Unit
01

Some Basic Concepts of Chemistry

Introduction

In this chapter the student finds the importance of chemistry in everyday life. It also provides a general awareness of scientific principles and methods used in Chemistry. The student gets an idea about the microscopic as well as macroscopic nature of particles and substances. The fundamental numerical calculations are also discussed in detail. A thorough discussion enables the students to get an idea about the nature of chemistry and makes the study of the subject easy so that he can pursue the studies with enthusiasm.

Concepts/ Ideas	Process/Activity with assessment	Learning outcome
Importance of chemistry in different spheres of life. • Observing • Communicating &understanding communication of others.	General discussion initiated by teacher about the importance of chemistry Charting of importance of chemistry in daily life **Assessment** • Participation in discussion(process) • Chart preparation(portfolio)	Explains the importance of chemistry in different spheres of life.
Three states of matter and its characteristics. • Observing • Communicating &understanding communication of others	General discussion by showing different samples of solids, liquids and gases. Charting of properties of solids, liquid and gases. **Assessment** • Participation in discussion(process) • Chart preparation(portfolio) • Quiz questions(portfolio)	Explains the characteristics of three states of matter
Classification of matter into elements, compounds and mixtures • Observing • Communicating &understanding communication of others • Collecting data	General discussion by showing elements, compounds and mixtures. Charting the classification **Assessment** • Participation in discussion(process) • Chart (portfolio)	Classifies different substances into elements, compounds and mixtures. Identifies pure substances
Different units and their measurement. • Using number relationships • Communicating &understanding communication of others	General discussion followed by small group discussion by giving the seven basic units for each group. Discussion of units of volume and density Problem solving based on prefixes in SI system **Assessment** • Participation in discussion(process) • Solving numerical problems(process) • Activity log (portfolio)	Defines SI base units and lists some commonly used prefixes. Identifies derived units like volume and density
Scientific notations and simple mathematical operations • Using number relationships • Communicating &	General discussion based on the importance of scientific notations expressing very large and very small numbers Problem solving based on scientific notations.	Uses scientific notations and performs simple mathematical operations on numbers

Concepts/ Ideas	Process/Activity with assessment	Learning outcome
understanding communication of others	**Assessment** • Participation in discussion(process) • Solving numerical problems(process)• Activity log (portfolio)	
Precision and accuracy • Observing • Using number relationships • Interpreting data • Infering	General Discussion giving examples of measurements clarifying precision and accuracy. **Assessment** • Participation in discussion(process) • Skill in data analysis(process)	Differentiates between precision and accuracy
Significant figures • Observing • Using number relationships • Measuring & charting	General discussion by giving examples. Problem solving based on measurements **Assessment** • Participation in discussion. (process) • Solving numerical problems. (process)	Identifies number of significant figures
Dimensional analysis • Using number relationships	General discussion on the importance of inter conversion of units Problem solving **Assessment** • Solving numerical problems. (process) • Activity log (Portfolio)	Converts physical quantities from one system of unit to another
Laws of chemical combinations • Classifying • Interpreting data	General discussion followed by small group discussion based on Laws of chemical combinations. Problem solving **Assessment** • Participation in discussion(process) • Solving numerical problems(process) • Activity log(Portfolio)	Explains various laws of chemical combinations
Dalton's Atomic Theory • Communicating &understanding communication of others	General discussion of Daltons atomic theory. **Assessment** • Participation in discussion (process)	Explains Daltons Atomic Theory
Atomic mass, molecular mass and mole concept. • Observing • Classifying • Using number relationships	General discussion leading to the importance of atomic mass, molecular mass and mole concept Problem solving based on atomic mass, molecular mass and mole concept	Describes the term, atomic mass, malar mass and mole..

Concepts/ Ideas	Process/Activity with assessment	Learning outcome
	Assessment • Participation in discussion(process) • Solving numerical problems(process) • Activity log(Portfolio)	
Percentage composition. • Using number relationships • Interpreting data	General discussion by citing common examples like water, carbon dioxide etc. Problem solving based on Percentage composition **Assessment** • Participation in discussion(process) • Solving numerical problems(process) • Activity log(Portfolio)	Calculates the mass percent of different elements constituting a compound
Empirical formula and molecular formula. • Using number relationships • Interpreting data	General discussion by taking an example Problem solving based on empirical formula **Assessment** • Participation in discussion(process) • Solving numerical problems(process) • Activity log(Portfolio)	Determines empirical formula and molecular formula for a compound from the given experimental data
Stoichiometric calculations. • Using number relationships • Interpreting data	General discussion by giving examples of balanced chemical equations, Limiting reagent and reactions in solutions. Problem solving **Assessment** • Participation in discussion(process) • Solving numerical problems(process) • Activity log(Portfolio)	Solves numerical problems based on stoichiometric equations.

