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APPENDIX : I

LESSON TRANSCRIPTS BASED ON IPM
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<td>5</td>
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<td>Different Types of Chemical Reactions.</td>
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GOAL OBJECTIVES OF CAM

1. The VIII th standard students should recognise the attributes of the concepts 'Physical change' correctly
2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.
3. They will generate new examples of the concepts.
4. They will form concept rules.
5. They will locate the examples and state the attributes of the concept as appear in the example

Type of Model : Reception
Type of Concepts : Conjunctive
Learning Modality : Experiment and examples
Reception Strategy : Wholists Strategy

Elements of the Concepts.

1. Name : Physical change
   Chemical change
2. Essential attributes : Formation of a new substance
3. Positive exemplars : 1) A wooden stick is broken into two pieces
                      2) A chalk piece is broken into two
                      3) A paper is cut into two
                      4) A glass tumbler is broken into pieces
                      5) Water vapourises to form steam
                      6) An iron nail is magnetised
7) When current is switched on to an electric bulb
8) Sulphur in a test tube when boiled and then cooled

4. Negative exemplars:-
   1) Magnesium burns in Oxygen to form Magnesium oxide
   2) When a piece paper is burnt
   3) When acidified water is electrolysed
   4) Mercuric oxide is heated in a test tube.
   5) Sodium chloride is treated with silver nitrate solution.
   6) Zinc is treated with dilute sulphuric acid.

5. Rule:

   A temporary change of a substance which does not involve the formation of a new substance is called a physical change.

   The change in which the original materials disappear and new substances are formed, is called a chemical change

Phase One: Presentation of the Data and identification of the Concept.

T. Today we are going to play a game. I will give you some examples of a particular concept. If the example contains the concept, I will say it a ‘yes’ example. If it does not provide the concept, I will say it a ‘No’ example. You should say what is that particular concept in my mind. You should cite more examples and form a definition of that concept according to the characteristics.
Now let us see an example which is a 'yes'
'A wooden stick is broken into two'
Can you say what the concept is?

S: No. Please give more examples.

T: Let us pass to the second 'Yes' example.
'a chalk piece is broken into pieces'

S: Can you give another example which does not contain the concept?

T: Yes. Here is a no example. a piece of Magnesium is burnt. White powder of Magnesium Oxide is obtained. Can you write the chemical equation?

Yes, \(2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}\)
This is an example for a chemical reaction

T: Yes, I shall give you another 'Yes' example
'A glass tumbler was broken to pieces' Have you got any idea of my concept.

S: Yes; A change in the shape and size of the material. But no new substance is formed.

T: Yes. Here is a 'No' example of my concept. Sodium chloride is treated with Silver nitrate solution 'What is the change that you observe?

S: A white precipitate is formed.

\(\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3\). This is also a chemical reaction where new substances are formed.
You have got the concept. Can you name the concept?

S: NO

It is a physical change. It is a temporary change of a substance which does not involve the formation of a new substance.

Can you name the concept of the ‘No’ examples.

S: Yes, it is chemical change

Right. The change in which original materials disappear and new substances are formed is called a chemical change.

Phase Two: Testing the Attainment of the Concept

Now I am going to test whether you have understood the concept. I shall give you some examples and you should say whether it is a ‘yes’ or ‘No’ for physical change and chemical change. ‘Appaer is cut into pieces’

S: It is a ‘Yes’ example for physical change and ‘No’ example for chemical change.

Correct. Another one. Sulphur is burnt with bluish flame giving a colourless gas.

S: It is a ‘No’ example for physical change and ‘Yes’ example for chemical change.

Yes, Can you give an ‘yes’ example for chemical change?
S: Sugar when heated changes to carbon

T: Correct, then give an ‘Yes’ example for physical change.

S: The iron piece in contact with water changes into rusted iron.

Phase three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept

S: When you present two yes examples, it was difficult to form the concept. But when you present the ‘No’ example it can be guessed that, you were thinking about changes where substances are not formed and in the ‘NO’ examples you presented later too helped to attain the concept on physical change which is a temporary change where new substances are not formed. But in chemical changes new substances are formed.
LESSON PLAN No : 2

LEARNING MATERIAL FOR AOM

Simple combination is a reaction in which the molecules of two or more substances combine to form a molecule of a single new substance.

Simple decomposition is a reaction in which the molecules of one substance break up to form molecules of two or more different substances.

LESSON TRANSCRIPTS

Advance organisers

1. Simple combination
2. Simple decomposition

The strategy here is to present the students with major ideas (organisers) that can help them as they try to read and understand the material. In this particular episode, two organisers are presented. The organisers are based on chemical experiments and equations.

T: Today we are going to study the different types of chemical reactions. It depends on the type of reactants and the procedure of reactions. You have already studied the differences between physical and chemical changes. In this concept, you have to identify the different characteristics. What is meant by physical change?

How it differs from chemical change?

S: Physical change is a temporary change in which no new substances are formed. But in chemical change, the original reactants disappear and new substances are formed.

Orientation to the process. clarifies the aims of the lesson.

Existing cognitive structure
Phase one: Presentation of Advance Organisers.

T: There are different types of chemical reactions. In simple combination the molecules of two or more substances combine to form a molecule of a single new substance. In simple decomposition the molecules of one substance break up to form molecules of two or more different substances.

Phase Two: Presentation of Learning Material

T: A piece of Magnesium ribbon is burnt in a flame. What happens?
S: The ribbon burns with a dazzling white light and white powder is obtained.
T: Can you write the chemical equation for this reaction?
S: \(2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}\)
T: Yes, Sulphur powder is taken in a test tube and it is fused with a little Iron powder. What changes you observe? Can you write the chemical equation.
S: Iron combines with Sulphur to form Iron sulphide
\(\text{Fe} + \text{S} \rightarrow \text{FeS}\)
T: Calcium oxide is mixed with water. What is the product obtained?
S: Calcium Hydroxide is formed.
\(\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2\)
T. Yes, What similarity can you observe in the above reactions?

S. Two substances combine to form a single substance.

T. Yes. It is called a simple combination reaction. It can be symbolically presented as \( A + B \rightarrow AB \).

In the case of Lead nitrate when it is heated, Lead monoxide, Nitrogen dioxide and Oxygen are formed. Can you write the equation?

S. \( 2\text{Pb(NO}_3\text{)}_2 \rightarrow 2\text{PbO} + 4\text{NO}_2 + \text{O}_2 \)

T. Yes. A little Potassium permanganate is heated in a test tube. What changes you observe? Write the chemical equation.

S. The pellets of \( \text{KMnO}_4 \) breakup and a gas is evolved

T. When \( \text{KMnO}_4 \) is heated, Potassium manganate, Manganese dioxide and Oxygen are formed.

\( 2\text{KmnO}_4 \rightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2 \)

What happens when Potassium nitrate is heated?

S. \( 2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2 \)

Potassium nitrite and Oxygen are formed.

T. What is the action of heat on Mercuric Oxide?

S. \( 2\text{HgO} \rightarrow 2\text{Hg} + \text{O}_2 \)

Mercury and Oxygen are formed.

T. What are the products obtained when acidified water is electrolysed?
S: \( H_2 \) and \( O_2 \) are the products
\[
2H_2O \rightarrow 2H_2 + O_2
\]

T: What is the peculiarity of the above reactions?

S: Molecules of one substance break up to form molecules of two or more different substances

T: Yes. These type of reactions are called simple decomposition reactions. It can be symbolically represented as:

\[
AB \rightarrow A + B
\]

Phase Three: Strengthening the Cognitive Organisation

T: Can you give a summary of the major attributes of the concepts we described?

S: In simple combination reactions, molecules of two or more substances combine to form a single substance. In simple decomposition, the molecules of one substance break up to form molecules of two or more different substances.
LESSON PLAN No:3

LEARNING MATERIAL FOR AOM

Simple displacement is a reaction in which atoms of an element replaces the atoms of one of the elements in the molecule of a compound.

Double decomposition is a reaction in which the molecules of two compounds exchange their component parts to form two different substances.

LESSON TRANSCRIPT

Advance Organisers

1. Simple displacement
2. Double decomposition

The strategy here is to present the students with major ideas (organisers) that can help them as they try to read and understand the material. In this particular episode, two organisers are presented. The organisers are based on chemical experiments and equations.

T. Today we are going to study the different types of chemical reactions. It depends on the type of reactants and the procedure of reactions. You have already studied the different types of reactions like simple combination and simple decomposition. In this lesson, you have to identify the different characteristics of the concepts.

What is the difference between simple combination and simple decomposition reactions?

In simple combination, two or more molecules combine to form a single molecule, and in simple
decomposition the molecule of a substance break up to form molecules of two or more different substances.

Phase one: Presentation of the Advance Organisers

T: In addition to simple combination and simple decomposition reactions, two or more types of reactions are there. In simple displacement, the atoms of an element replace the atoms of one of the elements in the molecules of a compound in double decomposition reactions the molecules of two compounds exchange their component parts to form two different substances.

Phase Two: Presentation of Learning Material

T: Immerse a clean iron nail in a solution of copper sulphate. What do you observe?
S: A red deposit can be seen on the surface of iron nails.
T: Yes, Fe+CuSO$_4$ → FeSO$_4$+Cu
A few zinc pieces are added to dilute sulphuric acid. What can you observe?
Can you write the chemical equation for the reaction.
S: A gas is evolved.
T: A burning splinter is shown at the mouth of the test tube. It is put off with a sound, what is that gas?
S: It is hydrogen gas.
Zn+H$_2$SO$_4$ → ZnSO$_4$+H$_2$
T: Right. Can you represent the above reactions in a symbolic form?

S: A + Bx → Ax + B

T: Correct. These type of reactions are called simple displacement reactions. Can you define simple displacement reactions?

S: In simple displacement reactions, the atoms of an element replace the atoms of one of the elements in the molecules of a compound.

T: OK. Sodium chloride is treated with silver nitrate solution in a test tube. What can you observe?

S: A white precipitate is formed.

T: Yes, a white precipitate of silver chloride is formed.

\[ \text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3 \]

H₂S gas is passed through copper sulphate solution. Can you write the equation?

S: H₂S + CuSO₄ → H₂SO₄ + CuS

T: Lead nitrate solution is treated with Potassium iodide solution. What can you observe? Can you write the equation?

S: An yellow precipitate is formed

\[ \text{Pb(NO}_3)_2 + 2\text{KI} \rightarrow 2\text{KNO}_3 + \text{PbI}_2 \]

T: Barium chloride solution is treated with sodium sulphate solution. What is your observed result?
S: A white precipitate is obtained.

$$\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$$

T: These type of reactions are called double decomposition reactions. They can be represented as $$A\text{x}+B\text{y} \rightarrow A\text{y}+B\text{x}$$

Can you define double decomposition reactions?

S: The reactions in which the molecules of two compounds exchange their component parts to form two different substances are called double decomposition reactions.

Phase three: Strengthening Cognitive Organisation

T: Can you give a summary of the major attributes of the concepts we discussed?

S: In simple displacement reactions the atoms of an element replace the atoms of the one of the elements in the molecule of a compound. In double decomposition reaction, the molecules of two compounds exchange their components parts to form two different substances.
LESSON PLAN No:4
SUPPORT SYSTEM FOR ITM

The matter cannot be created or destroyed. The mass of the reactants remains the same as the mass of the products.

Phase One: Orientation to the Process and Encounter with the Problem.

T: I am going to teach you in a different manner which is quite new to you. First of all I will present you a problem, the solution of which shall be found out by yourselves. You can ask as many questions as possible. But one condition is that the questions should be framed in such a way that I can answer YES or NO. Only one question at a time. Here is the problem which is an experiment.

Sodium chloride is taken in a conical flask and silver nitrate taken in a test tube is hanged by a string into the flask. The mass of the equipment is noted. The test tube is filled so that silver nitrate reacts with sodium chloride solution. The mass of the equipment is noted again. It remains the same. What you infer from this?

Phase Two & Three Data Gathering Verification & Data Gathering Experimentation

S: Is it something related to the speed of the reaction?
T: No
S: Does the mass of the apparatus used an influencing factor?
T: No.

S: Does the mass remains the same even after some days?

T: Yes

S: If the mass changes after sometime, would the inference also changes?

T: Yes

S: If the mass of the reacting substances changes, would it show the same mass (as in the previous case) after the reaction

T: No

Phase Four: Formulation of an Explanation

T: You have noted the mass of the reactant substances and the mass of the products. Then can you formulate an explanation.

S: Yes, the mass of the reacting substances and the mass of the products formed remain the same in a reaction

T: Yes, Matter cannot be created or destroyed. This law is known as law of conservation of mass.


T: What kind of questions did you ask?

S: About the properties of the substances used in the reaction
S: About the mass of the equipments used

T: OK That was what you did. You saw the problem, then by asking questions you arrived at the theory.
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LESSON PLAN No. 1

GOAL OBJECTIVES OF CAM

1. The IXth standard students should recognise the attributes of the concepts ‘Oxidation’ ‘Reduction’ Oxidising agent and ‘Reducing agent’ correctly.

2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.

3. They will generate new examples of the concepts.

4. They will form concept rules.

5. They will locate the examples and state the attributes of the concept as appear in the example.

Type of Model : Reception
Type of Concepts : Conjunctive
Learning Modality : Chemical reactions and experiments

Elements of the Concepts

1. Name : Oxidation

2. Essential Attributes : Addition of Oxygen

3. Positive Exemplars : 1) C+O\textsubscript{2} → CO\textsubscript{2}
2) 2Mg+O\textsubscript{2} → 2MgO
3) 2CuO+C → 2Cu+CO\textsubscript{2}

4. Negative Exemplars : 1) 2H\textsubscript{2}O\textsubscript{2} → 2H\textsubscript{2}O+O\textsubscript{2}
2) Zn+2HCl → ZnCl\textsubscript{2}+H\textsubscript{2}
3) AgNO\textsubscript{3}+NaCl → AgCl+NaNO\textsubscript{3}

5. Rule:

The reactions in which any substance combines with Oxygen is called Oxidation.
1. Name : Reductions

2. Essential Attributes : Loss of Oxygen.

3. Positive Exemplars:
   1) \(2CuO+C \rightarrow 2CuO+CO_2\)
   2) \(2ZnO+C \rightarrow 2Zn+CO_2\)
   3) \(Mg+H_2O \rightarrow MgO+H_2\)

4. Negative Exemplars:
   1) \(C+O_2 \rightarrow CO_2\)
   2) \(S+O_2 \rightarrow SO_2\)
   3) \(2H_2+O_2 \rightarrow 2H_2O\)

5. Rule:
   Chemical reaction in which a substance loses Oxygen comes to be called Reduction.

Phase One : Presentation of Data and Identification of the Concept

T: Today we are going to play a game. I will show you some experiments and write some chemical equations, which bear the concept. If it contains the concept I will say it a “Yes” example. If it does not contain the concept, I will say it is a “No” example. You should say what is that particular concept in my mind. You should cite more examples and form a definition of that concept according to its characteristics.

Now let us see the first example, which is a “Yes” when Carbon burns in air Carbon dioxide is formed.

