand the basic concepts and vocabulary of the topic
- To review developments of chemistry, their impact on society and famous chemists.
- To introduce students steps of developing chemistry and people who contributed

Activity 1. Introduction of the theme. Teacher give information about history of the chemistry and developments which made great change in this way with pictures and power point presentation. Students will make some notes

The **history of chemistry** represents a time span from ancient history to the present. By 1000 BC, civilizations used technologies that would eventually form the basis of the various branches of chemistry. Examples include the discovery of fire, extracting metals from ores, making pottery and glazes, fermenting beer and wine, extracting chemicals from plants for medicine and perfume, rendering fat into soap, making glass, and making alloys like bronze. Arguably the first chemical reaction used in a controlled manner was fire. However, for millennia fire was seen simply as a mystical force that could transform one substance into another (burning wood, or boiling water) while producing heat and light. Fire affected many aspects of early societies. These ranged from the simplest facets of everyday life, such as cooking and habitat heating and lighting, to more advanced uses, such as making pottery and bricks and melting of metals to make tools. It was fire that led to the discovery of glass and the purification of metals; this was followed by the rise of metallurgy.

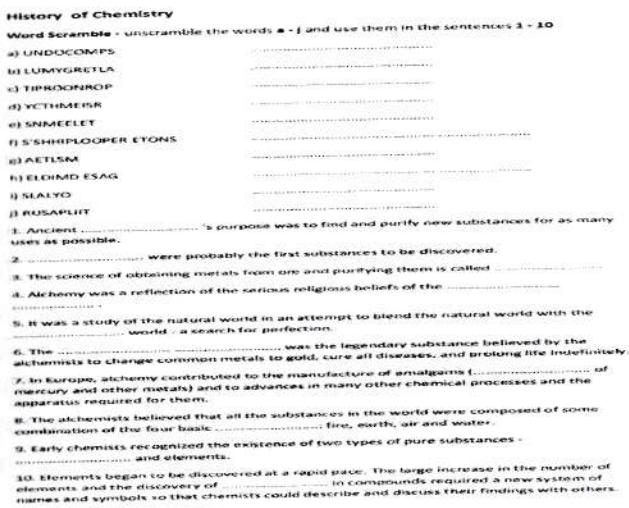
Activity 2. Telling one important development that changed the world. Students should find a development from the history of chemistry and give some facts to their groupmates. By this

way they may get more information in short time. Others will make some notes wihile listening to their classmates. Teacher will monitor class and make some explanation if needed.

e.g. fire, atom, iron, paint...

Archeologists believe that iron was discovered by the Hittites of ancient Egypt somewhere between 5000 and 3000 BCE. During this time, they hammered or pounded the metal to create tools and weapons. They found and extracted it from meteorites and used the ore to make spearheads, tools and other trinkets.

Activity 3. Completing tasks . Teacher will distribute handouts for each pair. Students fulfill tasks according to gained knowledge about history of chemistry.



History of Chemistry

Word Scramble - unscramble the words **a - j** and use them in the sentences **1 - 10**

a) UNDOCOMPS .....
b) LUMYGRETLA .....
c) TIPRDONROP .....
d) YCTHMEISR .....
e) SNMEELET .....
f) S'SNHRPLOOPER ETONS .....
g) AETISM .....
h) ELDIMD ESAG .....
i) SLALYO .....
j) RUSAPLIIT .....

1. Ancient ..... 's purpose was to find and purify new substances for as many uses as possible.
2. ..... were probably the first substances to be discovered.
3. The science of obtaining metals from ore and purifying them is called .....
4. Alchemy was a reflection of the serious religious beliefs of the .....
5. It was a study of the natural world in an attempt to blend the natural world with the ..... world - a search for perfection.
6. The ..... was the legendary substance believed by the alchemists to change common metals to gold, cure all diseases, and prolong life indefinitely.
7. In Europe, alchemy contributed to the manufacture of amalgams (..... of mercury and other metals) and to advances in many other chemical processes and the apparatus required for them.
8. The alchemists believed that all the substances in the world were composed of some combination of the four basic ..... fire, earth, air and water.
9. Early chemists recognized the existence of two types of pure substances - ..... and elements.
10. Elements began to be discovered at a rapid pace. The large increase in the number of elements and the discovery of ..... in compounds required a new system of names and symbols so that chemists could describe and discuss their findings with others.