Towards the Unit.....

Total 8 Periods

Concept: Importance of chemistry in different spheres of life

Suggested Activity 1.1 (1 period)

Teacher initiates a discussion on the topic 'importance of chemistry in different spheres of life'. Students are encouraged to participate in the discussion.

The following points can be used to ensure students participation.

- What are the basic constituents of matter?
- What are the areas in which chemical principles are applied?
- Importance of chemistry in food preparation, medicines and industry.
- What is the need of a good chemist in the present day world?

The students prepare a chart of the importance of Chemistry.

Consolidation:

Importance of chemistry in different spheres of life

Concept: Three states of matter and their characteristics.

Suggested Activity 1.2 (1 period)

The teacher invites the attention of students by showing common objects available in class room like chalk, water, etc, and starts a discussion which leads to the idea of matter and its three forms.

Discussion points

- What are these substances?
- Which physical state they have?
- What are the different physical states of matter?
- What are the properties of three physical states?

The properties of three states of matter are elicited from students and it is listed on the board or chart.

Consolidation: Three states of matter and its characteristics

Concept: Classification of different substances into elements, compounds and mixtures.

Suggested Activity 1.3 (½ period)

Teacher shows a metal piece of copper or aluminum, water or benzene or naphthalene and a mixture of substances like sand and water, sugar and

sand, sugar in water and asks the students to classify them according to the fundamental building units of matter contained in it.

The following questions can be used to lead them.

- What are these substances?
- What are the constituent particles of these substances?
- ……?
- ……?

Teacher should point out that copper contains only atoms, water contains only molecules and others contain more than one substances.

Teacher elicits from students the terms mixtures, pure substances and the types of mixtures. Teacher lists the classification on a board or chart.

Consolidation:

Classification of different substances into elements, compounds and mixtures

Concept: Different units and its measurements

Suggested Activity 1.4 (½ period)

- Teacher initiates a discussion on measurable properties of matter like mass, volume, pressure, temperature etc.
- Discussion is directed to two systems of measurement i.e. English and Metric.
- Teacher introduces the SI system of measurements, its origin and necessity (mention CGPM).
- Teacher lists some of the units of measurement on the board or chart by eliciting responses from students and the remaining units, if any, are introduced to students.
- Teacher introduces the basic difference between mass and weight, followed by the concept of volume, temperature and density.
- Simple mathematical problems are solved.

Consolidation:

Different units and its measurements

Concept: Scientific notations and simple mathematical operations

Suggested Activity 1.5 (½ period)

- Teacher introduces the difficulty of scientists in expressing large number of particles and very small amount of mass.
- For that Teacher can use Avogadro number and the mass of a hydrogen atom without using scientific notation.

- Teacher now explains the convenience of using scientific notation and solves numerical problems.
- Teacher can create small groups of students for solving the problems.

Consolidation:

Scientific notations and simple mathematical operations

Concept: Precision and accuracy

Suggested Activity 1.6 (½ period)

- Teacher introduces data of measurements taken by different persons and explains the terms accuracy and precision.

Consolidation:

Precision and accuracy

Concept: Significant figures

Suggested Activity 1.7 (½ period)

In continuation of the above discussion, teacher explains the importance of significant figures and lists the rules and illustrates it.

Simple mathematical operations are done using significant figures.

Consolidation:

Significant figures

Concept :Dimensional analysis

Suggested Activity 1.8 (½ period)

- Teacher introduces the concept by asking students to measure the length of an object like a chalk or pen in inches.
- Then He/She asks to convert the unit to centimeter. (They are not supposed to measure it with scale).
- Then teacher introduces the Unit factor method or Factor label method.

Consolidation:

Dimensional analysis

Concept: Laws of chemical combinations

Suggested Activity 1.9 (1 period)

Teacher checks the previous knowledge of students regarding elements and compounds. He/She develops a curiosity among students by asking how the elements are converted to compounds. The following prompting questions can be used.