\(C+O_2 \rightarrow CO_2\)

S: Burning in air means reaction with Oxygen.

T: It is a mere guess. Let us pass on to an experiment.
Magnesium burns in air. Magnesium Oxide is formed.

\[ 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \]

This is also an "Yes" example. Can you say what my concept is?

S: Burning in air

S: Reaction with oxygen

T: Yes, you are coming to the concept. I shall give another example which is a "No" example

\[ \text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2 \]

S: In this reaction Oxygen is not involved

T: Here is another "No" example

\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]

Can you say what my concept is?

S: Here also oxygen is involved. Give more examples

T: An "yes" example is providing. Heating a mixture of Cupric oxide and Carbon powder. What are you observing?

S: A reddish brown powder is obtained.

T: Can you write the chemical equation?
S: \[2\text{CuO} + \text{C} \rightarrow 2\text{Cu} + \text{CO}_2\]

Here also Oxygen is added to Carbon

T: Yes, Can you name the concept?

S: No

T: It is oxidation

T: The reaction in which any substance combines with Oxygen is called Oxidation. Now I can bear another concept in mind. I shall provide an "Yes" example.

\[2\text{CuO} + \text{C} \rightarrow 2\text{Cu} + \text{CO}_2\]

Can you guess what my concept is?

S: No. Give more examples

T: Here is another "Yes" example.

\[2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2\]

S: Here also Oxygen is added to carbon

T: No. Look at the other part of the reaction

S: Oxygen is removed from CuO and ZnO

T: Yes, I shall give a "No" example, then you will say the concept in mind

\[\text{C} + \text{O}_2 \rightarrow \text{CO}_2\]

S: Please give one more "No" example

T: \[\text{S} + \text{O}_2 \rightarrow \text{SO}_2\]
S: It is removal of Oxygen from Compounds

T: Yes. It is reduction. Chemical reaction in which a substance loses Oxygen is called reduction.

In the above reactions CuO and ZnO are called oxidising agents and C is acting as a reducing agent. Can you state the attributes of Oxidising agent and Reducing agent?

S: Oxidising agents provide Oxygen in reactions and reducing agents removes Oxygen from compounds.

T: Yes, you are correct. In reaction, Oxidising agents are reduced and reducing agents are oxidised. The combined process of Oxidation and Reduction is called redox reaction.

Phase Two: Testing the Attainment of the Concept

T: Now I am going to test whether you have understood the concepts "Oxidation" & "Reduction". I shall give some examples and you should say whether it is a "Yes" or "NO". The concept in my mind is Oxidation.

AgNO₃ + NaCl → AgCl + NaNO₃

S: No

T: Correct. Another one

₂H₂ + O₂ → ₂H₂O₂

S: "Yes"

The concept in my mind is reduction. Say whether this example is "Yes" or "No".
C+O₂ → CO₂

S: No

T: Good. What is meant by redox reaction

S: The combined process of Oxidation and Reduction

T: Can you cite an example for reduction

S: 2ZnO+C → 2Zn+CO₂

ZnO is reduced

Phase Three: Analysis of Thinking Strategies

S: From the first two examples I got an idea of burning in Oxygen. When you provide the "No" example I confirmed it. Similarly in the case of reduction also I got the concept by comparing the similar cases of Oxidation reactions When you asked to think of the remaining part of the chemical equation I confirmed the concept of Reduction.

Student states concept rules.

Student supplies his own example

Student describes thoughts
LESSON PLAN No. 2
GOAL OBJECTIVES OF CAM

1. The IX\textsuperscript{th} standard students should recognise the attributes of the concepts 'Oxidation' and 'Reduction'.

2. They will state the attributes correctly, and label the unlabelled examples given by the teacher correctly.

3. They will generate new examples of the concepts.

4. They will form concept rules.

5. They will locate the examples and state the attributes of the concept as appear in the example.

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<td>Type of Concepts</td>
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<tr>
<td>Learning Modality</td>
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<td>Reception Strategy</td>
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Elements of the Concepts

1. Name: Oxidation and reduction

2. Essential Attributes: Gain or loss of electrons

3. Positive Exemplars:
   1) \( \text{Na} \rightarrow \text{Na}^+ + e^- \)
      \[2,8,1 \quad 2,8\]
   2) \( \text{Mg} \rightarrow \text{Mg}^{2+} + 2c^- \)
      \[2,8,2 \quad 2,8\]

4. Negative Exemplars:
   1) \( \text{Cl} + e^- \rightarrow \text{Cl}^- \)
      \[2,8,7 \quad 2,8,8\]
   2) \( \text{O} + 2e^- \rightarrow \text{O}^{2-} \)
      \[2,6 \quad 2,8\]
Positive exemplars above mentioned can be treated as negative exemplars for reduction and negative exemplars mentioned above are positive exemplars for reduction.

5. Rule: Oxidation is a process involving loss of electrons.
Reduction is a process involving gain of electrons.

Phase one: Presentation of Data and Identification of the Concept

T: I am going to present before you some ionic equations. Some equations bear the concept that I have in my mind and some others do not bear the concept. Now let us see the first example which is a "Yes" example.

Sodium chloride is formed from Sodium atom and a Chlorine atom. Sodium loses its outermost electron and forms a positive ion.

\[ \text{Na} \rightarrow \text{Na}^+ + e^- \]

2,8,1 2,8

Can you say what my concept is?

S: Is it formation of ions?

T: No. Here is a "No" example.

Chlorine atom gains an electron to form chloride ion.

\[ \text{Cl}^- + e^- \rightarrow \text{Cl}^- \]

2,8,7 2,8,8

S: Please give one more "Yes" examples.

T: When Magnesium Oxide is formed from Magnesium and Oxygen, Magnesium atom loses two electrons.

Teacher presents third labelled example.
Mg → Mg$^{2+}$ + 2e$^-$
2,8,2  2,8
S: Reaction in which there is loss of electrons

T: Yes, the concept is Oxidation. Can you define it?

S: Oxidation is a process involving loss of electrons

T: Now I have another concept in my mind. One "Yes" example for it is,

Cl$^-$ + e$^-$ → Cl$^-$
2,8,7  2,8,8

S: Please give a "NO" Example?

T: Mg → Mg$^{2+}$ + 2e$^-$
2,8,2  2,8

S: Is it gain of electrons?

T: Yes, it is reduction. Can you define it?

S: Reduction is a process involving gain of electrons

T: Can you define Oxidising agent and Reducing agent?

S: Oxidising agent gains electrons and reducing agent loses electrons

Second hypothesis compares the "Yes" example
Teacher names the concept
States the attributes of the concept
Teacher presents first labelled example
Teacher presents second labelled example
First hypothesis
Teacher names the concept
States the attributes of the concept
Asks questions that focus on students thinking on essential attributes
States the attributes of the concept
Phase Two : Testing the Attainment of the Concept

T: Now I am going to test whether you have understood the Concepts Oxidation and Reduction. I shall give some examples. You should say whether it is a ‘Yes’ or ‘No’

The Concept in my mind is Reduction

\[ \text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl} \]
\[ \text{H} \rightarrow \text{A}^+ + e^- \]

S: No

T: Correct

\[ 2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2 \]
\[ \text{Zn}^{2+} + 2e^- \rightarrow \text{Zn} \]

S: Yes

T: Can you identify the Oxidiser in the above reaction?

S: ZnO

T: Can you define Reducer?

S: Reducer is a substance that loses electrons

Phase Three : Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: When you gave the first example, I didn’t get a clear idea. When I got the second ‘Yes’ example and a third ‘No’ example I could be able to compare them and I got the concept of Oxidation that you thought.
Oxidation state

The Oxidation state of an element is said to be the number of electrons lost or gained by the atom during chemical reaction relative to its elemental state.

LESSON TRANSCRIPT

Advance Organiser - Oxidation State

The strategy here is to present the students with major ideas (Organiser) that can help them as they try to read and understand the material. In this particular episode the organiser presented is based on electronic concept of Oxidation and Reduction.

T: Today we are going to study oxidation and reduction reactions in terms Oxidation state or Oxidation number

How can you define oxidation and reduction using electronic concept?

S: Oxidation is a process involving loss of electrons and reduction is a process involving gain of electrons.

Phase One : Presentation of the Advance Organiser

T: The Oxidation state of an element is said to be the number of electrons lost or gained by the atom during chemical reaction relative to its elemental state.

Advance organizer is introduced
Have you heard of the electronegativity of atoms? Can you define it?

S: It is the ability of an atom to attract electrons towards it during chemical reaction.

T: How are atoms represented if they have a difference in electronegativity?

S: The more electronegative atom gains electrons and forms a negative charge and the less electronegative atom forms a positive charge

**Phase Two: Presentation of Learning Material**

T: Let us consider the formation of HCl molecule. What charges can be ascertained to H and Cl?

S: Chlorine is more electronegative and forms a negative charge and H forms a positive charge.

T: Yes, Chlorine develops -1 charge or -1 Oxidation state and H develops +1 Oxidation state. Similarly can you say the Oxidation states of H and O in H2O?

S: Hydrogen atom develops +1 Oxidation State and Oxygen develops -2 Oxidation state.

T: What is the algebraic sum of Oxidation numbers in a molecule?

S: It is zero
What will be the Oxidation number of Carbon and Hydrogen in Methane?

Oxidation state of Chlorine is -1 and that of Carbon is +4

Why the Oxidation state of an atom in a molecule of an element is zero?

The electronegativities of the atoms are same and electrons are mutually shared between them

In the case of F₂O and the Oxidation state of Oxygen is +2 since F has an Oxidation state -1

What will be the Oxidation state of N in HNO₃?

H₃N⁺O₃⁻ = 0
+1⁺N⁺(3 x -2) = 0
N = +5

Consider the reaction 2CuO+C → 2Cu+CO₂

What happens to the Oxidation state of various elements

The Oxidation State of Copper in CuO decreases from +2 to zero and that of Carbon increases from 0 to +4

What happens to CuO and C in the reaction?

CuO is reduced to Cu and C is oxidised to CO₂

Yes, Can you define oxidation and reduction using Oxidation number concept?

If the Oxidation state increases it is oxidised and if it decreases the atom is reduced.
Phase Three: Strengthening of the Cognitive Structure

T: Can you give a summary of the major attributes of the concept we discussed?

S: Due to electronegativity difference between atoms, they develop + or - Oxidation state depending on the number of electrons gained or lost.

T: How do you explain the concept of oxidation and reduction using the Oxidation number concept?

S: If the oxidation state of an element increases, in a chemical reaction, the element is said to be oxidised and if it decreases, the element is said to be reduced.

Relates the learning material to the subsumer.

Promotes active reception learning.

Repeats precise definitions.
LESSON PLAN No: 4
SUPPORT SYSTEM FOR ITM

LEARNING MATERIAL

INSTRUCTOR FACT SHEET

Valency is the combining capacity of an element. The electrons in the outermost shell of an atom are called valence electrons. Therefore Valency and Oxidation state are mutually related. They are numerically equal. Valency is a mere number. The transition elements show variable valency because the electrons of not only the outermost shell but also of the penultimate shell take part in the chemical reaction.

Phase I: Orientation to the Process and Encounter with the Problem.

T: I am going to teach you in a very different manner which is quite new to you. First of all, I will present a problem to you, then we will try to find out the solution. You will have to ask questions for which I will say only ‘Yes’ or ‘No’

Valence electrons are the electrons present in the outermost shell of an atom. But Iron shows a Valency of 2 in Ferrous compound and 3 in Ferric compounds. What is your solution for this anomaly?

Phase II & III: Data Gathering Verification and Experimentation

S: Does valency mean the electrons in the outermost shell?

T: No

S: Does valency mean the electrons that gain or loss from an atom during reaction?
T: Yes
S: If it is the electron that take part in chemical reaction responsible for valency, would they differ from an atom to atom?
T: Yes.
S: Do the electrons in the outermost shell only take part in reaction always?
T: No
S: If other electrons too take part in the reactions, would they determine the valency of an electron?
T: Yes.
S: Then the inference can be stated as Iron uses not only electrons present in the outermost shell but also electrons present in the penultimate shell.

Phase IV: Formulation of an Explanation

T: Your inference is correct, then can you relate the valency and oxidation number?
S: Both are same
T: Yes, numerically same, but oxidation number bears negative or positive signs
T: Does the valency of Mn remains the same in MnO₂, MnCl₂ and in KMnO₄?
S: In MnCl₂ Valency of Mn is 2
   In MnO₂ , Valency of Mn is 4
   In KMnO₄ , valency of Mn is 7

Asks data gathering experimentation questions.
Asks data gathering verification questions.
Asks data gathering experimentation questions.
Isolates relevant variables and finds casual relationship.
Invites clear statement of the theory.
Teacher gives relevant information.
Applies the knowledge in similar situations.
Phase V: Analysis of the Inquiry Procedure

T: What kind of questions did you ask?

S: The questions related to the oxidation state and how they are related or affected during chemical reactions.

T: Yes then —

S: From your responses it became easy to arrive at an inference regarding the different valencies shown by same atom.
1. Name of Teacher          : Rema Devi. K.
2. Name of School           : S.H.H.S. Changanacherry
3. Class                   : X
4. Subject                 : Chemistry.
5. Unit                    : Chemical Kinetics.
LESSON PLAN No : 1

GOAL OBJECTIVES OF CAM

1. The Xth standard students should recognise the attributes of the concepts 'Fast reactions' and 'Slow reactions' and 'Chemical Kinetics' correctly.
2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.
3. They will generate new examples of the concepts.
4. They will form concept rules.
5. They will locate the examples and state the attributes of the concept as appear in the example.

Type of Model : Reception
Type of Concepts : Conjuctive
Learning Modality : Chemical reactions and the experiments
Reception Strategy : Wholist's strategy

Elements of the Concepts

1. Name
   - Fast reactions
   - Slow reactions
   - Chemical kinetics
2. Essential Attributes
   - energy changes during the reactions
3. Positive Exemplars
   - 1. Sodium Chloride reacts with silver nitrate solution
   - 2. Potassium reacts with water
   - 3. Marble reacts with concentrated hydrochloric acid
   - 4. Iron rusts in air
      For fast reactions
5. The combination of Hydrogen and Iodine at room temperature for Slow reactions

4. Negative Exemplars
   1. Sodium chloride reacts with Silver nitrate solution.
   2. Potassium reacts with water for slow reactions
   3. Marble reacts with concentrated Hydrochloric acid.
   4. Iron rusts in air
   5. The combination of Hydrogen and Iodine at room temperature for fast reactions

6. Rule
   Chemical kinetics deals with the changes in energy during reactions and the factors influencing them.
   There are reactions which are fast, slow and moderate.
Phase one: Presentation of Data and Identification of the Concept

T: Today we are going to play a game. I will show you some experiments which bear the concept. If the experiment contains the concept, I will say it a 'Yes' example. If it does not provide the concept, I will say it is a 'NO' example. You should say what is that particular concept in my mind. You should cite more examples and form a definition of that concept according to its characteristics.

Now let us see the first experiment, which is a 'Yes'

Sodium chloride is treated with Silver nitrate solution in a test tube.

\[ \text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl} \]

Can you say what the concept is?