Theme 13: Forensic chemistry

• Aims: to teach learners to recall and use common forensic chemistry vocabulary

• To introduce some common applications of forensic chemistry in everyday life and industry

• To enable students to name well-known experts of this field

Activity 1. Introduction to the forensic chemistry. Teacher will began the class by asking some questions about forensic chemistry and its uses in our life. Then continue explanation by a video about forensic chemistry and some pictures. Students will make some notes while watching the video.

Forensic chemistry is a branch of chemistry that deals with the application of analytical techniques to solve criminal cases. Forensic chemists analyze evidence from crime scenes and work in conjunction with other law enforcement professionals to identify perpetrators, collect information about their methods, and reconstruct events following forensic toxicology. Many students think that forensic chemistry and forensic toxicology are the same subjects. However, there exist some differences between forensic chemistry and forensic toxicology. The introduction to forensic chemistry blog post will give you an introduction to this fascinating field! Forensic chemists can be found at crime scenes, working with law enforcement professionals or performing analysis on evidence found at crime scenes such as DNA samples taken from blood stains or saliva left behind by suspects while they talk under interrogation.

Activity 2. Match 2 parts of the task. Teacher will distribute terms and definitions separately to the class. Students will find their pair by mingling around the class and sit together in order

to do the next tasks together.

1.	Microscope	What is the first tool used to examine evidence after your eyes.
2.	Total magnification	Objective lens x (ocular lens) BrainpowerRead
3.	Transmitted Light	Light up and through the specimen
4.	Reflected Light	Light above and reflected by specimen's surface
5.	Numerical Aperture	Directly proportional to resolution. The widest cone of light that can enter a lens
6.	Reflected, transmitted, absorbed	Light can be_____, _____, or _____ by the substance under study.
7.	Two types of reflection :	Specular and diffuse
8.	Specular Reflection	Common to compound and stereo microscopy.
9.	Reflected, pass through it	In order to see objects with a microscope, light must either be ___ or _ __ __.
10.	Stereoscopic Microscopes are most useful for	Soil analysis, entomology, macroscopic evidence.
11.	Comparison microscope	Which microscope is best used for a side by side comparison?

Activity 3. Multiple choice questions. Students do the activity individually in order to check their understanding of the theme. The answers will be discussed in the class at the end of the activity

1. One of the earliest crime labs was founded by:

a. Osborn

b. Gross

c. Locard

d. Lattes

2. The judicial case that set forth the guidelines for determining the admissibility of scientific examinations in the Federal courts is:

a. *Frye v. US*

b. *Daubert v. Merrell Dow Pharmaceuticals*

c. *Mapp v. US*

d. *People v. Williams*

3. The case of *Frye v. US* deals with the legal issue of

a. admissibility of photographs in court

b. search and seizure guidelines

c. general acceptance of scientific principles

d. admissibility of fingerprint evidence

4. The following service does not normally lie within the expertise of the forensic scientist:

a. drug id

b. wood comparisons

c. document examination

d. polygraph examination

5. The effectiveness of an expert's testimony is almost always dependent on:

a. the experience of the expert

b. the ability of the expert to talk in clear, concise language

c. the educational background of the expert

d. all of the above

6. The process by which the body temperature cools after death is known as:

a. rigor mortis

b. algor mortis

c. livor mortis

d. denaturatation

7. Which of the following techniques can be used to estimate the time of death?

a. rigor mortis

b. livor mortis

c. insect infestation

d. all of the above

8. List the functions of a forensic scientist

9. Discuss the underlying reasons for the rapid growth of crime labs in the US since the late 1960s.

10. Describe the advantages of incorporating an evidence collection unit into the organizational structure of the crime lab.