- What do you mean by a chemical reaction?
- What about the mass of reactants and products?
- Is there any relation between mass of reactants and products?
- What about the elements present in a compound?
- What about the ratio of the masses of elements in the compound?
- What is the mass ratio if two elements combine to form more than one compound?
- ……
- ……

Teacher introduces five laws of chemical combinations and illustrate with examples.

- Simple problems are solved.

Consolidation: Laws of chemical combinations

Concept: Daltons Atomic Theory

Suggested Activity 1.10 (½ period)

Teacher initiates a discussion by using the following prompting question.

- What are the basic constituents of matter?
- Why is there a definite ratio between masses of elements in a compound?

Discussion should direct the attention of students to the fundamental particle, atoms.

Teacher consolidates the discussion by introducing the points of Dalton's atomic theory and charting it.

Consolidation: Daltons Atomic Theory (Total 1 Period)

ASSESSMENT

- Participation in discussion (process)

Concept: atomic mass, average atomic mass, molecular mass and formula mass

Suggested Activity 1.11 (½ period)

Teacher discusses with students the idea of weighing an atom in a conventional balance just like weighing common substances. Students share the difficulty in the process of weighing an atom in a physical balance.

Then teacher draws the attention of students to the fact that how peoples compared the weight of substances in ancient times, where no modern

weighing systems were available.

Discussion points are;

- How can we weigh common substances like rice, sugar, etc?
- What about weighing an atom in a physical balance?
- Why is it difficult?
- How we can measure the weight of an atom if atoms of elements only are available?

Teacher concludes with the idea that mass of atoms can be measured by comparing the mass of a particular atom, say, hydrogen with other atoms and the mass of atoms can be expressed as numbers which indicates how many times it is heavier than a particular atom.

Teacher introduces the use of C-12 atoms as a standard for measuring atomic mass of elements and the reason for this choice.

- Unit of atomic mass is introduced.
- Numerical problems are solved.
- The concepts of molecular and formula mass are also introduced.

Consolidation:

atomic mass, average atomic mass, molecular mass and formula mass.

Concept:

Mole and Molar mass

Suggested Activity 1.12 (½ period)

Teacher initiates a discussion on the problem of counting atoms in chemical reactions. Teacher can ask interesting questions related to daily life situations like;

- Can you buy 10000 green grams from a grocery shop just by counting?
- What is the difficulty in it?
- What is the easy method of buying the same thing from the shop?
- How you will buy 10000 green grams, if one weighs exactly 500mg, assuming all the grains have the same mass?
- ……?
- ……?

Teacher then compares the mass of different substances like grapes, lemons, oranges etc to make the students understand the idea that for the same number of different objects, they will have different masses. Teacher can ask the following type of questions

- What is the mass of 1 dozen each of grapes, lemons, oranges, etc.?
- If they have different masses, what is common regarding their number?
- ……?
- ……?

Teacher now extend this idea to atoms of different elements and introduces the concept of mole and Avogadro number. Further He/She introduces the concept of molecular mass and molar mass of atoms and molecules.

- The concept of formula unit mass of ionic compounds is also introduced.
- Numerical problems are solved.

Consolidation:

Mole and Molar mass

Concept:

Percentage composition

Suggested Activity 1.13 (1 period)

The teacher shows the students a sample of substance like water or sugar or any substance commonly used and interacts with the following type of questions.

- What is this substance?

If they say the correct answer or they are doubtful about the substance, Teacher can ask;

- How will you make sure that it is ……. .?
- If you are doubtful, how will you confirm it?
- How will you identify the elements present in it?
- How will you determine the mass of each element present?

(Teacher can now give a rough information of detection of elements and determination of its mass In the chapter 12 part 2)

Teacher explains the fact that, in such situations you can compare the given substance with a known one and confirms its percentage composition.

Teacher clarifies the expression for calculation of percentage composition and explains it with examples.

Consolidation:

Percentage Composition

Concept:

Empirical formula and Molecular formula

Suggested Activity 1.14 (2 period)

Teacher continues from the concept percentage composition and introduces the concept of empirical formula which is obtained from percentage composition.

The method of calculating molecular formula from empirical formula is also discussed.

- How can percentage composition be used to calculate number of moles?
- How the knowledge of number of moles can be converted to ratio of atoms?
- ……?
- ……?
- ……?

Teacher explains with suitable examples.