S: A white precipitate is formed in the reaction

T: It is a guess. You have to be more specific. Let us pass to the second experiment which is a 'Yes'

Potassium is treated with water

\[ 2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2 \]

Do you have any idea of the concept?

S: It is vigorous, potassium burns. No give more examples

T: O.K. Here is a third 'Yes' example for my concept.

Marble is treated with concentrated Hydrochloric acid.

Orientation to the process

Teacher presents the first labelled example

First hypothesis

Teacher presents the second labelled example

Second hypothesis

Teacher presents the third labelled example
S: Marble disappears

T: Here is a 'No' example

Iron nails are kept on a watch glass

S: Nothing happens

T: Here is another 'No' example

Hydrogen peroxide is taken in a test tube. Look at the chemical equation

\[ 2H_2O_2 \rightarrow 2H_2+O_2 \]

S: We can't see the reaction

T: Yes, Here is another 'No' example

Rusted iron nails - showing

S: That is a slow reaction

T: Now can you name the concept?

S: Fast reactions

T: Yes you are right. There are reactions which are fast and slow. The science that deals with the energy changes of chemical reactions and the factors influencing them is termed Chemical kinetics.

**Phase Two: Testing the Attainment of the Concept**

T: Now I am going to test whether you have understood the concepts ‘Fast reaction’, ‘Slow reaction’ and ‘Chemical kinetics’. I shall give some examples and you should say whether it is a ‘Yes’ or ‘No’

Digestion of food - Fast reaction

S: No
T: Correct, another one. Combination of Hydrogen and Iodine at room temperature - Slow reaction
S: Yes
T: Good, What is Chemical Kinetics
S: It deals with energy changes during chemical reactions and factors affecting it.

Phase three: Analysis of the Thinking Strategies.

T: Can you describe how did you arrive at the concept?
S: When you gave the first example I didn't get any idea. When the second and third examples were given, again I didn't get to say anything about fast reaction. When the 'No' examples were given it became easy to identify the speed of the reaction that you thought.
Rate of reactions

Rate of reaction is defined as the quantity of any one of the products obtained or the reactants consumed at unit time. The unit of rate of reaction can be gram/second, mole/second, or millilitre/second.

LESSON TRANSCRIPT

Advance Organiser - Rate of reaction

The strategy here is to present the students with major ideas (Organizer) that can help them as they try to read and understand the material. In this particular episode, the organizer presented is based on experiments.

T: Today we are going to study the rate of chemical reactions. You have already learned about the different types of reactions. What are the different types of reactions?

S: Fast reactions and slow reactions

T: There are reactions which are of moderate speed. Today we try to assess the rate of reactions.

Phase One: Presentation of the Advance Organizer

T: The rate of reaction is the quantity of any one of the products obtained or the reactants consumed in unit time. The unit, Gram, Mole, Millilitre etc. can be used to denote the quantity of the products and reactants and the time may be expressed in second, minute, hour etc.
Phase Two: Presentation of the Learning Material

T: Take a small piece of Magnesium ribbon. Measure its mass (1 g). Take some dilute hydrochloric acid in a test tube and put the Magnesium into it. The Magnesium reacts and disappears. Measure the time taken to complete the reactions. Let the time taken be 10 seconds. What will be the rate of reaction?

S: The reaction rate is 1/10 g/s

T: Yes, let us take one more example. Take 20 ml of Hydrogen peroxide in a conical flask and add 1 gram of Manganese dioxide. Close it with a one holed cork to which an injection syringe is attached. Now where lies the piston?

S: At the bottom of the syringe

T: Yes, Oxygen starts collecting in the syringe. The piston is pushed away. The volume of oxygen produced can be read from the syringe. Can you calculate the rate of reaction?

S: Yes, after a fixed time note the reading on the syringe. From the two values we can calculate the rate of reaction.

T: Can you define the rate of reaction?

S: The rate of reaction is defined as the quantity of any one of the products obtained or the reactants consumed in unit time.

Verbalises the essence of the material in own words.

Verbalises the essence of the learning material
T: What will be the unit of reaction rate?

S: The unit Gram, Mole, Millilitre etc. can be used to denote the quantity of the reactants and products and the time may be expressed in second, minute, hour etc.


T: Can you give a summary of the major attributes of the concept we discussed?

S: The reaction rate can be measured on the basis of the amount of the reactants consumed or the amount of the products obtained in unit time.
LESSON PLAN No : 3

SUPPORT SYSTEM FOR ITM

LEARNING MATERIAL
INSTRUCTOR FACT SHEET

The main factors that influence the rate of reaction are the following.

1. **Nature of the reactants**

2. **Concentration of the reactants:** The reaction rate increases with an increase in concentration and decreases with a decrease in concentration. The effect of concentration can be explained on the basis of collision theory. This theory assumes that chemical reactions take place when molecules collide with one another. An increase in the concentration of the reactant leads to an increase in the frequency of the collision; in turn, it produces an increase in the reaction rate.

3. **Effect of pressure:** When pressure of the gaseous system increases, the volume decreases resulting in an increase in the concentration of the reactants. When concentration increases, the rate of reaction will also increase.

4. **Effect of temperature:** There is an increase in reaction rates with the increase in temperature. To react, the molecules must collide with enough force to disrupt the bonding of the molecule. The minimum amount of kinetic energy that the molecules should possess for a chemical reaction is called threshold energy. The rate of reaction depends on the kinetic energy of the molecules that collide. The greater the energy, the faster the reaction.

   Effective collisions produce activated complexes. In a chemical reaction before reaching the equilibrium, some transition complexes are formed. These are called activated complexes. It has more potential energy than the reactants and products. They get rid of their high energy by breaking into the products.
Phase - I  
Orientation to the Process and Encounter with the Problem

T: I am going to teach you in a very different manner which is quite new to you. First of all I will present a problem to you and then we will try to find out the solution. You have to ask Yes/No type questions which will help you in finding out the answer. For your questions I will only say ‘Yes’ or ‘No’. Now I will present the problem.

Do you remember what we learnt in the previous class?

S: Yes. Chemical kinetics, Rate of reactions.

T: Yes. Here are two substances which are usually kept in kerosene. Take two vessels with water. Put these substances in water. What do you observe?

What is your inference?

Phase II & III - Data Gathering Verification and Experimentation

S: Both of them melts and swims about on the surface of the water. The second reaction is more vigourous

T: Yes. What is your inference?

S: Is it connected to the water used?

T: No

S: Is it related to the nature of the substances?

T: Yes

S: If it is related to the nature of the substances used, does it alter if the same substance is used?
T: No
S: Is it related to the rate of reaction?
T: Yes
S: Then the inference can be the nature of the reactants influences the rate of reaction.

**Phase IV Formulation of an Explanation**

T: Your inference is correct. Can you identify the substances used?
S: No
T: They are Sodium and Potassium.
Then can you write the chemical equations for the reactions?
S: Yes,
\[
2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2
\]
\[
2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2
\]

**Phase V Analysis of the Enquiry Process.**

T: What kind of questions did you ask?
S: The questions related to the reactants used and how they affect the reaction rate.
T: Yes then,
S: From your answers we were succeeded in arriving at an inference that the nature of reactants affect the reaction rate.
T: O.K. That was what you did. You got your inference asking simple questions.

Students asks data verification questions
Teacher gives relevant information.
Applies the previous knowledge
Teacher probes for clarity and accuracy
The teacher summarises.
Teacher presents a descrepant event

Here is another problem. Take equal volumes of these solutions in two test tubes. Put equal size of marble chip in each test tube. What you observe? Why?

S: The marble chips disappeared

T: Which one disappear first?

S: The chip in the second test tube.

Phase Two : Data Gathering Verification

S: Do the two solutions are water?

T: No

S: Do they belong to the same substance?

T: Yes

S: Do they belong to the salt solutions

T: No

S: Do they belong to the acid solution?

T: Yes

S: Is it HCl?

T: Yes.

S: Do they belong to same concentration?

T: No

Phase Three : Data Gathering Experimentation

T: Now our job is to ask questions that explore the possibility. Remember that all evidence are tentative. There are two kinds of questions that you
can ask to experiment with your theory to find out what the variables are. The first are exploration questions. In other words You would say "Would it make a difference if this happened"? or "Would the same thing happen if ———".

S: These two solutions are said to be not water. If it was water, would the marble chips disappear as seen earlier.

T: No

S: If the solutions were in the same concentration, would the marble chip react as explained earlier?

T: No

S: Then the Inference can be the concentration of reactants influences the rate of reaction.

**Phase IV Formulation of an Explanation.**

T: Your inference is correct. The concentrated acid reacts with the marble chips faster. This can be explained using the Collision theory. Can you explain Collision theory?

S: Is it something related to the collision of the reacting molecules.

T: Yes

S: If the collision are responsible for the reaction, would the collision increase as the concentration increases?
T: Yes as the concentration increases, the number of collisions of the reacting molecules increases which results in the increase in the reaction rate. Then can you explain what happens when the solid is broken into small pieces or agitating the solution?

S: The number of collisions increases and the reaction rate also increases.

**Phase V: Analysis of the Inquiry Process**

T: What do you think about the process?

S: It helps to develop skill in asking questions.

T: Did the 'Yes' questions get you more information or the 'No' questions:

S: 'No' questions

T: What type of questions did you ask first?

S: About the properties of the solutions used.

T: What do you think about the way you ask questions?

S: It was alright that no body stuck to one thing if it was right. They would move to totally different question.

T: Here is another discrepant event. You have to follow the very same procedure as in the above case.

Why do gaseous reactions occur faster if the pressure of the reacting gases increased? For example, $\text{N}_2$ combines with $\text{H}_2$ to form ammonia. The amount of ammonia formed will increase with increase in pressure.

Teacher presents a discrepant event
Phase Two and Three: Data Gathering Verification-Experimentation

S: Do the substances in solid/liquid state exhibit the same property?
T: No

S: Do the gaseous substances only show this property?
T: Yes.

S: When the pressure is decreased the amount of ammonia formed also decreases. Am I correct?
T: Yes

S: Can I explain the property on the basis of collision theory?
T: Yes

S: If the pressure increases would the volume of the gas decreases?
T: Yes

S: If the volume decreases would the concentration increases?
T: Yes

Phase four: Formulation of an Explanation

S: Then if the pressure increases the reaction rate also increases.
T: Yes when the pressure increases, volume decreases and number of collisions between the reacting molecules increases which results in an increased rate.

Student asks data gathering verification questions

" "

Student asks data gathering verification questions

" "

Student asks data gathering verification questions

" "

Student derives a simple linear theory

T: What do you think of the process?
S: It helps to develop skill in asking questions.
T: What type of questions did you ask first?
S: About the property of reacting substances.
S: About the theory already learned.
T: What do you think about the way you asked questions?
S: It was alright that nobody stuck to one thing if it was right. They would move to a totally different question.
T: O K You are correct. Here is another discrepant event. The combination of H₂ and I₂ to form Hydrogen Iodide is very slow at room temperature. But its speed increases with the increase in temperature. Similarly take equal volume of a solution of Potassium peroxy sulphate and add equal volumes of dilute Potassium iodide solution to each test tube. Heat one of them and observe. What changes are observed?
S: The solution becomes brown
T: Yes because Iodine is liberated. Can you write the equation for the above reaction.
S: $K_2S_2O_8 + 2KI \rightarrow 2K_2SO_4 + I_2$
$H_2 + I_2 \rightarrow 2HI$
T: Why this happens?
Phase II & III  Data Gathering and Verification and Experimentation

S: Do other substances also react slowly at room temperature?

T: Questions must be specific.

S: Do the above two reactions only take place at room temperature?

T: NO

S: If they bear some pressure would they react faster at high temperature?

T: Yes

S: If they bear same concentration would they react faster at high temperature?

T: Yes

Phase IV: Formulation of an Explanation

S: Increase in temperature results in an increased reaction rate.

T: Can explain this based on Collision theory?

Derives a theory
S: Do all collisions result in a reaction?

T: No

S: If all collisions were not result in reactions, would certain collisions which bear minimum energy result in a reaction?

T: Yes. That is threshold energy

S: Do the molecules which bear the minimum energy that is, threshold energy results in reaction?

T: Yes, and as result, an activated complex is formed which has a short life and more potential energy than reactants and products.

S: To release the excess energy they decompose to form products. Am I correct?

T: Yes, at higher temperatures molecules acquire greater energy to reaction and results in a faster reaction rate.

The activated complex in the reaction between $H_2$ and $I_2$ is:

$\text{H}_2 + \text{I}_2 \rightarrow \text{H}_2\text{I}_2^+$

$\text{H}_2\text{I}_2^+ \rightarrow 2 \text{H} \text{I}$
Phase V - Analysis of Inquiry Process

T: What kind of questions did you ask?

S: About the temperature difference between reactants.

T: Yes then,

S: With your help it became very easy to learn about Threshold Energy, Activated Complex etc.

T: OK. That was what you did. You saw the problem then by asking questions you arrived at the answer.
LESSON PLAN No:4
LEARNING MATERIAL FOR AOM

Effects of the catalyst in a reaction

A substance that alters the rate of reaction without itself undergoing change is called a catalyst. The action of catalyst is specific. The molecules taking part in reaction should have certain minimum amount of energy to form the activated complex. Often this energy barrier is so high that very few molecules can reach that level. When a catalyst is present it offers another easier path for the formation of the activated complex. The catalysed route requires only a lower threshold energy.

Importance of Chemical Kinetics.

The study of chemical Kinetics is important because industry uses a large number of chemical reactions in the manufacture of various products.

LESSON TRANSCRIPT

First advance Organizer : Effect of catalyst in a reaction
Second Advance Organizer : Importance of chemical Kinetics

The strategy here is to present the student with major ideas (Organizers) that can help them as they try to read and understand the materials. In this particular episode the organizer presented is based on experiments, Charts and explanations.

T: Today we are going to study the effects of catalysts on the rate of reactions and importance of Chemical kinetics. You have already learned about the other factors that affect the rate of reaction. What are they?
Phase one: Presentation of the Advance Organizer

T: A substance that alters the rate of reaction without itself undergoing change is called a catalyst. The action of a catalyst is specific. The molecules taking part in the reaction should have a minimum energy to form activated complex. Often this barrier is so high. When a catalyst is present it offers another easier path for the formation of the activated complex. The catalysed route requires only a lower threshold energy.

Phase Two: Presentation of the Learning Material

T: Hydrogen peroxide is taken in a test tube. A little Manganese dioxide is added. What do you observe?

S: The reaction becomes speedy

T: Yes Unless Manganese dioxide is added the reaction will be slow. The amount of Managanese dioxide doesnot change. It is a catalyst and alters the speed of a reaction without itself undergoing change. The catalyst is specific in its action.
When Potassium chlorate is heated Oxygen is formed. MnO₂ is the catalyst.

When Potassium permangante is heated, oxygen is formed. Here MnO₂ is not used as the catalyst. So what do you understand about the nature of the catalyst.

S: The catalyst for a particular reaction may not be useful for another reaction.

T: Iron is used as the catalyst for the manufacture of Ammonia. Vanadium pentoxide is used as the catalyst in the manufacture of sulphuric acid. You have already learned that before reaching equilibrium a stage is reached in a reaction. What is that?