Theme 14: Pharmaceutical chemistry

- **Aims:** to teach learners to define pharmaceutical chemistry and understand its importance
- To introduce some common pharmaceutical vocabulary and their use
- To enable students to name different types of drugs and their effects on body

Activity 1. Introduction to pharmaceutical chemistry. Teacher will start the class by asking students if they have ever taken medicine or know anyone who has and introduce the concept of pharmaceutical chemistry and explain that it is the study of drugs and their properties, including how they are made, their effectiveness and their safety. Students will be presented power point presentation with examples of common drugs and explained how pharmaceutical chemistry played a role in their development.

Pharmaceutical chemistry is a scientific discipline at the intersection of chemistry and pharmacy involved with designing and developing pharmaceutical drugs. Medicinal chemistry involves the identification, synthesis and development of new chemical entities suitable for therapeutic use. It also includes the study of existing drugs, their biological properties, and their quantitative structure-activity relationships .

Medicinal chemistry is a highly interdisciplinary science combining organic chemistry with biochemistry, computational chemistry, pharmacology, molecular biology, statistics, and physical chemistry. Compounds used as medicines are most often organic compounds, which are often divided into the broad classes of small organic molecules (e.g., atorvastatin, fluticasone, clopidogrel) and "biologics"(infliximab, erythropoietin, insulin glargine), the latter of which are most often medicinal preparations of proteins (naturaland recombinant antibodies, hormones etc.). Medicines

can also be inorganic and organometallic compounds, commonly referred to as metallodrugs (e.g., platinum, lithium and gallium-based agents such as cisplatin, lithium carbonate and gallium nitrate, respectively.

Activity 2. Vocabulary Building. Teacher will divide students into pairs and distribute list of pharmaceutical chemistry terms and definitions. Students will be instructed to work in pairs and match the terms with their correct pairs. After all pairs finished teacher will review the correct answers as a group and ask students to share any new vocabulary they learned during activity. At the end students will answer some question related to the topic.

- **Organic Synthesis** A branch of chemical synthesis that focuses on the synthesis of organic molecules.
- **Organometallic Chemistry** A branch of chemistry that mainly studies the chemistry of compounds that contain Carbon-Metal bonds.
- **Orphan Drug** Pharmaceutical agents that are used to treat rare medical conditions.
- **Pharmacodynamics** The study of the processes by which ligands interact with their binding site and the biochemical and physiological changes associated with the ligand. In simple terms, it is the study of what the drug does to the body.
- **Pharmacokinetics** The study of the fate of the drug administered to a living organism. Pharmacokinetics involves the study of a compound's ADME properties. In simple terms, it is the study of what the body does to the drug.
- **Pharmacopoeia** An official documentation which details the analytical procedures, effects and directions of use of medicinal substances.
- **Pharmacophore** A description of the main molecular features necessary for biological activity and their relative

positions in space. Sometimes referred to as the minimum structure required to elicit a biological response.

- **Phases of Drug Action** The three phases of drug action are the pharmaceutical phase, pharmacokinetic phase, and the pharmacodynamic phase.
- **Pi-Pi (p-p) interactions** Attractive non-covalent interactions that arise between aromatic rings
- **Prodrug** Inactive derivatives of active drug molecules that are converted to parent drug molecules in the body.

1.Why is medicinal chemistry an important field in science?

a. It highlights the importance of macromolecules in the body

b. It explores the different ways to perform clinical studies

c. It allows for the creation of new drugs to treat disease

d. It explains how toxins affect different biological systems

2. Which of the following research topics might you see listed in a medicinal chemistry journal?

a. The liquid-liquid extraction of fatty acids to make soap

b. The identification of chemical properties for novel compound.

c. The synthesis of spirocyclic ethers that occur in nature

d. The study of milk thistle and its treatment for liver damage

Activity 3. Identify which of the following bonds are inter- and intramolecular. Students come to blackboard and choose a bond which is written on a piece of colorful paper and guess if it is intermolecular or intramolecular. Teacher will monitor the class by giving answers any questions.