Consolidation:

Empirical formula and molecular formula

Topic:

Stoichiometric calculations

Concept:

Limiting Reagent

Suggested Activity 1.15 (1 period)

Teacher writes a balanced chemical equation in board and asks students;

- What information can be obtained from the balanced equation?
- What are the amount of reactants and products in terms of number of atoms, number of moles, grams, Avogadro number, etc.
- Teacher also introduces the concept of limiting reagent with an example.

Consolidation: Limiting reagent and other calculations based on chemical equations.

Concept:

Reactions in solutions

Suggested Activity 1.16 (2 period)

Teacher introduces the terms mass percentage, mole fraction, molarity and molality by the demonstration of dissolution of suitable solutes in suitable solvents.

For example, molarity and molality can be demonstrated to students by dissolving a suitable amount of solute in water and making upto one litre and one kilogram water.

Consolidation:

Mass percentage, Mole Fraction, Molarity and Molality

Unit wise TE Questions

1. The importance of Chemistry in everyday life is significant. Considering the above fact, match the following items appropriately.

1.Cisplatin	a. Super conducting material
2.CO_2	b.Ozone depletion
3.CFC	c.Cancer therapy
4.Ceramics	d.Green house effect
	e.Polymers

2. The measurement of mass of a substance by two students is reported below.

	I	II
Student A	1.99g	2.01g
Student B	1.85g	1.91g

(i) If the true mass of the object is 2g. Which of the following is correct?

a.) A is both precise and accurate
b.) B is both precise and accurate
c.) Both A and B is precise and accurate
d.) Neither A nor B is precise and accurate.

(ii) Justify your answer.

3. Multiplication of two significant figures 2.5 and 1.25, four students reported the result in four different ways as

a.) 3.125 b.) 3.1
c.) 3.12 d.) 3

(i) Identify the correct one
(ii) Represent the result if the above two numbers are added.

4. Unit factor method or dimentional analysis is a method to convert from one unit to another.

(i) In converting 1inch to centimeter, a student used the unit factor 1. 1inch/2.54cm =1 and another student used the unit factor 2.

2.54cm/1inch = 1. Which will yield the correct answer?

a.) 1inch/2.54cm =1 b.) 2.54cm/1inch = 1

c.) Both a and b d.) Neither a nor b

(ii) Prove that there are 172800 seconds in 2 days, using unit factor method.

5. A raindrop contains about 0.05 grams of water.

a. How many molecules of water are there in a raindrop?
b. How many hydrogen atoms are there in a raindrop?
c. How many oxygen atoms are there in a raindrop?

6. Mole is the fundemental unit of amount of Substance. It is defined as the amount of substance that contain 6.022×10^{23} particles.

(a) Which of the following pairs have the same number of atoms.

(i) 16 g of $O_{2\,(g)}$ and 4 g of $H_{2\,(g)}$

(ii) 16 g of O_2 and 44 g of O_2

(iii) 28 g of N_2 and 32 g of O_2

(iv) 12 g of $C_{(s)}$ and 23 g of $Na_{(s)}$

(b) In the reaction $2A+4B \rightarrow 3C + 4D$, when 5 moles of A react with 6 moles of B, then

(i) Which is the limiting Reagent

(ii) Calculate the amount of C formed.

7. 4.54L of dinitrogen reacts with 22.7L of dioxygen and 45.4L of nitrous oxide was formed. The reaction is given below.

$$2N_{2(g)} + O_{2(g)} \rightarrow 2N_2O_{(g)}$$

What are the laws being obeyed in this experiment. Write the statement of the laws?

8. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated Zinc. Following reactions takes place.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Calculate the volume of hydrogen gas liberated at STP when 32.65g of Zinc reacts with HCl. *(1 mol of a gas occupied 22.4L volume at STP, atomic mass of Zn = 65.34).*

Molarity and molality are used to express concentration of solutions. One litre of 1 molal and 1 molar solution are given. Justify the following statements.

(i) Both the solutions contain same number of moles of solute

(ii) 1 molal solution contain more amount of solvent than 1 molar solution.

(iii) 1 molal solution undergo change in concentration if it expands.

(iv) Molarity does not vary with temperature.

Data regarding isotopes of carbon are given below.

Isotope	Relative abundance (percentage)	Atomic mass (amu)
^{12}C	89.892	12
^{13}C	1.108	13.00335
^{14}C	$2x10^{-10}$	14.00317

(i) Calculate the average atomic mass of carbon

(ii) Express the mass of carbon-13 (^{13}C) atom grams.