S: Activated complex is formed.

T: What about the energy required for the molecules to react?

S: The energy of the molecules must be greater than the threshold energy.

T: (explains the action of the catalyst using a chart) When a catalyst is present it offers an easier path of lower threshold energy for the promotion of the activated complex.

Similarly the study of Chemical kinetics is important in industry. How?
S: A large number of reactions are involved in Industry.

T: Yes, Correct. In order to obtain best results, the reactions have to be carried out under optimum conditions.

Phase Three: Strengthening of Cognitive Structure

T: Can you give summary of the major attributes of the concepts we discussed?

S: The catalyst influences reaction rate. It offers an easier way to complete the reaction without undergoing any change. It is specific in its action. The study of Chemical Kinetics is very important in Industry, since it involves a large number of chemical reactions in the manufacture of various products.
1. Name of Teacher : Rema Devi. K.
3. Class : XI
4. Subject : Chemistry.
5. Unit : Surface Chemistry.
LESSON PLAN NO: 1

GOAL OBJECTIVES OF CAM

1. The XI\textsuperscript{th} standard students should recognise the attributes of the concepts—
   "Adsorption" and "Absorption" correctly

2. They will state the attributes correctly and label the unlabelled examples given by
   the teacher correctly

3. They will generate new examples of the concepts

4. They will form concept rules

5. They will locate the examples and state the attributes of the concept as appear in
   the example

   Type of Model : Reception
   Type of Concepts : Conjunctive
   Learning Modality : Examples
   Reception Strategy : Wholist's Strategy

Elements of the Concepts

1. Name : Absorption
   Adsorption

2. Essential Attributes : Uniform and Non uniform distribution of
   Molecules in the adjoining bulk

3. Positive Examples
   1) Silica gel for drying air
   2) Nickel takes away H\textsubscript{2} gas \{ For adsorption
   3) Chlorine gas in presence of activated charcoal
4. **Negative Examples**

1) Crayon in water  
2) Sponge in water

**5 Rule**

The existence of substance at a surface in a different concentration than in the adjoining bulk is called adsorption.

The substance being adsorbed is called adsorbate and adsorbing bulk substance is called adsorbent.

Adsorption is a process in which the molecules are uniformly distributed throughout the bulk.
SUPPORT SYSTEM FOR AOM

LEARNING MATERIALS

Physical Adsorption

If the adsorbate is held on surface by weak Vander-waals forces, the adsorption process is called physical Adsorption

Chemical Adsorption

If the forces holding the adsorbate are as strong as experienced in Chemical bonding, the adsorption process is called chemical adsorption

Adsorption Isotherm:

The graph showing the variation of the amount of substance adsorbed against pressure at constant temperature is called adsorption Isotherm

Adsorption Isobar

The graph showing the variation of the amount of substance adsorbed against temperature at constant pressure is called adsorption Isobar

LESSON TRANSCRIPT

First Advance Organiser : Physical Adsorption
Second Advance Organiser : Chemical Adsorption
Third Advance Organiser : Adsorption Isotherm
Fourth Advance Organiser : Adsorption Isobar

The Strategy here is to present the students with major ideas that can help them as they try to read and understand the material. In this particular episode four organisers are presented. The first two are based on examples and the third and fourth organisers are based on Graphs.
LESSON PLAN No. 1

Phase One : Presentation of the Data and Identification of the Concept

T: Today we are going to play a game. I shall provide some examples of the concept which may or may not contain the concept.

If it contains the concept it is a 'Yes' example otherwise a 'No' example. From these yes and no examples you must find out the attributes of the concept, generate new examples and form the concept rule.

The first 'Yes' example. Silica gel is used for drying air. Can you say what my concept is?

S: Dehydration

T: It is only a guess. Here is my second 'Yes' example. Nickel takes away H₂ gas

S: Your concept is not that of dehydration. Here a gas is removed. Can you state any other example?

T: Crayon removes water when dipped in water. This is a 'No' example.

S: Give more examples

T: Sponge when dipped in water take away water molecules. This is a 'No' example

S: Your concept is related to removal of a substance by another substance
T: I shall give you a picture the figure marks '1' is a yes example and figure marks '2' is a "No" example. Suppose the dots are molecules and 1 and 2 are two substances. Can you say what is my concept?

S: Your concept is that of high concentration of molecules on the surface of a substance. Am I correct?

T: Yes, can you name the concept?

S: No

T: It is adsorption. The substance being adsorbed is called adsorbate and adsorbing bulk substance is called adsorbent. The process of removing adsorbed substance from a surface is called desorption.

What about the 'No' examples

S: There the molecules are uniformly distributed throughout the bulk.

T: Can you name?

S: Is it absorption?

T: Very good it is called absorption

**Phase Two : Testing the Attainment of the Concept**

T: Can you give more examples for adsorption?

S: Activated Charcol adsorbs Chlorine gas
S: Charcol is used for decolourising Sugar solution. Am I correct sir?

T: Yes, can you define adsorption?

S: The existence of substance at a surface in a different concentration than in the adjoining bulk is called adsorption.

T: What is an adsorbate?

S: It is substance being adsorbed.

T: What is Desorption?

S: It is the process of removing an adsorbed substance from a surface on which it is adsorbed.

Phase Three : Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: Your first example of Silica Gel made me guess that your concept might be of dehydration but the removal of H2 gas by Nickel directed me to right path. Again the 'NO' examples made me think about the removal of substances but the figure denoting the process helped me a lot to arrive at the right conclusion. Thus the 'Yes' and 'No' examples of the concept helped me to arrive at the concept.
Today we are going to learn two types of adsorption. Physical adsorption and chemical adsorption. You must be able to form definition for the concept. You might have studied the phenomenon of adsorption.

What is an adsorbate?

S: The substance being adsorbed.

T: What is the absorbing bulk substance?

S: Adsorbent

Phase One: Presentation of the Advance Organizer

T: If the adsorbate is held on surface by weak vander waals forces the adsorption process is called physical adsorption. For example charcoal adsorbs polluting gases present in air. It is reversible and decreases with increasing temperature.

Phase Two: Presentation of the Learning Material

T: What happens when active charcoal is exposed to Chlorine?

S: Chlorine is adsorbed on the surface of charcoal.

T: What happens when temperature is increased?

S: The adsorbed gas may be liberated.

T: What does that mean?

S: The process is reversible and occurs at very low temperature

T: What about the extent of adsorption to easily liquifiable gases?
S: More easily liquifiable gases are adsorbed more easily and to a great extent.

T: Yes, the process is more specific and forms multi-molecular layers.

T: What about the attractive forces existing between the adsorbant and adsorbate?

S: It is very weak.

T: Yes the attraction is due to Vander waal's forces and the heat of adsorption is very low in the range of 20-40 KJ/Mol.

**Phase Three: Strengthening of Cognitive Organistaion**

T: Can you give a summary of major attributes related to the phenomenon of physical adsorption?

S: Low heat of adsorption.

S: Weak Vander waal forces between adsorbate and adsorbant.

S: Reversible.

S: Occurs at low temperature.

S: Forms multimolecular layers.

T: What about the extent of adsorption in the case of easily liquifiable gases?

S: More easily liquifiable gases are adsorbed more easily.

Uses verbal explanation to enhance the organization of the presentation.

Summarises the major attributes of the new material.

Promotes active reception learning.
Phase one: Presentation of Advance Organizer.

T: If the forces holding the adsorbate are as strong as experienced in chemical bonding, the adsorption process is given the name chemical adsorption or Chemisorption.

Phase Two: Presentation of Learning Task

T: Can you explain the role of platinum in the preparation of toluene from n-heptane?

S: In the first step the reactant adsorbs on the surface of the catalyst and then forms an intermediate compound.

T: Does the intermediate compound stable?
S: No.

T: Does energy release during the process of adsorption?

S: Yes.

T: In which of the adsorption processes the energy-heat of adsorption is greater?

S: In chemical adsorption.

T: Why?

S: Because the attraction is due to chemical bond forces.

T: Do these chemical adsorptions occur at low temperature?

S: No.

T: Whether they are reversible or not?

S: They are irreversible.

T: Yes they are highly specific and forms monomolecular layers too.

**Phase Three: Strengthening Cognitive Organization**

T: Can you compare Physical adsorption and chemisorption?

S: In physical adsorption weak vander waals forces are existing. They are highly reversible and occurs only at low temperatures. They are not specific and forms...
multimolecular layers. They have low heat of adsorption.

In chemical adsorption, strong chemical bonds are formed and hence they have a high of adsorption. They are irreversible and more specific. They occur at high temperature and form monomolecular layers.
Today we are going to study about adsorption of gases on solids and similar phenomenon of adsorption of solids from solutions. You have already studied the process of adsorption. In this part you are going to study adsorption isotherm, the variation in the quantity of gas adsorbed with pressure and the variation of adsorption with temperature at constant pressure (adsorption isobar).

What happens when chlorine gas is exposed to active charcoal?

Active charcoal adsorbs chlorine gas.

In the above example which acts as the adsorbent and which adsorbate?

Charcoal is the adsorbent

Chlorine gas is the adsorbate.

Phase One: Presentation of the Advance Organiser

When a substance gets adsorbed replaces a substance adsorbed earlier held by weaker forces, the amount of gas adsorbed varies with pressure. As pressure increases the amount of gas adsorbed increases, reaches the maximum and there remain constant. This plot is called adsorption isotherm.

The isotherm for the adsorption of solutes from solutions also shows a similar behaviour.
Phase Two: Presentation of the Learning Material

T: Look at this graph. It is a plot of the amount of gas adsorbed ($\frac{x}{M}$) against pressure. Where $x$ is the mass of the adsorbate and "M" is the mass of the solid adsorbent at constant temperature.

\[ \frac{x}{m} \quad \uparrow \quad P \rightarrow P_x \]

What is the relationship between the pressure and the amount of gas adsorbed?

S: As pressure increases, the amount of gas adsorbed also increases, reaches a maximum value then remains constant.

T: Do you know what is that pressure at which maximum adsorption takes place?

T: It is saturation pressure ($P_x$)

Can you relate the two values mathematically?

S: No

T: $\frac{x}{m} = K p^{1/n}$

where 'n' can have any value between 1 and a larger number depending on pressure. Take logarithms of both sides.

S: $\log \left( \frac{x}{m} \right) = \log \left( K p^{1/n} \right)$

i.e. $\log \left( \frac{x}{m} \right) = \log (K + 1/n) \log P$
T: Suppose we plot \( \log \frac{x}{m} \) against \( \log P \) what will be the nature of the graph?

S: It will be a straight line with a slope of \( \frac{1}{n} \)

T: This plot of \( 'x/m' \) against \( 'P' \) at constant temperature is called adsorption isotherm. The isotherm from solutions also shows a similar behaviour.

**Phase Three: Strengthening of Cognitive Organisation**

T: Animal charcoal is used to decolourise raw sugar solution. Why?

S: Animal charcoal adsorbs colouring matter from solutions.

T: Silica gel is used for drying air. Why?

S: Silica gel adsorbs moisture from atmosphere.

T: Can you say any other examples

S: Yes, Gases like \( N_2, O_2, H_2 \) and \( CO \) are adsorbed by transition metals like nickel, cobalt etc.

T: What is an adsorption isotherm?

S: It is a graph plotting the variation of the amount of gas adsorbed with pressure at constant temperature.

**Phase One: Presentation of the Advance Organizer**

T: At constant pressure, as temperature increases, in the case of physical adsorption, the amount adsorbed decreases and in chemical adsorption, the amount adsorbed initially increases and then

Uses supplementary media for maintaining attention

Applies the knowledge

Applies the knowledge

Verbales the essence of the concept in the organiser
decreases. This graph showing the variation of the amount of substance adsorbed against temperature, at constant pressure is called adsorption isobar.

**Phase Two : Presentation of the Learning Material**

T: Look at this graph

![Graph](image)

This graph shows the variation of the adsorption with temperature at constant pressure in physical adsorption. Can you explain?

S: In physical adsorption, increase in temperature results in a decrease in the amount adsorbed gas at constant pressure.

T: Can you explain the reason.

S: Yes Adsorption is Exothermic

T: Yes this graph is called adsorption isobar. The adsorption isobar for chemical adsorptions shown below

![Graph](image)

What is the nature of the graph?

S: As temperature increases the amount adsorbed increases initially and then decreases.
T: Can you say the reason?
S: In chemical adsorption, chemical reaction is taking place and it requires some initial energy.

T: Very good. These isobars are used for distinguishing physical adsorption and chemical adsorption. Adsorption from solution also follows the same behaviour. What do you infer from this?
S: In the case of adsorption from solutions shows a relationship between \( x/m \) and concentration of the solute 'C' ie it follows the relation

\[
x/m = K C^{1/n}
\]

\[
\log x/m = \log K + 1/n \log C
\]

This graph will be a straight line with a slope of \( 1/n \)

**Phase Three: Strengthening Cognitive Organisation.**

T: How is an adsorption isotherm differs from an adsorption isobar?

S: Adsorption isotherm is a graph showing the variation of the amount of the adsorbed gas against pressure at constant temperature. Where as adsorption isobar shows the variation of the amount of the gas against temperature at constant pressure.

T: How the adsorption isobar of physical adsorption differs from that of chemical adsorption?

S: In physical adsorption the amount of the gas adsorbed decreases with increase in temperature
and in chemical adsorption the amount of gas adsorbed increases initially and then decreases.

T: Why it is so?

S: Since in chemical adsorption, some activation energy is required just as ordinary chemical reactions, it promotes active reception learning.
LESSON PLAN NO: 11

GOAL OBJECTIVES OF CAM

1. The XI\textsuperscript{th} standard students should recognize the attributes of the concepts—Colloid, Dispersed Phase, Dispersion Medium, Emulsion, Gel, Aerosol of liquids, Foam Aerosol of solids, Sol, Solid Sol etc.

2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.

3. They will generate new examples of the concepts.

4. They will form concept rules

5. They will locate the examples and state the attributes of the concepts as appears in the example

<table>
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Elements of Concepts

1. Name : Colloid, Dispersed Phase, Dispersion Medium, Emulsion, Gel, Aerosol of liquids, Aerosol of solids, Sol, Foam, Solid Sol.

2. Essential Attributes : Size of particles and phase of particles

3. Positive Examples
   - 1) Fat in milk
   - 2) Water in Oil
   - 3) Medium Muddy Water

For Dispersed phase

Prepared by BeeHive Digital Concepts Cochin for Mahatma Gandhi University Kottayam
4) Water in Sulphur Sol
5) Water in muddy water
6) Milk
7) Oil in water
8) Insecticide Sprays
9) Cloud
10) Soap Sud
11) Lemonade
12) Paint
13) Gem Stone
14) Starch in water

4 Negative Examples

1) Cheese
2) Table Jellies
3) Foam Rubber
4) Pumice Stone
5) Smoke
6) Gemstone
7) Ruby glass

5 Rule

Colloids are intermediate between true solution and suspension.

Solvent phase of Colloid is called dispersion medium and solute phase is called dispersed phase.