a. Ionic bonds – Intramolecular

b. Covalent bonds – Intramolecular

c. Polar Covalent bonds – Intramolecular

d. Dative covalent bonds - Intermolecular

e. Hydrogen bonds - Intermolecular

f. Dipole Interactions - Intermolecular

Activity 4. Using your knowledge of molecular structure, identify the main intermolecular force in the following compounds. Students may find it useful to draw Lewis structures to find the answer. Teacher will divide the class into 3 groups and give each group different compounds. Limit the time and find out the winner group. At the end of the activity students will present answers to other groups

a. PF 3 - Dipole-dipole interaction

b. H 2 CO – Dipole-Dipole interaction

c. HF – Hydrogen bonding

Activity 5. Explain how dipole-dipole forces work. Using your knowledge of intermolecular bonds rank the following compounds from lowest to highest boiling point: methane (CH 4), methanol (CH 4 O) and dimethyl ether (CH 3 OCH 3). Teacher will distribute handouts to groups of learner and give clear direction of what to do.

Order: methane (CH 4), dimethyl ether (CH 3 OCH 3) methanol (CH 4 O). This is due to the different types of intermolecular forces: Methane forms Van Der Waals forces which are very weak.

Dimethyl ether forms dipole-dipole interactions which are stronger then Van Der Waals but weaker thanHydrogen bonds.

Methanol can form hydrogen bonds which are stronger than both Van Der Waals and Dipole-dipole interactions. Polar molecules will have one side which is partially negative and one side which is partially positive. Because opposites attract the partially negative side of a polar molecule will interact with the partially positive side of a different polar molecule.

Theme 15: Gases

- **Aims:** to teach learners to define the role of the gases in daily life
- To introduce some common vocabulary of the types and applications of gases
- To enable students form and present arguments about current issue in chemistry and society

Activity 1. Brainstorming. Teacher will ask some questions about the topic and ask students to guess the theme. Then introduce the issue by pictures and obvious examples. Students will make notes of gases' properties and applications. After giving relevant information teacher will ask following questions from the class.

Gas, one of the three fundamental states of matter, with distinctly different properties from the liquid and solid states.

Structure

The remarkable feature of gases is that they appear to have no structure at all. They have neither a definite size nor shape, whereas ordinary solids have both a definite size and a definite shape, and liquids have a definite size, or volume, even though they adapt their shape to that of the container in which they are placed. Gases will completely fill any closed container; their properties depend on the volume of a container but not on its shape.

Kinetic-molecular picture

Gases nevertheless do have a structure of sorts on a molecular scale. They consist of a vast number of molecules moving chaotically in all directions and colliding with one another and with the walls of their container. Beyond this, there is no structure—the molecules are distributed essentially randomly in space, traveling in arbitrary directions at speeds that are distributed randomly about an average determined by the

gas temperature. The pressure exerted by a gas is the result of the innumerable impacts of the molecules on the container walls and appears steady to human senses because so many collisions occur each second on all sections of the walls. More subtle properties such as heat conductivity, viscosity (resistance to flow), and diffusion are attributed to the molecules themselves carrying the mechanical quantities of energy, momentum, and mass, respectively.

Questions

1. What's the connection between a gas particle's mass and the rate at which it diffuses through another gas?

Answer. The larger the particle is, the slower it diffuses.

2. What causes gas pressure?

- *Answer*: When the molecules collide with the container's walls, they exert force on the container. This force manifests as pressure on the container's walls.
- The collision of molecules will not cause pressure to build upon the container's walls.
- The random motion of gas molecules will not generate pressure.
- Hence, the collision of gas molecules against the walls of the container causes gas pressure.

3. State Avogadro's law.

Answer. Avogadro's law states that if the gas is an ideal gas, the same number of molecules exists in the system. The law also states that if the volume of gases is equal, it means that the number of the molecule will be the same as the ideal gas only when it has equal volume.

4. What do you understand by an Ideal gas?

Answer. Ideal gases are also known as perfect gas. It establishes a relationship among the four different gas variables such as pressure (P), Volume(V), Temperature(T) and amount of gas (n). Mathematically, the ideal gas law can be stated as- pV

= nRT

5. Give the difference between solids, liquids and gases.

Answer. The primary distinction between solids, liquids, and gases is:

- Solids (substances in their solid-state) have distinct shapes and occupy fixed volumes.
- Liquids (substances that exist in the liquid state) do not have distinct shapes, but they do occupy specific volumes. They are slightly compressible and occupy the shape of their containers.
- Gases (substances that exist in a gaseous state) have no definite shapes and no fixed volumes. Gaseous substances are highly compressible and occupy the shape of their container.