REPOSITORY OF CE ACTIVITIES

For process assessment

- General discussion(Individual participation, Clarity of concept and views, etc.)
- Small group discussion (Group involvements, Sharing of ideas, Attitude to accept other's opinion, etc.)
- Completion of work sheets (Accuracy of results, Levels attained, Sequencing of concepts, etc.)
- Presentation of multimedia animations (Observation skill, Correct interpretation of concepts, etc.)
- Problem solving (Skill in manipulating numbers, Speed in computing data, Accuracy of results, etc.)

Portfolio assessment

- Suggested Activity Log (Clarity, Systematic approach, etc.)
- Work sheets (Clarity, Proper sequencing, etc.)
- Charts (Clarity, Authenticity of data, Appearance, etc.)

Unit based assessment

- Oral assessment
- Preparation of Text items and their indicators (both MCQs and Descriptive)

- Quiz
- Open book assessment
- Performance assessment (Work sheet can be used)

Open Book Examination

Unit test - Open book assessment

1. Given 58 grams of butane (C_4H_{10}) molecules:

   (a) What is the molecular mass of butane?

   (b) How many moles of molecules of C_4H_{10} are present?

   (c) How many molecules of C_4H_{10} are present?

   (d) What is the total number of atoms in each molecule of C_4H_{10}?

   (e) What is the total number of moles of atoms in each mole of C_4H_{10} molecules?

   (f) What is the total number of moles of atoms in the sample?

   (g) What is the total number of atoms in the sample?

2. $CH_{4(g)} + 2\ Cl_{2(g)} \rightarrow CH_2Cl_{2(g)} + 2\ HCl_{(g)}$

   Methane gas reacts with chlorine gas to form dichloromethane and hydrogen chloride, as represented by the equation above. A 25.0 g sample of methane gas is placed in a reaction vessel containing 2.58 mol of $Cl_{2(g)}$.

   (a) Identify the limiting reactant when the methane and chlorine gases are combined. Justify your answer with a calculation.

   (b) Calculate the total number of moles of $CH_2Cl_{2(g)}$ in the container after the limiting reactant has been totally consumed.

3. Decomposition of $CaCO_3$ is given as $CaCO_3 \rightarrow CaO + CO_2$

   1. What is the mass of CaO obtained if we take 100kg of $CaCO_3$
   2. If the CO_2 formed is reduced to STP, What is the volume of CO_2 obtained from 100g $CaCO_3$.
   3. What is the molar ratio of CaO and CO_2 formed?
   4. To get 11.2mL of CO_2 at STP, What should be the amount of $CaCO_3$ to be taken?

4. 60 g of Urea is added to 500g water to form a solution.

   1. Find the molality of the solution.
   2. What is the mass percentage of the solution?
   3. Find the mole fraction of Urea in solution.

Appendix 1.1

Avogadro's number = 6.02×10^{23} atoms/mol
mol of a gas at STP occupies 22.4 L.

1. How many atoms of oxygen are there in 18g of water?	
2. How many atoms of hydrogen are there in 18g of water?	
3. How many molecules of H_2O are there in 18g of water?	
4. What is the mass of 1 mol of O_2?	
5. What is the mass of 1 molecule of O_2?	
6. What is the mass of 2 mol of H_2SO_4?	
7. What is the density of O_2 at STP?	
8. 3 L of a gas at STP weighs 2 g. What is the molecular mass?	
9. What volume does 22g of CO_2 at STP occupy?	
10. How many atoms of hydrogen are present in 67.2 L of H_2 at STP?	

Appendix 1.2.

Comparing sugar ($C_{12}H_{22}O_{11}$) & H_2O		
Same/different	**1 gram each**	**1 mol each**
volume?		
Mass?		
No. of moles?		
No. of molecules?		
No. of atoms?		

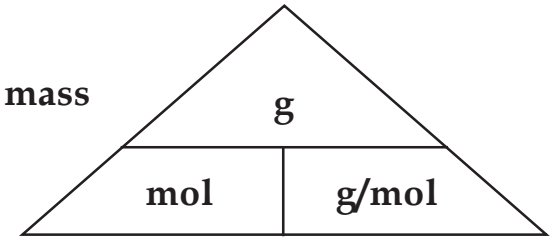
Appendix 1.3.