Based on the nature of the dispersed phase and dispersion medium these are varieties of Colloids like Emulsion, Gels, Sols, Aerosols, Solid Sols, foams etc.
LESSON PLAN No: II

Phase One : Presentation of Data and Identification of the Concept

T: Today we are going to play a game. I am going to give you some examples for the concept in my mind. By attending to the 'Yes' or 'No' examples (which may or may not contain the concept) you must find out the attributes of the concept generate new examples and form the concept rule.

The first 'Yes' example is the dissolved fat in milk. Can you say what my concept is?

S: Organic compound

T: It is only a guess. I shall give another 'Yes' example of the concept 'Water' in oil.

S: Your concept is not that of organic compound

T: The third 'Yes' example is 'Mud' in muddy water. Any guess this time?

S: No

T: The next example is a 'No' 'Water in sulphur sol

S: Your concept is that of solute in mixtures

T: Have you heard of colloids?

S: No

T: Have you heard of true solution?

S: Yes, it is a mixture of two substances with no surface of separation.

T: What is a suspension?
S: It is a mixture with distinct surface of separation

T: Colloids are intermediate between true solution and suspension. Can you name the concept?

S: No

T: It is dispersed phase in colloids. What about the 'No' example

S: It is the solvent phase

T: Yes. It is called dispersion medium. The diameter of a colloidal particle ranges from 1 to 100 nm. They do not settle under gravity. And they have slow rates of diffusion.

Phase Two: Testing the Attainment of the Concept

T: Can you give more examples for dispersed phase?

S: 'Proteins' in H$_2$O

S: Starch in Water

T: Can you cite more examples for the concept of dispersion medium.

S: 'H$_2$O' in Oil In Water colloid

S: 'H2O' in Sulphur Sol

T: What is the difference between true solution and colloid solution?

S: The particle size is larger than colloids

T: What is the dispersion medium in a colloidal system
Phase Three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: Your first and second ‘Yes’ examples made me think about a substance dissolved in another substance similar to the solute phase of a solution. The ‘No’ example helped me to state the concept in a right form. From your ‘Yes’ and ‘No’ examples it was made clear to me that solute phase in colloid was the concept.

Phase One: Presentation of Data and Identification of the Concept

T: Today we are going to play a game I will give you some examples of a particular concept which may or may not contain the concept. If it contains the concept, I will say it is a ‘Yes’ concept if not a ‘No’. You should cite more examples and form a definition of that concept.

Now let us see an example of the concept which is a ‘Yes’ ‘Milk’. Can you say what the concept is?

S: It contains a chemical Lactic acid

T: It is only a Guess. Let us see another ‘Yes’ example. ‘Oil in water’ Do you have any idea of the concept?

S: It is mixture of two liquids
T: The third 'yes' example of the concept is 'lotions'. Can you say what the concept is?
S: No. Give more examples
T: Here is another example which doesn't contain the concept or it is a 'No' 'Cheese'. Can you say what my concept is?
S: Your concept is about the mixture of two liquids
T: Here is another 'No' example
'Table jellies'
S: Would you mind to give another 'Yes' example
T: Yes. it is a 'Cream' in pharmaceuticals
S: A liquid substance is dissolved in another liquid
T: Can you say which are the dispersed phase and dispersion medium in the solution of oil in water
S: Yes , Oil is the dispersed phase and water is the dispersion medium
T: Can you name the concept?
S: No.
T: It is called an emulsion. Emulsions are generally unstable. Can you say the reason?.
S: The particles of the dispersed phase may coalesce together and the emulsion may breakup into two layers
T: Can you tell me how that problem be solved?
S: Using another substance like a stabilising agent
T: Yes; emulsifying agent coats the droplets and obstruct their aggregation.
T: Now, What about the 'No' examples i.e butter, table jellies etc. what is the nature of the dispersed phase and dispersion medium.
S: In jellies dispersed phase is liquid and dispersion medium is solid
T: Can you name that type of substance?
S: No
T: They are called Gels

Phase Two: Testing the Attainment of Concept
T: Can you give more examples for Gels
S: Cheese
S: Boot polish
T: Ointments. Is it a 'Yes' example or a 'No' example for the concept of emulsion
S: It is an 'Yes' example
T: Copper sulphate crystals. Is it a 'Yes' example or 'No example for the concept of Gel
S: It is a 'Yes' example
T: Can you explain the process of digestion with the use of emulsification process

S: Fat forms a sodium soap with alkali in the intestine and this emulsifies with the rest of the fat and making it easier for the digestive enzymes to carry out their function.

Phase Three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: Your first example was milk and second example was lotion. From those examples we got an idea that your concept might be related to mixture of liquids. And your 'No' examples made me differentiate the concept of emulsion from Gels in that in the latter case the dispersed is a solid.

It was with the help of exemplars and hypothesis I reached the concept.

Phase one: Presentation of Data and Identification of Concept

T: I have another concept in my mind. 'Cloud' is a 'Yes' example of the concept.

S: It is a mixture of solid and gas.

T: Another example which is a 'Yes' is insecticide sprays.

S: Liquid droplets in air.

T: The third one is a 'No' example, It is 'Form Rubber'.

---

Student labels unlabelled example

Applies the knowledge of the concept

Evaluates the effectiveness of the strategy

Student describes thought

Teacher presents first labelled example

First hypothesis

Teacher presents second labelled example

Second hypothesis

Teacher presents third labelled example
S: Air is a common factor in your examples. Would you mind to give more examples.

T: ‘Pumice Stone’ is a ‘No’ example for my concept

S: Your concept is liquid dissolved in a gas

T: Can you state in more clear terms

S: Yes, dispersed phase is liquid and dispersion medium is gas

T: Can you name the concept

S: No

T: It is aerosol of liquids. Now what about the ‘No’ examples

S: In them gas is the dispersed phase and solid is the dispersion medium

T: Can you name it?

S: No

T: It is solid foam

**Phase Two : Testing the Attainment of Concept**

T: Can you say whether Styrene foam is a ‘Yes’ or ‘No’ example for the concept of Aerosol of liquids

S: It is a ‘No’ example

T: Can you cite another example for Aerosol of liquid

S: Fog

T: Styrene foam is an ‘Yes’ example for the concept of solid foam. Am I correct?
Phase Three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: Your first 'Yes' example made me think that your concept might be that of mixture of two phases that is liquid and gas. Your 'No' examples helped me to rule out the fact that your concept might be that of gas in solid. Then on testing the 'Yes' examples I came to the conclusions that the concept is that of liquid dispersed phase in gas dispersion medium.

Phase One: Presentation of Data and Identification of Concept

T: I have another concept in my mind - 'Soap Sud' is a 'Yes' example for it. Can you say what my concept is?

S: Is it gas in solid mixture?

T: No. It is only a guess. I can give you another 'Yes' example - Lemonade Froth.

S: Would you mind to give more examples?

T: Here is a 'No' example for the concept 'Smoke'. Can you tell me what my concept is?

S: Your concept might be that of gas as dispersed phase and liquid as dispersion medium.

T: Can you name it?

S: No.

T: It is form or Froth.
What about the ‘No’ concept?

S: It is a solid in gas mixture i.e dispersed phase is solid and dispersion medium is gas

T: What is the name of it?

S: I can't say

T: It is Aerosol of solids

Phase two : Testing the Attainment of the Concept

T: Can you say whether paint is a ‘Yes’ or ‘No’ example for the concept of aerosol of solids.

S: No

T: Is starch a ‘Yes’ or ‘No’ example for form

S: No

T: Can you differentiate foam from aerosol of solid

S: Foam is a colloid of gas as dispersed phase and liquid as dispersion medium, whereas aerosol of solid is a colloid of solid as dispersed phase and gas as dispersion medium.

Phase Three : Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: Your first ‘Yes’ example of the concept i.e Soap sud and second one lemonade froth made me think that the concept is that of the colloid liquid of

States the attributes of the concept

Student labels unlabelled example

Student labels unlabelled example

Explains the attributes of the concept

Evaluate the effectiveness of the strategy
dispersion medium and gas as dispersed phase. And your 'No' example strengthens the above stated concept.

Phase One: Presentation of Data and Identification of Concept

T. I have another Concept. Paint is a ‘Yes’ example of it. What is my concept?

S: It is a mixture of solid and liquid

T: Another example is starch in water Can you say what my concept is?

S: It is a solid dissolved in a liquid

T: Now I shall give you a ‘No’ example. Gem stone

S: You concept is not of the type of Solid state

T: Here is another ‘No’ example Ruby Glass What is my concept?

S: Can you state one more ‘Yes’ example

T: Yes, it is gold sol

S: Your concept is that type of colloid in which dispersed phase is solid and dispersion medium is liquid

T: Can you name the concept?

S: No

T: It is sol

What about the ‘No’ examples
S: The colloid in which dispersed phase and dispersion medium are solids
T: Can you name it?
S: No
T: It is solid sol

Phase Two : Testing the Attainment of Concept
T: Can you give another example for Sol
S: Muddy Water
T: Can you say whether polish is ‘Yes’ or ‘No’ example for the concept of solid sol
S: No
T: Sulphur solution. To which type of colloid does it belong?
S: It is a Sol
T: How did you identify that Sulphur Solution is a Sol?
S: In sulphur Solution, Sulphur is a solid dispersed phase and water, dispersion medium

Phase Three : Analysis of the Thinking Strategies
T: Can you explain how you arrived at the concept?
S: From your first two ‘Yes’ examples came to know that your concept is that of a mixture formed from a soli and liquid. Your ‘No’ example made me think that the concept can never be solid-in-solids type of colloid. From your examples i came to the
conclusion that the concept in your mind belongs to that type of colloid where the dispersed phase is a solid and dispersion medium liquid.

Student describes thought

Phase One: Presentation of Data and Identification of Concept

T: I have another concept in mind. Protein in water is a 'Yes' concept for it. Can you say what my concept is?

S: Your concept is sol

T: It is only a guess. I shall give one more 'Yes' example. Ferric hydroxide sol in water. Can you say the concept?

Teacher presents first labelled example

First hypothesis

Teacher presents second labelled example
LESSON PLAN No.III

GOAL OBJECTIVES OF CAM

1. The Xth standard students should recognise the attributes of the concepts-Lyophilic and Lyophobic Solns
2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly
3. They will generate new examples of the concepts
4. They will form concept rules
5. They will locate the examples and state the attributes of the concepts as appear in the example.

Type of Model : Reception
Type of Concepts : Conjunctive
Learning Modality : Examples
Reception Strategy : Wholist's Strategy

Elements of the Concepts

1. Name : Lyophilic Sol
   Lyophobic Sol
2. Essential Attributes : The attractive force between molecules of Colloid
3. Positive Exemplars 1) Proteins in water
1) Ferric Hydroxide in Water
3) Polymer in Organic solvent
4. Negative Exemplars 1) Gold Sol
2) Sol of Metals

3) Metal Sulphides in Water

Lyophilic sols are solvent loving and there is a strong attractive force between molecules of Colloids.

Lyophobic Sols are solvent hating and there is not great attractive force between molecules of Colloids.
LEARNING MATERIAL FOR AOM

Preparation of Colloids

Colloids can be prepared by chemical method and by dispersion methods. When the dispersed phase can be obtained as insoluble reaction products, chemical method is used. In dispersion methods a lump of substance is broken down into small particles by mechanical or electrical means in the presence of dispersion medium.

Properties of Colloids

1. Brownian Movement

When we observe the colloidal particles through an ultramicroscope, we can see the particles moving in a Zig-zag manner.

Tyndal Effect

When light is passed through a colloidal solution its path becomes visible because of the scattering of light by the particles.

3 Electrophoresis

The movement of colloidal particles when an electric field is applied.

LESSON TRANSCRIPT

First Advance Organiser : Preparation of colloids

Second Advance Organiser : Properties of colloids

The strategy here is to present the students with major ideas that can help them as they try to read and understand the material. In this particular episode two organisers are presented. A primary organiser based on the experiments for the preparation of colloids and a secondary organiser based on experiments to prove the properties of colloids.
Phase One: Presentation of Data and Identification of Concept.

T: I have another concept in mind. Proteins in water is a 'Yes' example for it. Can you say what my concept is?

S: Your concept is Sol

T: It is only a guess. I shall give one more 'Yes' example. Ferric hydroxide sol in water. Can you say the concept?

S: No, more examples are needed

T: Here is another example which is a 'No' example. Gold sol. What is my concept?

S: So your concept is not that of colloidal mixture with solid dispersed phase and liquid dispersion medium

T: No, it is something connected to the nature of the dispersed phase and dispersion medium. Another 'No' example is sol of metals. Can you tell me the concept?

S: Your concept is about the stability of the colloid.

T: Can you be more specific

S: Strong attractive force between the dispersed phase and the dispersion medium

T: Yes. Can you name the concept?

S: No

T: It is lyophilic solsio,(solvent loving) Usually they are molecular colloid since the molecules of the
dispersed phase are large molecules. Can you say the name of the sol if water is the dispersion medium.

S: Is it hydrophilic sol?

T: Yes. What about the ‘NO’ examples?

S: They are solvent hating sols ie, there is not any great attraction between the solvent molecules and dispersed phase. They are unstable.

T: Yes. If we add a little electrolyte they will coagulate. When they coagulate they cannot be brought back to the colloidal state. While as in the case of lyophilic sol, they are reversible they can be reconverted to the sol state by agitating them with the dispersion medium. Can you name the former one?

S: NO

T: They are lyophobic sols. They are usually colloid multimolecular since the colloidal particles contain aggregate of atoms or small molecules. What will be the name of the sol if the dispersion medium is water.

S: It is hydrophilic sol

Phase Two: Testing the Attainment of Concept

T: Can you say any other example for a lyophobic sol

S: Metasulphides in water

T: Why metasulphide sols are lyophobic
S: They are insoluble in water

T: Yes, solution of high polymers in organic solvent is a 'YES' example for lyophilic sol. Am I correct?

S: Yes

T: Does lyophobic sol need a stabilising agent?

S: Yes

T: Very good. Why this lyophobic sols are considered to be multimolecular colloids

S: They contain large number of molecules in the dispersed phase

Phase Three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept.

S: It was with the help of 'Yes' exemplars and 'No' exemplars. I came to the conclusion. The first and second 'Yes' exemplars made me think that your concept might be that of sols. with your 'No' exemplar I came to the conclusion that your concept deals with the nature of the dispersed phase and dispersion medium and the attraction between them
Today we are going to study how the colloids are prepared and purified and also different properties of colloids.

Phase one: Presentation of the Advance Organiser

Colloids can be prepared by chemical methods and by dispersion methods. When the dispersed phase can be obtained as insoluble reaction products by appropriate reactions chemical method is used. In dispersion methods a lump of substance is broken down into small particles by mechanical or electrical means in the presence of dispersion medium. This process is called peptisation. The colloidal solutions are purified by dialysis. When electric field is applied during dialysis, it is referred to as electro dialysis.

Phase Two: Presentation of Learning Material

Dilute solution of ferric chloride is poured into boiling water (demonstration) what is obtained?

S: A white precipitate is obtained.

It is ferric hydroxide.