6. Gases cannot be liquefied unless their temperature is brought down to or below their critical temperature. Justify or rectify.

Answer. This statement is correct. At or below the critical temperature, a gas can be liquefied by applying more pressure alone. $P= (RT/V-b) - (a/V^2)$ is the Van der Walls equation for one-mole gas.

7. If the temperature is kept constant, how can we increase the pressure of a gas?

Answer. The ideal gas equation is pV = nRT

8. What are greenhouse gases? What are its causes and effect on the environment?

Answer. Greenhouse gases are gases that absorb infrared radiation and thus cause the greenhouse effect. Carbon dioxide, methane, and chlorofluorocarbons are examples."

Activity 2. Multiple choice questions. Teacher will distribute handouts with multiple choice questions to the class in order to check their understanding the topic. Students will work individually and discuss answers at the end with the whole class

1. Which of the following gases is used in refrigeration and in fire extinguishers?

a.) Nitrogen
b.) Hydrogen
c.) Carbon dioxide
d.) Methane

Correct Answer- (c.) Carbon dioxide

2. What is the name of the gas used in high-speed photography?

a.) Nitrous Oxide
b.) Krypton
c.) Xenon
d.) Radon

Correct Answer- (b.) Krypton

3. Which of the following gases is used in the production of chloroform?

a.) Methane
b.) Propane
c.) Butane
d.) Acetylene

Correct Answer- (a.) Methane

4. What is the name of the gas that is abundant on Earth in both combined and free form with other elements?

a.) Oxygen
b.) Nitrogen
c.) Hydrogen
d.) Sulphur

Correct Answer- (a.) Oxygen

5. Which of the following gases is used in the production of vanaspati ghee, alcohol, and ammonia?

a.) Hydrogen
b.) Ozone
c.) Propane
d.) Butane

Correct Answer. (a.) Hydrogen

6. Greenhouse gases absorb:

a.) Ultraviolet radiations

b.) Visible light radiations

c.) Microwave radiations

d.) Infrared radiations

7. Which of the gases is a neutral gas?

a.) O_2

b.) CO_2

c.) SO_2

d.) All of the above

8. In the lab, an unknown gas is being examined. 1g of this gas is placed in a 27°C container. The pressure and volume of the gas are 1.54 atm and 0.5 L, respectively. What is the name of the gas? Assume that the gas behaves ideally/perfectly.

9. A sample of argon gas has a volume of 563 mL at a pressure of 0.959 atm and a temperature of 27.5°C. What is the final volume of a gas sample if it is compressed at constant temperature until its pressure reaches 1.40 atm?

10. Given the ideal gas law, consider the following:

$P = \rho \frac{R}{M} T$ **Where D denotes density, P denotes pressure, R denotes the gas constant, M denotes molar mass, and T denotes temperature.**

Activity 3. Which of the following statements about the Ideal Gas Law is correct? Students will work on the activity according to teacher's instruction in pairs. Teacher will monitor to have healty discussion of questions.

I. Pressure and volume have an inverse relationship.

II. Pressure and density have an inverse relationship.

III. Pressure and temperature have a direct relationship.

IV. Temperature and density are inversely proportional

Theme 16: Chemistry and society

- **Aims:** to teach learners to define the role of the chemistry in society and its impact on daily life
- To introduce some common chemical vocabulary and their use
- To enable students form and present arguments about current issue in chemistry and society

Activity 1. Warm up discussion. Students will brainstorm and discuss the role of chemistry in society and its impact on daily life. Teacher will divide the class into small groups and give 5-7 minutes to discuss and come up with their ideas. Students will share their opinions with class.