Converting between grams and moles

- If we are given the number of grams of a compound we can determine the number of moles, & vise-versa
- In order to convert from one to the other you must first calculate molar mass

  g = (mol x g) mol

  mol = g ÷ (g/mol)
- This can be represented in an "equation triangle"



Formula	Gram/mol	Gram	Mol (n)	Equation
HCI			0.25	g= (g/mol) x mol
H_2SO_4		53.15		
NaCI			3.55	
Cu		1.27		

References

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2. *http://www.chemcollective.org/*
3. *http://www.rsc.org/learn-chemistry*
4. *http://www.chem.uiuc.edu/clcwebsite/OLresources.html*
5. *http://www.chemistryexplained.com/Ma-Na/Mole-Concept.html*
6. *http://www.helpteaching.com/questions/Science/Grade_12*

Unit
02 Structure of Atom

Introduction

This unit deals with the experiments leading to the discovery of electron, proton and neutron.It also comprises the model of atom proposed by Thomson, Rutherford and Bohr. Merits and demerits of different models of atom are also given. Some basic aspects of quantum mechanical model of atom are also introduced.

Basic concepts regarding atomic structure is necessary for the proper conceptualization of advanced chemistry topics.

Concepts/ Ideas	Process/Activity with Assessment	Learning outcome
Discovery of fundamental particles and their characteristics. • Communicating and understanding communication of others • Observing • Inferring	General discussion on earlier concepts of atomic structure Multimedia presentation of animated video of discovery of fundamental particles Preparation of short notes on properties of fundamental particles. **Assessment** • Participation in discussion (Process) • Short Note (Portfolio)	Explains the discovery of electron, proton, neutron and their characteristics.
Thomson model of atom • Communicating and understanding communication of others • Observing • Measuring and charting	General discussion on Thomson model of atom Charting of schematic representation of Thomson model of atom **Assessment** • Participation in discussion (Process) • Chart (Portfolio)	Describes Thomson model of atom.
Rutherford's alpha ray scattering experiment and Rutherford model of atom • Communicating and understanding communication of others • Observing • Measuring and charting • Using space - time relationship	General discussion on gold foil experiment Multimedia animation of Rutherford's gold foil experiment Sketching schematic molecular view of gold foil General discussion on Rutherford model of atom **Assessment** • Participation in discussion (Process) • Chart (Portfolio)	Explains Rutherfords alpha ray scattering experiment and Rutherford's atom model
Electromagnetic radiation and electromagnetic spectrum • Communicating and understanding communication of others • Observing • Using number relationship	General discussion on electromagnetic radiation and electromagnetic spectrum. Multimedia presentation on electromagnetic spectrum and spectrum of visible light. Problem solving on characteristics of electromagnetic radiation. **Assessment** • Participation in discussion (Process) • Skill in problem solving (Process and Portfolio) • Activity log (Portfolio)	Identifies the characteristics of electromagnetic radiation and electromagnetic spectrum.

Concepts/ Ideas	Process/Activity with Assessment	Learning outcome
Planck's quantum theory, Black body radiation and Photoelectric effect • Communicating and understanding communication of others • Measuring and Charting • Using number relationship • Observing	General discussion on Planck's quantum theory, Black body radiation and photoelectric effect Multimedia presentation of photoelectric effect **Assessment** • Participation in discussion (Process) • Chart (Portfolio)	Explains Planck's quantum theory, Black body radiation and photoelectric effect.
Hydrogen spectrum • Communicating and understanding communication of others • Observing • Using number relationship	General discussion on Hydrogen spectrum Multimedia presentation of origin of line spectrum of hydrogen Problem solving based on hydrogen spectrum **Assessment** • Participation in discussion (Process) • Problem solving (Process and Portfolio)	Identifies different regions of hydrogen spectrum, its origin and solves numerical problems.
Bohr model of atom • Communicating and understanding communication of others • Observing • Inferring • Using number relationships	General discussion on Bohr model of atom Multimedia presentation on Bohr's model of atom Charting of features of Bohr's atom model Problem solving based on Bohr model of atom **Assessment** • Participation in discussion (Process) • Problem solving (Process and Portfolio) • Chart (Portfolio)	Explains Bohr model of atom and solves numerical problems.
Dual nature of matter- de Broglie's equation • Communicating and understanding communication of others • Using number relationships	Group discussion on dual nature of matter Derivation of de Broglie's relation Problem solving based on de- Broglie's equation. **Assessment** • Participation in discussion (process) • Problem solving (Process and portfolio)	Explains dual behavior of matter and de Broglie's equation, solves numerical problems