T: It is ferric hydroxide sol. what happens when oxygen is bubbled through a solution of $\text{H}_2\text{S}$?

S: $\text{H}_2\text{S}$ is oxidised to sulphur.

T: Yes. That is how sulphur sol is produced. Similarly sols of metals like silver, gold and platinum are produced by the reduction of the compounds by
hydrazine and these are some of the chemical methods for the preparation of sols. Have you heard of peptisation?

S: NO

T: In the dispersion methods, a lump of substance is broken into small particles of colloid size by suitable mechanical or electrical means in the presence of the dispersion medium. Dispersion medium also break up certain substances into colloidal state. This process is called peptisation. Gelatin, Gum, starch, Soap etc. are peptised by warming the substance with a dispersion medium. Cellulose nitrate peptised by ethyl alcohol is called collodion. How can be purified the colloids? What happens when the soluble impurities present in large concentration.

S: It destabilises the colloid.

T: The purification of colloid is done by dialysis. keeping the sol in a bag made of parchment paper and suspending it in pure water what will be the process that is going to take place?

S: Small molecules pass through the pores of the parchment paper but not the colloidal particles.

T: Yes. The sol is retained and when an electric field is applied during dialysis it is referred as electro dialysis.
Phase Three : Strengthening the Cognitive Organisation

T: Can you give some examples by which colloidal solution is prepared chemically?

S: When oxygen gas is passed through H₂S solution sulphur sol is obtained. FeCl₃ is poured into boiling water we get Ferric Hydroxide solution.

T: What is the principle behind dialysis?

S: When colloidal solution contains electrolytes and other soluble impurities it destabilises the sol. By keeping the sol in a bag made of parchment paper and then dipping in water all impurities pass through the pores of the paper, but the sol is retained. This process of purification of sol is called dialysis.

T: What is peptisation?

S: In the dispersion methods, a lump of a substance is broken down into small particles by mechanical or electrical means. Dispersion media also break up certain substance into colloidal state. This process is called Peptisation.

Phase One : Presentation of Advance Organiser.

T: Colloidal dispersion show the properties of Brownian movement Tyndal effect and electrophoresis.

Phase Two : Presentation of Learning Material

T: When we observe the colloidal particles through an ultra microscope we can see the particles moving in a zigzag manner. Can you say why this type of movement is taking place in colloidal solutions.
S: It may be due to the collision of colloidal particles.

T: Yes. The molecules of dispersion medium are constantly colliding with colloidal particles. This movement is called Brownian movement since it was he who first noticed the zigzag movement of the pollen grains suspended in water.

Can you see the colloidal particles when light is passed through it?

S: Yes.

T: When light is passed through a colloidal solution its path becomes visible because of the scattering of light by the particles.

What is the change of the colloidal particles or whether they are not charged?

S: No. Colloidal particles are charged.

T: What happens when an electric field is applied to the colloidal particles?

S: They will move to the electrode bearing the opposite charge.

T: The movement of colloidal particles when an electric field is applied is called electrophoresis.

Phase Three: Strengthening of Cognitive Organisation.

T: What is the principle behind the property of Tyndall effect shown by colloidal particle.

S: It is due to the scattering of light by colloidal particles.
What is meant by Brownian movement and what is principle behind it?

Brownian movement is the zigzag motion of the colloidal particles. This is due to the bombardment of the particles of the dispersion medium with that of the colloidal particles.

What is meant by electrophoresis?

It is the movement of the colloidal particles in an electric field. They will move to the electrode bearing opposite charge.

Promotes active reception learning.

Verbalises the essence of the concept in the advance organiser.

Repeats precise definition.
LESSON PLAN No. IV

LEARNING MATERIAL FOR AOM

Activity of a catalyst

Activity is the ability of catalyst to accelerate chemical reactions.

Selectivity of a catalyst

Selectivity is the ability of catalysts to direct reaction to yield particular products.

Lesson Transcript

First Advance Organiser : Activity of a Catalyst.
Second Advance Organiser : Selectivity of a Catalyst.

The strategy here is to present the students with major ideas that can help them as they try to read and understand the material. In this particular episode two organisers are presented. They are based of chemical experiments and examples.
LESSON PLAN No:IV

T: Today we are going to study two aspects of heterogeneous catalysts namely activity and selectivity. You have already learned about heterogeneous catalysis.

What can be the nature of the catalysis in heterogeneous catalysis.

S: They can be pure substances or mixtures.

S: They can be crystalline or amorphous.

T: What is the function of catalysts?

S: To alter the speed of the reactions.

Phase One: Presentation of Advance Organiser.

T: Activity is the ability of catalysts to accelerate chemical reactions. The degree of acceleration can be as high as $10^{10}$ times in certain reactions.

Phase Two: Presentation of Learning Materials.

T: Hydrogen peroxide is taken in a test tube. Can you observe anything special?

S: Small bubbles are forming slowly.

T: A little manganese dioxide is added to the test tube. What you observe?

S: Bubbles are forming rapidly.

T: What does it mean?
S: It means reaction is taking place very quickly

T: Or can we say the rate of reaction is increased?

S: Yes.

T: What happens when pure $\text{H}_2$ and $\text{O}_2$ mixture is stored.

S: It can be stored indefinitely without any reaction.

T: Suppose a mixture is heated in presence of Platinum?

S: Water is formed with explosive violence.

T: What is the role of platinum here?

S: It acts as a catalyst it can accelerate the rate of reaction.

T: Yes Can you explain what is meant by activity of a catalyst?

S: It is the ability of the catalyst to increase the rate of chemical reactions.


T: Can you give a summary of the major attributes of the demonstrations that we have seen?

S: Catalysts accelerate the chemical reaction. Activity of a catalyst is the ability of it to accelerate the chemical reactions.

T: Can you give an example?

S: Manufacture of $\text{NH}_3$ from $\text{N}_2$ and $\text{H}_2$ in presence of iron

Verbalises the attributes of learning material.

Asks questions to maintain the attention.

Asks questions to maintain attention.

Uses examples to enhance the organisation of the material.

Verbalises the essence of the learning material

Cites additional examples.
Phase One: Presentation of Advance Organiser

T. Now we are going to learn another concept namely selectivity. We have seen the nature of catalysts and also learned about heterogeneous catalysts. Selectivity is the ability of catalysts to direct reaction to yield particular products.

Phase Two: Presentation of Learning Material

T. N-heptane gives Toluene in the presence of platinum catalyst is this a selective process?

S. Yes

T. CH₃CH=CH₂. Can you name the molecule?

S: Propylene

T. Yes, it gives acrolein over Bismuth molybdate catalyst. Can you say through what processes this phenomenon occurs?

S: Adsorption of reactant on the surface of the catalyst.

S: Chemical reaction at the surface.

S: Removal of products from the surface.

T. Yes. During chemical reactions intermediate compounds are forming which gives rise to products. Have you heard of Zeolites?

S: No.

T. They are Alumino Silicates of the general formula Mₓ₋₁ₙ₋₁(AlO₂)ₓ₋₁(SiO₂)ₓ·MH₂O. It is highly porous. Do these pores have any function in catalysis?
S: Yes, Depending on the size of the reactant and product molecules. Compared to the size of the pores of the Zeolite reaction may proceed in a specific manner. Am I right Sir?

T: Yes, Shape selectivity is the most remarkable feature of Zeolite catalysis. They are employed in the cracking of hydro carbons. They convert alcohols to petrol by dehydrating alcohol

Explanations the material.

Phase Three: Strengthening of Cognitive Organisation

T: What do you infer from the process of selectivity?

S: Selectivity is the ability of catalysts to direct reaction to yield particular product.

Student repeats precise definitions.

T: What are Zeolites?

S: They are microporous alumino silicates.

T: What are the steps involved in heterogeneous catalysis.


2. Chemical reaction on the surface of the catalyst to form activated intermediates.

3. Desorption of the products from the surface.

Student gives a summary of the major attributes of the concepts.
<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Name of Teacher</td>
<td>Rema Devi .K.</td>
</tr>
<tr>
<td>2. Name of School</td>
<td>Government Higher Secondary School, Karappuzha, Kottayam</td>
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<td>4. Subject</td>
<td>Chemistry</td>
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<tr>
<td>5. Unit</td>
<td>Nuclear Chemistry.</td>
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Lesson Plan No. 1

GOAL OBJECTIVES OF CAM

1. The XII th standard students should recognise the attributes of the concepts—Natural Radio Activity, 'Artificial Transmutation' and 'Artificial Radio Activity' correctly.

2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.

3. They will generate new examples of the concepts.

4. They will form concept rules.

5. They will locate the examples and state the attributes of the concept as appear in the example.

**Type of model**: Reception

**Type of concepts**: Conjunctive

**Learning modality**: Symbols, equations and examples

**Reception strategy**: Wholist's strategy

**Elements of the Concepts**

1. **Name**
   - Natural Radio activity
   - Artificial Transmutation
   - Artificial Radio activity.

2. **Essential Attributes**: Disintegration of atomic nuclei.

3. **Positive Exemplars**:
   - $^{234}_{91}$pa $\rightarrow ^{234}_{92}$U $+$ e
     - $91 \quad 92 \quad -1$
   - $^{234}_{92}$U $\rightarrow ^{230}_{90}$Th $+$ He
     - $92 \quad 90 \quad 2$ (for natural radio activity)
   - $^{238}_{92}$U $\rightarrow ^{234}_{90}$Th $+$ He
     - $92 \quad 90 \quad 2$
4. Negative exemplars:

\[
\begin{align*}
27 \quad &4 \quad 30 \quad 1 \\
\text{Al} + \text{He} &\rightarrow \text{P} + n \\
13 \quad &2 \quad 15 \quad 0
\end{align*}
\]

( for artificial transmutation)

\[
\begin{align*}
30 \quad &30 \quad 0 \\
\text{P} &\rightarrow \text{Si} + \text{e} \\
15 \quad &14 \quad +1
\end{align*}
\]

( for artificial radio activity)

\[
\begin{align*}
14 \quad &4 \quad 17 \quad 1 \\
\text{N} + \text{He} &\rightarrow \text{O} + \text{H} \\
7 \quad &2 \quad 8 \quad 1
\end{align*}
\]

( for artificial transmutation)

\[
\begin{align*}
234 \quad &234 \quad 0 \\
\text{Pa} &\rightarrow \text{U} + \text{e} \\
91 \quad &92 \quad -1
\end{align*}
\]

( for artificial radio activity)

\[
\begin{align*}
234 \quad &230 \quad 4 \\
\text{U} &\rightarrow \text{Th} + \text{He} \\
92 \quad &90 \quad 2
\end{align*}
\]

( for artificial radio activity)

\[
\begin{align*}
30 \quad &30 \quad 0 \\
\text{P} &\rightarrow \text{Si} + \text{e} \\
15 \quad &14 \quad +1
\end{align*}
\]

( for artificial transmutation)

\[
\begin{align*}
238 \quad &234 \quad 4 \\
\text{U} &\rightarrow \text{Th} + \text{He} \\
92 \quad &90 \quad 2
\end{align*}
\]

( for artificial transmutation)

\[
\begin{align*}
14 \quad &4 \quad 17 \quad 1 \\
\text{N} + \text{He} &\rightarrow \text{O} + \text{H} \\
7 \quad &2 \quad 8 \quad 1
\end{align*}
\]

( for natural radio activity)
5. Rule

Radioactivity is the spontaneous disintegration of atomic nuclei with the emission of alpha, beta and gamma rays.

Artificial transmutation is the conversion of one element into another by bombarding with a projectile.

If the new element is radioactive the process is called artificial radioactivity.
Phase One: Presentation of Data and Identification of the Concept.

T: Today we are going to play a game. I will give you some examples of a particular concept. If the example contains the concept, I will say it a ‘yes’ example. If it does not provide the concept, I will say it is a ‘No’. You should say what is that particular concept in my mind. You should cite more examples and form a definition of that concept according to the characteristics.

Now let us see an example of the concept which is a ‘yes’

\[ \text{Pa} \rightarrow \text{U} + e + e \]
\[ 91 \quad 92 \quad -1 \quad -1 \text{ an electron} \]

Can you say what the concept is?

S: It is the conversion of an element to another element.

T: It is guess; you have to be more specific. Let us pass to the second ‘Yes’ example.

\[ \text{U} \rightarrow \text{Th} + 4 \text{He} \]
\[ 92 \quad 90 \quad 2 \quad 2 \text{ alpha particle} \]

Do you have any idea of the concept?

S: No. Give more examples.
T: OK. Here is a third 'yes' example for my concept
\[
\begin{align*}
\text{U} & \rightarrow \text{Th + He} \\
238 & \quad 234 & 4 \\
92 & \quad 90 & 2
\end{align*}
\]
Teacher presents a third labelled example.

S: different isotopes are obtained.
Second hypothesis

T: Here is a 'No' example
\[
\begin{align*}
\text{Al} & \rightarrow \text{P} + \text{n} \\
27 & \quad 4 & 30 & 1 \\
13 & \quad 2 & 15 & 0
\end{align*}
\]
Teacher presents fourth labelled example.

Can you say what my concept is?

S: From an element two other elements are producing without any reaction
Third hypothesis

T: Good here is another 'yes' example
\[
\begin{align*}
\text{P} & \rightarrow \text{Si + e} \\
30 & \quad 30 & 0 \\
15 & \quad 14 & +1
\end{align*}
\]
Teacher presents fifth labelled example.

S: It is the emission of some particles
Fourth hypothesis

T: Is there any influencing factor for the emission of particles?

S: No. It is spontaneous emission.
States the attributes of the concept.

T: Yes, you are in the right track.

Can you name the concept?

S: No.
It is natural radio activity. It is spontaneous disintegration of atomic nuclei. They usually emit Alpha rays, Beta rays and Gamma rays. Do you know what is an alpha particle?

It is helium nucleus, positively charged.

Yes. They can penetrate an aluminium sheet of 0.02 thickness.

What is a Beta ray?

It is a flow of electrons. They are negatively charged.

Yes. They can penetrate an aluminium sheet of 0.2 cm thickness.

What about Gamma rays?

They are electromagnetic radiations.

Very Good. They are not deflected by an electrostatic field. They can penetrate up to 100 cm thick aluminium sheet.

What about the 'No' examples

They are prepared artificially by bombarding with other particles.
T: Yes. Radioactive elements can be prepared artificially. The process of conversion of an element is called Artificial transmutation. If the product nuclei is radioactive the process is called Artificial radioactivity.

Can you say why neutrons are used as bombarding particle in Artificial transmutation?

S: Since neutrons are neutral there will not be any repulsion between the bombarding nuclei and the target nuclei.

T: Yes. You are right. Usually particle accelerators are using to speed up the bombarding nuclei.

Phase Two: Testing Attainment of the Concept.

T: Now I am going to test whether you have understood the concept ‘Radioactivity’. I shall give some examples and you should say whether it is ‘Yes’ or ‘No’:

\[
\begin{align*}
14 & \quad 4 & \quad 17 & \quad 1 \\
N & + & He & \rightarrow O & + & H \\
7 & \quad 2 & \quad 8 & \quad 1
\end{align*}
\]

S: No.