For the first two-thirds of the 20th century, chemistry was seen by many as the science of the future. The potential of chemical products for enriching society appeared to be unlimited. Increasingly, however, and especially in the public mind, the negative aspects of chemistry have come to the fore. Disposal of chemical by-products at waste-disposal sites of limited capacity has resulted in environmental and health problems of enormous concern. The legitimate use of drugs for the medically supervised treatment of diseases has been tainted by the growing misuse of mood-altering drugs. The very word chemicals has come to be used all too frequently in a pejorative sense. There is, as a result, a danger that the pursuit and application of chemical knowledge may be seen as bearing risks that outweigh the benefits. It is easy to underestimate the central role of chemistry in modern society, but chemical products are essential if the world's population is to be clothed, housed, and fed. The world's reserves of fossil fuels (e.g., oil, natural gas, and coal) will eventually be exhausted, some as soon as the 21st century, and new chemical processes

and materials will provide a crucial alternative energy source. The conversion of solar energy to more concentrated, useful forms, for example, will rely heavily on discoveries in chemistry. Long-term, environmentally acceptable solutions to pollution problems are not attainable without chemical knowledge.

Activity 2. Questionnaire. Teacher will read some questions from different branches of chemistry. Students will answer them according to their background knowledge. They will gain a point for each right answer.

1. Metals

1. Can metals conduct electricity?
2. What materials cannot conduct electricity?
3. Name some properties of metals.
4. If metals are un-combined in the Earth's crust what does that tell you?
5. How could you extract silver, copper and aluminium from a compound?
6. Complete the word equation for the following reactions

• (a) Calcium + Water aWhat is the key insight of chemistry? - Properties at the macro scale (what we can see and interact with) are a function of structure at the molecular scale

• Pure substance - has definite and constant composition (ex. salt or sugar); can be an element or a compound

• Brainpower - physical combinations of pure substances that have no definite or constant composition

• Homogeneous mixture - a mixture whose composition is the same throughout (ex. vanilla)

• Physical change - changing states from something like water to ice; nothing about the identity of the compound changes

• Chemical change - transforms atoms in one substance into another; atoms rearrange and we can often see macro

level properties that show this change

• Volatile compound- able to temporarily take a gas form, which is why we can smell it

• Law - describes what happened, states what is

• Theory - an explanation to why something happens can include evidence

• Law of conservation of mass - mass can neither be created nor destroyed

• Law of definite proportions - a chemical compound always contains its component elements in a fixed ratio and does not depend on its source and method of preparation

• Law of multiple proportions - when elements can combine to form multiple compounds, a fixed mass of one element will react with the other elements' in a ratio of small whole numbers

• How does a mass spectrometer generate ions? - A sample is injected (often liquid) - this is heated, which vaporizes the sample, turning it into a gas; there is an electron gun that shoots electrons at the sample, giving it a negative charge or knocking off electrons

• How does a mass spectrometer accelerate ions Ions are shot as a beam by an electric field (like charges repel, unlike charges attract); there is a small and large plate - ions are attracted to small then accelerated as they are attracted to the large plate

• Ionic bond - positively charged cation combines with a negatively charged anion

• Covalent bond - atoms are sharing electrons

• Electron sea (bonding in metals) - electrons are shared across the entire solid

Theme 17: Analytical chemistry

- **Aims:** To enable students to generate ideas about applications of analytical chemistry in daily life
- To review key vocabulary related to analytical chemistry.
- To introduce students general information about analytical chemistry and terms of the topic

Activity 1. Brainstorming. Teacher will divide the group into subgroups and ask each group to write information about analytical chemistry, its application and other properties. The class will discuss and clarify any misconceptions and provide examples.

What is analytical chemistry?

Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists.

Analytical chemistry can be a challenging profession that makes significant contributions to many fields of science. It is one of the most popular fields of work for ACS chemists. Analytical chemists use their knowledge of chemistry, instrumentation, computers, and statistics to solve problems in almost all areas of chemistry and for all kinds of industries.

An analytical chemist may conduct basic laboratory research, perform process and product development, design instruments used in analytical analysis, teach, or work in marketing and law. Typical job functions include:

- Performing qualitative and quantitative analysis
- Sampling, defining, isolating, concentrating, and preserving samples
- Setting error limits
- Validating and verifying results through calibration and standardization

- Performing separations based on differential chemical properties
- Creating new ways to make measurements
- Interpreting data in proper context
- Communicating results and conclusions to other scientist

Activity 2. Case study. Teacher will distribute different tasks to each group and ask to accomplish them with their team. Students will present solutions to the class and teacher will discuss and evaluate each solution and provide feedback.