Concepts/ Ideas	Process/Activity with Assessment	Learning outcome
Heisenberg's Uncertainty principle. • Communicating and understanding communication of others • Using number - relationships	Group discussion on uncertainty principle Data analysis of uncertainties in position and momentum Problem solving based on uncertainty principle **Assessment** • Participation in discussion (Process) • Short note (Portfolio)	Explains Heisenberg's uncertainty principle and solves numerical problems.
Quantum mechanical model of atom • Communicating and understanding communication of others • Measuring and charting	General discussion on quantum mechanical model of atom and Schrodinger wave equation. Charting of features of quantum mechanical model **Assessment** • Participation in discussion (Process) • Chart (Portfolio)	Summarises the important features of quantum mechanical model of atom
Quantum numbers • Communicating and understanding communication of others • Using number - relationships	Group discussion on quantum numbers Charting of each quantum number, its significance and values Problem solving based on quantum numbers **Assessment** • Participation in discussion (Process) • Chart (Portfolio) • Problem solving (Process and Portfolio)	Explains the significance of quantum numbers
Probability density curves and shapes of atomic orbitals • Communicating and understanding communication of others • Observing • Inferring • Using space-time relationships	General discussion on probability density curves and shapes of atomic orbitals Charting on probability distribution curves and shapes of orbitals Multimedia animation on shape of orbitals **Assessment** • Participation in discussion (process) • Chart (Portfolio)	Sketches the probability distribution curve and boundary surface diagrams of s, p , and d orbitals
Aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity	General discussion on rules for filling electrons. Charting of electronic configuration Problem solving based on electronic configuration.	Explains the rules for electron filling in atoms and writes the electronic configuration of atoms.

Concepts/ Ideas	Process/Activity with Assessment	Learning outcome
• Communicating and understanding communication of others • Inferring • Using number relationships • Predicting • Measuring and charting	**Assessment** • Participation in discussion (Process) • Problem solving (Process and Portfolio)	

Towards the Unit.....

Content : Rutherford alpha ray scattering experiment and Rutherford's model of atom

Suggested activity 2.1 -

General discussion with the aid of multimedia animation on alpha ray scattering experiment (1 period)

Multimedia animation of Rutherford's alpha ray scattering experiment is shown in the class and afterwards a general discussion is conducted based on the following discussion points

→ Observations regarding the path of alpha particles

→ Conclusions arrived from the above observations

→ Features of Rutherford's model of atom

→ Demerits of Rutherford's model of atom

Consolidation

- Rutherford's gold foil experiment
- Rutherford's model of atom and its demerits

Content: Quantum numbers

Suggested activity 2.2 Small group discussion (1 period)

Learners are grouped benchwise and given a handout comprising the features of any one quantum number and allowed to conduct a small group discussion based on the handout. Representative of each group is allowed to present it generally.

Model of handout

Principal quantum number

Designation : n

What it denotes : The main energy level or shell to which an electron belongs

Values : 'n' can have any integral values , n=1,2,3,4,….

n=1 denotes K shell, n=2 denotes L shell ,….

Suggested activity 2.3- General discussion (1 period)

A general discussion is done in the class based on quantum numbers

Suggested activity 2.4- Problem solving (1 period)

Problems based on quantum numbers are given to learners and allowed to solve them.

Consolidation

Quntum of numbers

Repository of CE works

Process assessment

- General discussion and small group discussion
- Chart making
- Problem solving
- Presentation of multimedia animation
- Preparation of short notes

Portfolio assessment

- Activity log
- Chart

Unit based assessment

Unit test

Open book assessment

Quiz

ICT Possibilities

Multimedia presentation or animated video of

- Discovery of fundamental particles
- Rutherford's gold foil experiment

- Electromagnetic spectrum
- Spectrum of visible light
- Emission spectrum
- Absorption spectrum
- Hydrogen spectrum
- Bohr model of atom
- Shapes of orbitals
- Probability distribution curves

Sample TE Questions

1. The minimum energy needed to eject an electron from potassium metal is 3.83×10^{-19} J.

   (i) Identify the lights which can trigger photo electric effect. (Their wavelengths are given along with them)