T: Correct, another one

\[
\begin{align*}
27 & \quad 27 & \quad 0 \\
Si & \rightarrow & Al & + & e \\
14 & \quad 13 & \quad 1
\end{align*}
\]
S: Yes.

T: Good. What is Artificial transmutation?

S: It is the conversion of one element into another.

T: Why the reaction in the Artificial transmutation process is very slow.

S: Because of the repulsive force between the target nuclei and bombarding nuclei.

T: Yes. What are the bombarding nuclei that are usually using?

S: Alpha particles, protons, neutrons, etc.

T: What are the different types of radiations emanating from a radio-active isotope?

S: Alpha Rays
Beta Rays
Gamma Rays

Phase Three: Analysis of Thinking Strategies

T: Can you explain how did you arrive at the concept?

S: When you gave the first example I thought you were referring to writing of nuclear equations, from you 'Yes' examples and 'No' examples it became very easy to arrive at the right answering avoiding unnecessary thoughts.
Less on Plan No. II

LEARNING MATERIALS FOR AOM

Group Displacement Law

When a radioactive nucleus emits an alpha particle its atomic number is reduced by two and its mass number is reduced by four. The new element will be two places to the left of parent element in the periodic table.

When a radioactive nucleus emits a beta particle its mass number is not changed but its atomic number is increased by one. The new element will be one place to the right of the parent element in the periodic table.

Radioactive Series

The chain of the successive disintegrations from an initial radioactive nucleus to a final stable element.

LESSON TRANSCRIPT

First Advance Organizer - Group Displacement Law
Second Advance Organizer - Radioactive Series.

The strategy here is to present the students with major ideas (organizers) that can help them as they try to read and understand the material. In this particular episode two organizers are presented. A primary organizer based on the chemical equations for nuclear changes and group displacement law and a secondary organizer based on radioactive series.
T: Today we are going to study the chemical equations for nuclear changes. It depends on group displacement law and also about the naturally occurring and artificially prepared radioactive series. You have already studied the phenomenon of radioactivity. You must have to identify the characteristics of the concept.

What are the different types of radioactive disintegrations?

S: Alpha rays
Beta rays
Gamma rays

T: What is the mass number of alpha particle?
S: Four

Phase One: Presentation of the Advance Organiser

T: When a radioactive nucleus emits an alpha particle its atomic number is reduced by two and its mass number is reduced by four. When it emits a beta particle, its atomic number is increased by one and no change in the mass number. i.e., when a radioactive nucleus emits an alpha particle the daughter element occupies two places to the left of the parent element in the periodic table and when a radioactive nucleus emits a beta

Orientation to the process
Clarifies the aims of the lesson

Existing
Cognitive
Structure

Existing
Cognitive
Structure

An Advance organiser is introduced.

Explains the essential characteristics of the organiser in the concept.
particle, the new element occupies one place to the right of the parent element in the periodic table. This is called group displacement law.

**Phase two: Presentation of Learning Material**

T: What is the symbolic representation of an alpha particle?

S: \( ^4_2 \text{He} \)

T: What about a Beta particle?

S: It is an electron represented by \( ^0_{-1}e \)

T: Look at this example

\[
\begin{array}{ccc}
14 & 14 & 0 \\
C & \rightarrow & N + e \\
6 & 7 & -1
\end{array}
\]

What about the change in atomic number and in mass number of the resulting nucleus?

S: Atomic number is increased by one and no change in mass number

T: What will be the position of the new element in the periodic table?

S: It will be one group of the right of the parent element.
T: Yes. Look at this example

\[
\begin{align*}
238 & \quad 234 & \quad 4 \\
U & \rightarrow & \text{Th} + \text{He} \\
92 & \quad 90 & \quad 2
\end{align*}
\]

What will be the position of the new element?

S: It will be two groups to the left of the parent element in the periodic table.

T: Can you state the group displacement law in the light of the above mentioned facts?

S: When an element emits an alpha particle the new element occupies two groups to the left of the parent element and when it emits a Beta particle, the new element occupies one place to the right of the parent element.

Phase Three: Strengthening of Cognitive Organisation

T: Can you give a summary of the major attributes of the concept we discussed?

S: Radioactive nuclei emit alpha particles or beta particles. If alpha particles are emitted the new element will be occupied two places to the left and when a beta particle is emitted the new element will be one place to the right of the parent element in the periodic table.

Uses examples that enhances the organisation of the presentation.

Verbalises the attributes of the learning material.

Student describes how the new learning material supports the concept in the subsumer.

Summarises the major attributes of the new material.
T: Can you explain why group displacement occurs?

S: Yes. Alpha particle is helium nucleus with mass number four and atomic number -2 and beta particle is an electron with a single negative charge.

Phase One: Presentation of the Advance Organiser

T: Now we are going to learn another concept. Now we know the disintegration of nuclei results in a stable isotope. But complete stability is not reached in a single step. The daughter element may still be radioactive. The chain of the successive disintegrations continues until on finally arrived at a stable isotope lead-206. All nuclei from the initial element constitutes a series which is called Disintegration series or Radioactive series.

Phase Two: Presentation of Learning Material

T: Here is an example for radioactive disintegration.

\[
238 \quad 206 \quad 4 \quad 0 \\
U \rightarrow \quad Pb + 8 \quad He + 6 \quad e \\
92 \quad 82 \quad 2 \quad -1
\]

Can you explain this nuclear change?

S: Uranium -238 emits 8 alpha particles and 6 beta particles and finally converts into lead-206.
T: Yes, this is a naturally occurring radioactive series. This is called $4n+2$ Series. Look at the Series (Shows the detailed series) can you explain why this series is called $4n+2$ series.

S: Is it related to the mass number?

T: Yes

S: All members have mass numbers that fit into the formula $4n+2$ by giving various values to '$n$'.

T: Very good. Look at this series (shows Thorium series) Can you name it?

S: It is Thorium series. The mass numbers fit into $4n$ where '$n$' bears different values.

T: This is another one. (Shows Actinium series) What is it?

S: It is Actinium series. The mass numbers of the various nuclei fit into the formula $4n+3$. Where '$n$' bears differing values.

T: Yes, these three are naturally occurring, there is one series which consists of man made elements. (shows Neptunium Series)

Can you name it?

S: It is Neptunium series. starting with Np-237 and ending with Bi-209. The members of the series fit into the formula $4n+1$.

Presents another problem situation.

Verbalises the essence of the material in own words.

Links diagram with the material in the organiser.

Links diagram with the material in the organiser.

Uses supplementary media for maintaining attention.

Verbalises the essence of the learning material.
Phase Three: Strengthening of Cognitive Organization

T: Can you explain what is meant by $4n$ series?

S: It is Thorium series. The starting element is Thorium 232 and the last stable element is lead 208. The mass numbers of the various elements fit into the formula $4n$.

T: What is meant by radioseries?

S: The chain of the successive disintegrations from an initial radioactive nucleus to a final stable element.

T: In which of the formula the mass numbers of the elements of the actinium series belong?

S: $4n+3$
GOAL OBJECTIVES

1. The XII standard students should recognise the attributes of the concepts, nuclear fission and nuclear fusion.

2. They will state the attributes correctly and label the unlabelled examples given by the teacher correctly.

3. They will generate new examples of the concepts.

4. They will form concept rules.

5. They will locate the examples and states the attributes of the concepts as appear in the example.

Type of Model : Reception.

Type of Concepts : Conjunctive.

Learning Modality : Nuclear equations.

Elements of the Concepts.

1. Name
   - Nuclear fission.
   - Nuclear fusion.

2. Essential Attributes
   - Breaking of heavier nucleus,
   - fusion of lighter nuclei.

3. Positive exemplars
   - $^{235}\text{U} + n \rightarrow ^{236}\text{U} \rightarrow ^{144}\text{Ba} + ^{93}\text{Kr} + 3n$
   - $^{92}\text{U} + n \rightarrow ^{92}\text{U} \rightarrow ^{144}\text{Xe} + ^{90}\text{Sr} + 2n$
   - $^{235}\text{U} + n \rightarrow ^{236}\text{U} \rightarrow ^{144}\text{Cs} + ^{90}\text{Rb} + 2n$

    (for nuclear fission and negative exemplars for nuclear fusion)

4. Negative exemplars:
   - $^1\text{H} + ^4\text{He} \rightarrow ^{2}\text{He} , \quad ^1\text{H} + ^4\text{He} \rightarrow ^{2}\text{He} + n$
   - $^1\text{H} + ^4\text{He} \rightarrow ^{1}\text{H} + ^{2}\text{He} + e$

    (for nuclear fusion and positive exemplars for nuclear fusion)
5. Rule: In nuclear fission reaction a heavy nucleus breaks up into fragments consisting of lighter nuclei and several neutrons. A large amount of energy is released during this process.

A large amount of energy is released in nuclear fusion reactions, in which two or more lighter nuclei combine to form a heavy nucleus.

Support System for ITM

LEARNING MATERIAL

Instructor Fact sheet

The principle underlying an atomic bomb is the nuclear chain reaction. Two or more pieces of fissionable material each less than the critical mass are brought together rapidly by means of a conventional explosive so that the subcritical piece come together to, form a single piece exceeding the critical mass. A chain reaction will start releasing a large amount of energy. This energy released during nuclear fission is because of a loss in mass; the sum of the masses of the two fragments and neutrons released is less than the sum of the masses of one uranium $^{235}$U and one neutron.

The principle behind hydrogen bomb or thermonuclear bomb is the nuclear fusion. It occurs at very high temperature. The energy released by the atomic bomb is utilised in the explosion of the hydrogen bomb. This high temperature is in order to overcome the electrostatic repulsion between the fusing nuclei.
Phase one: Presentation of the Data and Identification of the Concept.

T: Today we are going to play a game. I will give you some examples of a particular concept. If the example contains the concept, I have in my mind I will say it is a 'yes'. If it does not provide the concept, I will say it is a 'No'. You should say what is that particular concept in my mind you should cite more examples and form a definition of that concept according to the characteristics.

now let us see an example of the concept which is a "Yes"

\[
\begin{array}{cccccc}
235 & 1 & 236 & 140 & 93 & 1 \\
U + n & \rightarrow & U & \rightarrow & Ba + Kr + 3 n \\
92 & 0 & 92 & 56 & 36 & 0 \\
\end{array}
\]

can you say what the concept is?

S: Nuclear reaction

T: OK, it is a guess. Let us take a look at another one which is a 'yes'

\[
\begin{array}{cccccc}
235 & 1 & 236 & 144 & 90 & 1 \\
U + n & \rightarrow & U & \rightarrow & Xe + Sr + 2 n \\
92 & 0 & 92 & 54 & 38 & 0 \\
\end{array}
\]

Any other guesses what it might be?

S: Reacting atoms are same but the products are different
T: All right. Here is another example. It does not contain the concept. It is a 'No'.
\[
\begin{array}{ccc}
2 & 2 & 4 \\
H & H & \rightarrow & He \\
1 & 1 & 2 \\
\end{array}
\]
Can you say what the concept is?

S: No. Give more examples.

T: Here is another 'No' example
\[
\begin{array}{cccc}
2 & 3 & 4 & 1 \\
H & H & \rightarrow & He + n \\
1 & 1 & 2 & 0 \\
\end{array}
\]
Any guess this time?

S: Your concept may be reaction involving neutrons.

S: When neutron acts as a reactant different products are obtained.

T: Good. In all these examples neutrons are involved. You are on the right track. Compare the 'Yes' examples with 'No' examples. Anybody else have any other guesses?

S: From a single element more than one element is formed.

T: Can you name the concept?

S: No.

T: It is called a nuclear fission.

Teacher presents third labelled example

Teacher states an essential attribute of the concept.

Student states the essential attributes of the concept.

Teacher states an essential attribute of the concept.

Now what about the other 'No' examples look at the black board.
S: Two atoms combine to form a single atom

T: What is the type of phenomenon?  
   Can you name it?

S: No.

T: It is nuclear fission

Teacher names the concept

**Phase Two: Testing the Attainment of the Concept**

T: Can you say whether the following example is a 'yes' or 'No' for nuclear fission?

\[
236 \quad 144 \quad 90 \quad 1 \\
_{\text{U}} \rightarrow \quad \text{Cs}^+ \quad \text{Rb} + 2 \quad \text{n}
\]

236 92 55 37 0

Student labels unlabelled example

S: It is a 'Yes' example

T: Can you cite another example for nuclear fusion?

\[
4 \quad \text{H} \rightarrow \quad \text{He} + 2 \quad \text{e}
\]

4 1 2 +1

Student generates additional example.

T: Can you define the nuclear phenomenon?

S: Nuclear fission is a phenomenon in which a heavy nucleus breaks up into two fragments consisting of lighter nuclei and several neutrons.

Student states the concept rule

T: Can you define nuclear fusion?
Phase Three: Analysis of Thinking Strategies

T: Can you explain how you arrive at the concept?

S: It was with the help of the 'Yes' and 'No' examples. The first two 'Yes' examples made me to think that your concept was reactions involving nuclear particles. But your 'No' examples revealed something more i.e., you were concerned with the splitting of nuclei and combination of nuclei.

T: What about the 'Yes' example with regard to neutrons?

S: In both the examples neutrons combine with a nuclei and form an unstable nuclei which breaks to form fission products.

T: Similarly what is the role of neutron in nuclear fusion?

S: There neutrons are released.
Phase - I

Orientation to the Process and Encounter with the Problem

T: I am going to teach you in a very different manner which is quite new to you. First of all, I will present a problem to you and then we will try to find out the solution. You have to ask Yes/No type of questions which will help you in finding out the answer. For your questions I will only say 'Yes' or 'No'. How I will present the problem.

Do you remember what we learnt in the previous class

S: Yes, the phenomena of nuclear fission and nuclear fusion

T: Yes you are right.

Have you heard of the Atomic bomb and Nuclear reactors

S: Yes

T: Can you say the principle underlying an Atomic bomb? Suppose I say it is nuclear fission do you agree with me. If so give me reasons. I shall give you a hint that nuclear energy is utilised in Atom bomb and Nuclear reactors.
Phase II & III Data gathering-Verification - Experimentation

S: Is this neutron responsible for the abundant energy?

T: Yes, Not a lot but to some extent

S: Do the other nuclei also have a role in producing energy?

T: Yes. Can you explain how the energy is released. You examine the examples.

S: Does a single neutron, produce more than one neutron?

T: No

S: Do mass numbers of the reacting nuclei and the product nuclei are the same.

T: Yes. Make out the difference in masses between reacting nuclei and product nuclei in the following example.

\[
\begin{align*}
235 & \quad 1 & 236 & \quad 95 & \quad 139 & \quad 1 \\
U + n & \rightarrow U & \rightarrow Mo + La + 2n \\
92 & \quad 0 & 92 & \quad 0
\end{align*}
\]

S: The mass of the reacting nuclei is equal to the sum of the isotopic mass of U-235(235.118) and the mass of one neutron (1.009) and that of the product nuclei is equal to the sum of isotopic Formulates the hypothesis
masses of $^{95}$Mo, $^{139}$La and that of two neutrons. Am I right Sir?

T: Yes.

S: Is there any difference in atomic masses and mass numbers?