1. State the colour of the following salts:

1. Copper chloride
2. Ferric chloride
3. Copper nitrate
4. Lead nitrate
5. Calcium carbonate
6. Zinc hydroxide

2. State the colour of the aqueous solution of the following salts:

1. Calcium sulphate crystals
2. Ferrous chloride crystals
3. Ferric chloride crystals
4. Ferrous sulphate crystals
5. Ferric sulphate crystals
6. Copper sulphate crystals

3. A metal, whose alloy is used in the construction of aircrafts, in the powered form was added to sodium hydroxide solution, a colourless gas was evolved and after the reaction was over the solution was colorless.

1. Name the powdered metal added to sodium hydroxide solution.
2. Name the gas evolved.
3. Name the salt present in the colorless solution.

4. Name:

1. An amphoteric oxide.
2. A salt of zinc which is efflorescent.
3. An alkali
4. One metal which forms more than one type of positive ions.
5. The ion responsible for the blue colour of an aqueous solution of a salt.

Activity 3. Review. Stdents will review gained knowledge by the questions which are distributed for each learner in the group. Teacher will monitor the class and evaluate each answer.

Question 1. What are amphoteric metals? Describe their reactions with hot caustic alkali. What are amphoteric oxides? Why these oxides react with NaOH?

Question 2. State the effect of adding a small amount of

- Sodium hydroxide
- Ammonium hydroxide

Followed by an excess in each case to sample of each of the salt solutions.

- Calcium nitrate
- Zinc nitrate
- Lead nitrate

Question 3. Using sodium hydroxide solution, how would you distinguish (ICSE 2009)

- Ammonium sulphate from sodium sulphate
- Zinc nitrate solution from calcium nitrate solution
- Iron (II) chloride from iron (III) chloride
- Calcium nitrate solution from calcium chloride solution

Question 4. Name the anion present in each of the following compounds :

- Compound A when warmed with concentrated sulphuric acid gives a gas which fumes in moist air and which gives dense white fumes with ammonia.

- When barium chloride solution is added to a solution of compound B , a white precipitate insoluble in dilute hydrochloric acid is formed.
- The action of heat on the insoluble compound C produces a gas which turns lime water turbid.
- Compound D when warmed with dilute sulphuric acid gives a gas which turns acidified dichromate solution green.

Question 5. Two elements A and B are stored under water and kerosene oil respectively. When a small piece of element is left in the open air, both starts warming up. The product in each case is dissolved in water. The solution from the residue of A was found to be acidic which that of residue was basic.

- Identify elements for the reaction of elements A and B on exposure to air.
- Write chemical equations for the reaction of elements A and B exposure to air.
- Write chemical equations for the reaction of the products formed in '(ii) with water.
- What is meant by "Activity series of Metals"?

Question 6. State what you see when

- A piece of moist blue litmus paper is placed in a jar of chlorine.
- A piece of red litmus paper is placed in a jar of ammonia.
- A burning splint is plunged in a jar containing carbon dioxide .
- Hydrogen and chlorine react in direct sunlight.
- Nitric oxide reacts with oxygen.

Question 7. Calculate the relative molecular mass ammonium chloroplatinate.

$[(NH_4)_2PtCl_4]$ [N=14,H=1, Pt=195, Cl=35.5]

- Thin strips of three different metals A, B and C are known to be magnesium, copper amd iron respectively.
- Write down what you would observe in each case when the metals are treated as follows:

- When each metal is heated in air.
- When each metal is treated with dilute hydrochloric warmed, if necessary.
- Arrange the metal A, B and C in the descending order of activity.
- At which electrode are the metals liberated during the electrolysis of metal slats?

Question 8. Name and state the gas law which his explained by Avogadro's law.

- Describe the changes you would observe when concentrated sulphuric acid is added to formic acid, HCOOH and warmed. Give equations.
- Name two crystalline substances which don't contain water of crystallization
- Give the name and formula of acid salt which gives sodium ions and sulphate ions in solution.