   (a) Violet (400nm) (b) Orange (650 nm)

   (c) red (750 nm) (d) Green (550nm)

   (ii) Calculate the maximum kinetic energy of these ejected electrons

2. Some electromagnetic radiations are given below. Their wavelengths or frequency is given along with them. Construct a line spectrum of these. Identify the radiation which has an energy of 7.95×10^{-20} J

   [X-rays (2×10^{15}kHz), IR (40000 nm), FM radio waves (108Hz), AM radio waves (102m), UV (10^{16}Hz), Green (550nm)]

3. Write all the possible quantum numbers for the electrons belonging to 3s, 4s and 4p and construct the following table as instructed.

	3s	4s	4p
Principal quantum number			
Azimuthal quantum number/s			
Magnetic quantum number/s			
Spin quantum number/s			
Quantum numbers common in3s & 4s			
Quantum numbers common in 3s and 4p			
Quantum numbers common in 4s and 4p			

4. Some facts or statements are given below. Find out the rules or principle related to them. State the rules/ principles you identified.

   (i) Electronic configuration of Nitrogen is $1s^2$, $2s^2$, $2p_x^1$,$2p_y^1$,$2p_z^1$

   (ii) An orbital can accommodate only two electrons

   (iii) Electrons fill in 4s orbital before it enters 3d

5. Select the odd one out regarding electronic configuration in the following groups and justify

   (i) (a) Carbon (b) Nitrogen (c) Oxygen

   (ii) (a) Cobalt (Z=28) (b) Copper (Z=29) (c) Zinc (Z=30)

6. Solve the following problems, Name the proponents of the equation you used for solving the problems and clearly state the concept/ principle related to the equations

   (i) Find out the wavelength of an electron moving with a speed of 4 km/s ($h=6.626 \times 10^{-34}$Js)

   (ii) A ball of mass 50 g is moving with a speed of 50 m/s. If the speed can be measured only with in an accuracy of 10%. Calculate the uncertainty in position.

7. Analyse the following data

Mass number	**Number of neutrons more than that of proton (in percentage)**
206	51.21
207	49.39

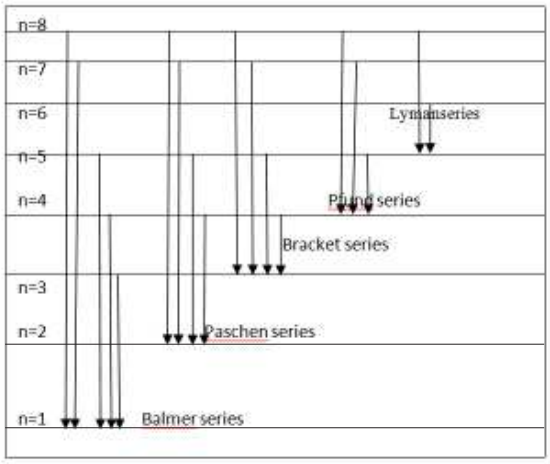
   (i) Assign atomic symbol

   (ii) Identify the relationship between them (isotope, isobar or isotone). Justify.

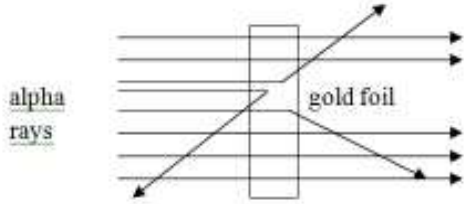
8. Reason for origin of different lines in hydrogen spectra is schematically represented below. The names of series are represented wrongly

   (i) Redraw it representing the correct series

   (ii) Calculate the wave number corresponding to missing lines in the diagram of each series. (R_H = 109677 cm^{-1})



9. Analyse the following diagram



(i) Give the scientific observations from the diagram

(ii) Also write the conclusions arrived from the above observations

10. "Orbit and orbital differs in many aspects" Substantiate this statement. Also draw the boundary surface diagrams of 3d orbitals.

References

1. *Castellan, Physical chemistry, 3rd Edition*
2. *Puri, Sharma, Pathania, Principles of physical chemistry*
3. *Puri, Sharma, Pathania, Principles of Inorganic chemistry*
4. *Olmsted & Williams, Chemistry*
5. *Huheey, Keiter, Inorganic chemistry*
6. *Manaschanda , Atomic structure and the chemical bond*