Question 9. A strip of copper is placed in four different colourless salt solution. They are KNO_3, AgNO3, $Zn(NO_3)_2$. Which one of the solutions will finally turn blue? Give a reason.

- How can you obtain (i) chlorine from hydrochloric acid and (ii) hydrochloric acid from chlorine? Give necessary equation.
- How is hydrogen chloride gas collected and dried?

Question 10. Why in the laboratory preparation of nitric acid, the apparatus is made of all glass?

- On heating magnesium powder in dry nitrogen, a light yellow solid is produced . This solid produces a pungent smelling basic gas when warmed with water. Write equation for the reaction mentioned above.

Theme 18: Research skills

- **Aims:** to teach learners to define the role of the research skills and their importance in science
- To introduce some common steps and rules of research skills
- To enable students use research skills in chemistry works and daily life

Activity 1. Brainstorming research topics. Teacher will divide class into groups of 5 or 6 and instruct them to write potential research topics related to chemistry that they find interesting or important. After the time is up groups will present topics. Discuss the topics in a class and choose the most interesting ones to work on it

Here is some possible answers:

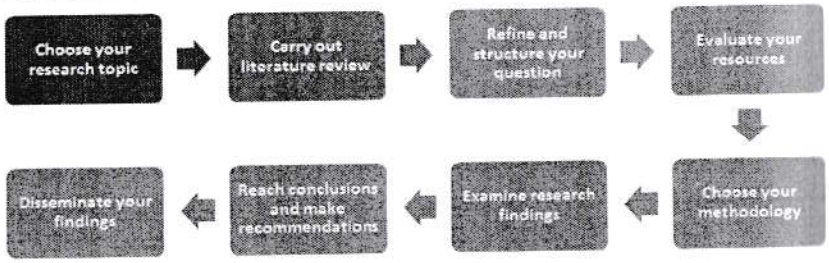
- Materials Chemistry. Synthesis of 2D Materials. Metal-Organic Frameworks (MOFs)
- Environmental Chemistry. Green Chemistry. Climate Change.
- Analytical Chemistry. Mass Spectrometry. Microfluidics.
- Organic Chemistry. Natural Products. Synthetic Chemistry.

Activity 2. What is research skiils and why do we need them? Teacher will explain what is research skill and why its needed by videos or power point presentation. Students will be introduced with some steps and rules of making research. Students will make notes of steps and benefits of research skills and write their own opinion on the topic of why do we need research skills.

Research skills allow you to find information and use it effectively. It includes creating a strategy to gather facts and reach conclusions so that you can answer a question.

Top tips of Starting your research

- **think about your topic** – don't be too vague or too specific (try mind mapping or keyword searching).
- **read broadly** around your subject (don't just use Google and Wikipedia). Think about a research question that is clearly structured and builds on literature already produced.
- **find information** using the subject databases. View the Database Orientation Program to learn about databases and using search strategies to refine your search and limit results.
- **carry out a literature review**. You may want to include journals, books, websites, grey literature or data and statistics for example. See the list of sources below for more information. Keep a record and organise your references and sources. If you are intending to carry out a systematic review then take a look at the systematic review page on our Research Support library guide.
- **evaluate your resources** – use the CRAAP test (Currency, Relevancy, Authority, Accuracy, Purpose - watch the video, top right).
- **reach considered conclusions** and **make recommendations** where necessary.



Why do I need research skills?

- they enable you to locate appropriate information and evaluate it for quality and relevance
- they allow you to make good use of information to resolve a problem

- they give you the ability to synthesize and communicate your ideas in written and spoken formats
- they foster critical thinking
- they are highly transferable and can be adapted to many settings including the workplace

Activity 3. Planning a research and presenting it. Students will choose a theme from exercise 1. And write their own research plan. Teacher will encourage students to think about the purpose, objectives, research questions, methodology and outcomes of their research project.

After students have finished writing they will present their plan to the class, others will ask questions and give feedback to the presenter. Teacher wiil ask students to make notes of each presentation for future reference.

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