T: Yes

S: If there is difference, then is that difference responsible for the energy released?

T: Yes.

**Phase IV - Formulation of an Explanation**

S: It is $(94.936 + 138.950 + 2 \times 1.009) - (235.118 + 1.009)$ amu

i.e., 0.223 a.m.u

1 amu is 931.48 Mev. Is it sir?

T: Yes

S: So the difference in mass is converted into energy.

T: Yes, you are correct. Can you say the amount of energy released in the above fission reaction.

S: It will be equal ≈ 280 Mev per one gram of $^{235}$U

T: What will happen to the neutrons evolved as a result of fission process?
S: Does these neutrons come back to react with the uranium nuclei and try to sustain the reaction?

T: Yes. Do you know the process of chaining. now you will be able to explain chaining of fission reaction.

S: If the mass of the uranium nuclei is sufficient chaining of fission reaction may sustain.

T: Yes. That mass is called critical mass. The critical mass of uranium is 1 to 100 Kg.

S: Is there any mass difference occur in nuclear fusion process?

T: Yes notice the following example and try to find it out

\[
\begin{align*}
2 \quad & 2 \quad 4 \\
H \quad & H \rightarrow \text{He}
\end{align*}
\]

S: Mass decrease is 0.026 amu and corresponding energy released will be \(23 \times 10^8\) KJ /mol. Am I right?

T: Yes. Can you explain why fusion process is considered as thermo nuclear process?

S: Something related to temperature. Does high temperature an essential factor for fusion?

T: Yes. What is it's role?

S: Whether there is any repulsion between the fusing nulei?
T: Yes. High temperature is needed in order to overcome the electrostatic repulsion between the nuclei when they come together to fuse. Now you will be able to explain the processes in atom bomb, nuclear reactor hydrogen bomb.

S: In atom bomb the energy released from the fission reaction is utilised, is it Sir?

T: Yes, in nuclear reaction the fission reaction is made at a controlled rate. So the energy released is used for construction purposes. A reactor consists of

a) a fissile material
b) a moderator to slow down the neutrons
c) control rod (Boron\Cadmium) which capture some of the neutrons so that chain reaction does not become violent. The heat energy released can be converted into electrical energy. Breeder reactors produce more fissile nuclei than it consumes.

How is it possible?

S: $^{238}_{92}$U for example is bombarded with fast neutrons it produces plutonium $^{239}_{93}$Pu which is a fissile nuclei.

$$
^{238}_{92}U + n \rightarrow ^{239}_{93}Np + e^{-}
$$
239 Pu + n → Fission products + neutrons

in hydrogen bomb, is it fusion reaction taking place.

T: Yes. High temp needed for nuclear fusion is used by an atomic bomb.

Phase V - Analysis of the Inquiry Processes

T: What kind of questions did you ask?

S: About the role of neutrons in producing energy

S: About the differences in atomic masses and mass numbers.

S: About the mass difference occur in nuclear fission and fusion processes.

T: OK, that was what you did. You saw the problem and arrived at the solution by yourself.
LESSON PLAN NO. IV

Support System For ITM

LEARNING MATERIAL SESSION

Instructor Fact sheet

The number of atoms disintegrating in radioactive material is related to the number of atoms originally present by the equation $N_t = N_0 e^{-\lambda t}$

Where $N_t$, the number of nuclei disintegrating after a time 't'
$N_0$, the number of disintegrating nuclei initially present
$\lambda$, the disintegration constant

Radiocarbon dating the process of determination of the age of archeological findings radiocarbon. $^{14}C$ is absorbed along with $^{12}C$ as $CO_2$ by plants during photosynthesis. The disintegration rate of $c$-14 is constant when the plant is alive. When it decays then there will be no more accumulation of $c$-14 from air, but the $c$-14 begins to disintegrate. By measuring the original disintegration rate and the rate of decay at present it is possible to calculate the time interval using the equation

$$t = \frac{2.303 \log N_0}{\lambda}$$
Phase I

Orientation to the process and encounter with the problem

T: I am going to teach you in a different manner which is quite new to you. First of all I will present you a problem, the solution of which shall be found out by yourselves. You can ask as many questions as possible. But one condition is that the questions should be framed in such a way that I can answer ‘Yes’ or ‘No’. Only one question at a time and you have to test, and verify the matter according to your wish.

Here is the problem

A wood specimen from an archeological find shows a $^{14}_{6}$C activity of 3.8 counts per minute per gram of carbon. The archeologist immediately calculated the age the wood specimen as 11540 years.

How is it possible? (t $1/2$ =5770 years)

Phase II & III Data gathering - Verification & Experimentation

S: Is there any peculiar property of emitting radioactive rays for the wood specimen?

T: Yes

S: Do all wood specimens possess the same property?
T: Yes

S: Is $^{14}\text{C}$ radio active?

T: Yes

S: If the wood does not contain $^{14}\text{C}$ would the archeologist be able to find out the age of the specimen?

T: No

S: Is there any instrument to measure the extent of radioactivity as mentioned in the problem?

T: Yes. Instruments like Scintillation counter, Wilson cloud chamber and Geiger-Müller counter etc. are used to find the rate of decay by counting the number of particles emitted per unit time.

S: Is there any relationship between the number of atoms disintegrating and the number of atoms originally present?

T: Please be more specific.

S: That is freshly cut wood gives 15.3 Counts/minute (given). After some time it becomes 3.8 counts/minute per g of carbon. Now my question is whether there is some relationship between the two values.

T: Yes

S: If there is not a relationship between the two values...
could we be able to calculate the age of the specimen?

T: No (The student arrives at a simple linear theory that there is a relationship between the disintegration rate when the plant is alive and when it is dead)

T: There two values are related and they obey the rate law

\[ N_t = N_0 e^{-\lambda t} \]

where \( N_0 \) = No.of disintegrating nuclei initially present
\( N_t \) = No.of disintegrating nuclei at a time \( t \) and
\( \lambda \) = disintegration constant

T: Can you calculate the time required for half of a sample to decompose?

S: Can I use the above formula to solve the problem?

T: Yes

S: \( N_t \) will be equal to \( N_0/2 \), am I correct?

T: Yes

S: Then the equation can be re-written as

\[ \frac{N_0}{2} = N_0 e^{-\lambda t}, \text{ is not it?} \]

T: Yes you are on the right track

S: On taking logarithms, for the equation

\[ \frac{1}{2} = e^{-\lambda t} \]
\[ 2 = e^{\lambda t} \]
\[ 2.303 \times \log 2 = \lambda t \]
Phase IV - Formulation of an Explanation

T: Yes it is called half life period of a radio active substance (given)

S: The half life period is independent of the initial number of atoms, isn’t it?

T: Yes. The decay too is independent of the temperature, pressure and other physical conditions.

S: Does the half life period of different atoms differ?

T: Yes

S: The \( \lambda \) for the above problem can be calculated

\[
\lambda = \frac{0.693}{t^{1/2}}
\]

\[
= \frac{0.693}{5770}
\]

\[
= 1.20 \times 10^{-4}/\text{year}
\]

Can I proceed Sir?

T: Yes

S: \( N_t = N_0 e^{-\lambda t} \)

\[
\frac{N_t}{N_0} = e^{-\lambda t} = \frac{t}{e^{\lambda t}}
\]

\[
\frac{N_0}{N_t} = e^{\lambda t}
\]

on taking logarithms on both sides

\[
\log \frac{N_0}{N_t} = \lambda t \log e
\]

\[
\log 15.3 = 1.20 \times 10^{-4} \times t
\]
\[ t = \frac{\log 4 \times 2.303}{1.20 \times 10^{-4}} \]
\[ = 11,540 \text{ years} \]

Am I right sir?

T: Yes. This procedure is called Radio-Carbon dating. Do you know how the $^{14}C$ is entered into the plants and animals.

**Phase Five: Analysis of the Inquiry Process**

T: What kind of questions did you ask?

S: About the number of atoms originally present and the number of atoms after disintegration, in the decay process.

Teacher probes for clarity and accuracy

S: About the relationship between the above two.

Recapitulates the steps of inquiry

S: About half-life period of radioactive nuclei.

T: Yes, then,

S: Using the equation for radioactive decay we were succeeded in finding out the age of the material containing carbon.

The teacher summarises

T: Ok, that is what you did. You saw the problem, then by asking questions you arrived at the answer.

T: Let us study about the application of the radioactivity which have some relations with your acquired knowledge. First of all I will give you a
general picture of it and give you some material to observe. After that we will discuss some more ideas. Now tell me what you know about radio carbon dating?

S: It is the determination of the age of materials containing $^{14}$C which decays

T: How will you obtain the date from the decay process?

S: According to the rate law

$$N_t = N_0 e^{-\lambda t}$$

T: Is it proportional to the original no. of atoms present in the material?

S: Yes

T: From where this $^{14}$C enters into the plant body?

S: From atmosphere

T: Yes. $^{14}$C in the form of CO$_2$ is incorporated into the plant body. What this equation stands for?

$$^{14}C \rightarrow ^{14}N + e$$

S: Is it showing the decay of $^{14}$C?

T: Yes. we can count the rate of decay of $^{14}$C in plants when it is alive which is a contant. when the plant dies, the process of incorporation of $^{14}$C stops and $^{14}$C already present begins to decay. By
Knowing the rate of decay you can calculate the age of the material.

S: Yes, using the rate law

\[ N_t = N_0 e^{-\lambda t} \]

Where \( t \) represents time taken for \( N_0 \) to become \( N_t \).

T: This process called radio carbon dating is developed by W.F. Libby.

**Phase Three: strengthening of cognitive organisation**

T: Can you define radio carbon dating?

S: Determining the age of objects of animals or vegetable origin by the principle of radioactive decay.

**Phase One Presentation of Advance Organiser**

T: Matter contains a definite proportion of 14C by the bombardment of nitrogen in the atmosphere by cosmic rays. This 14C is converted into 14CO2 which is incorporated into living plants. Because of natural plant-animal carbon cycle, an equilibrium will be set and all living matter will contain a constant equilibrium concentration of Carbon-14. Once the plant or animal dies the process of incorporation of 14C stops and already present begins to decay.
Phase Two: Presentation of Learning Task

T: Look at this equation

\[
\begin{array}{cccc}
14 & 1 & 14 & 1 \\
N & + & n & \rightarrow C + H \\
7 & 0 & 6 & 1
\end{array}
\]

Can you explain the process involved in this equation?

S: Yes. It is the conversion of \(^{14}\text{N}\) to \(^{14}\text{C}\) by means of neutrons.

T: Can you say the source of neutrons?

S: It is from Cosmic rays emanating from sun.

T: How this \(^{14}\text{C}\) enters into the plant body?

S: In photosynthesis, plants absorb \(\text{CO}_2\) along with \(^{12}\text{C}\). \(^{14}\text{C}\) can also be incorporated.

T: Can you explain the process of decay involved in the above technique.

S: Yes \(^{14}\text{C}\) formed by the bombardment of neutrons to \(^{14}\text{N}\) is incorporated into the plant body during the process of photosynthesis. It decays at a constant rate when the plant is alive and when it dies the incorporated \(^{14}\text{C}\) begins to decay. By measuring the rate of decay after a particular period the time taken for the process can be calculated using the equation.

\[
N_t = N_0 e^{-\lambda t}
\]

\(N_0\) = No of atoms originally present

\(N_t\) = No of atoms originally after a time 't'
\( \lambda = \text{decay constant} \)

T: How will you calculate the decay constant?

S: It is calculated from the half-life period of the material.

\[ \lambda = \frac{0.693}{t_{1/2}} \]

where \( t_{1/2} \) is the half-life period of the material.

T: Radioactive isotopes are used in other fields too. They are Radio iodine is employed to diagnose and treat hyperthyroidism, radiophosphorous (P-32) is used in the treatment of leukaemia. Cobalt-60 is used to destroy malignant cells. This type of application of radioactivity in medicine is termed radiotherapy. In industry, radio isotopes are used in the measurement of the thickness of a material etc.

Reminds the whole cognitive structure active reception learning is promoted by giving additional examples.
Teacher gives more examples for the application of radioactive isotopes.
APPENDIX II

LESSON TRANSCRIPTS BASED ON CM
LESSON PLAN NO.1

Name of teacher : K. Rema Devi
Subject : Chemistry
Unit : Different Types of Chemical Reaction.
Topic : Physical Change and Chemical Change.

Standard : VII
Strength : 42
Duration : 45 minutes

CONTENT ANALYSIS

Newterms : Physical Change, Chemical Change.

Facts 1. When a wooden stick is broken into two the properties of the wood are not changed
2. When a chalk piece is broken into two, its properties are not disturbed.
3. The paper when cut into two, the properties of the paper are not changed. The only change is in its size and shape.
4. When glass tumbler is broken, the pieces are still glass and is not changing its properties.
5. A piece of wood when burnt, then ashes are formed.
6. The iron piece in contact with water or moisture changes into rusted iron.
7. Some sulphur when heated, burns with bluish flame giving a colourless gas.
8. Sugar when heated changes into carbon.

Concepts : 1. A temporary change of a substance which does not involve the formation of a new substance is called a physical change.
2. The change in which original materials disappear and new substances are formed, is called a chemical change.

Instructional objectives: The pupil develops,

1. Knowledge in terms like physical change, chemical change and facts and concepts regarding the above terms;
2. Understanding in the above mentioned terms, facts and concepts;
3. Application of the acquired knowledge in familiar and unfamiliar situations;
4. Skill in observation;
5. Interest in studying natural and man made surrounding;
6. Attitude by developing curiosity.

Teaching aids: A piece of wood, iron nail, Sulphur, Sugar crystals, rubber band, chalk, paper, spirit lamp etc. and usual classroom facilities.

Previous knowledge: The pupil knows that there are many changes taking place in the nature like germination of seeds, formation of curd from milk.

<table>
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<th>Learning experiences</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td>Introduction</td>
<td>You might have observed different changes in nature such as germination of seeds, cloths getting dried in the sun, changing of day and night, rusting of iron, formation of curd from milk etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are some changes in which no new substances are formed and there is change only in size and shape of the objects. Such a change is called physical change.

What do you observe in these changes.
All these changes are caused due to changes in position, shape, size, colour, state, structure etc.

**Presentation:**

A wooden stick is taken and broken into two. What changes do you observe?

The size of the original wooden stick has changed.

Is there any change in its composition?

No. It has only changed in its size and shape.

A chalk is broken into two. What do you observe?

The shape and size of the chalk is changed but there is no change in its composition.

A paper is taken and torn into two pieces. What do you observe?

What happens to its composition, size and shape?
Si observes

The composition of glass does not change but its size and shape changes.

What happens when water is boiled and vapour is formed and vapour when cooled?

Si observes

The composition of water remains the same when it changes into vapour and vice versa. Only its state of existence has changed.

Does the iron nail change its existence when magnetised?

U/explains

Iron nail is acquiring magnetic properties only. It is not changing its state. The nail is still an iron nail. No new substance is formed.

U/explains

When current is switched on to an electric bulb, does the filament undergo any change?

No. The filament remains the same and no new substance is formed.

U/explains

Sulphur when taken in a test tube and heated changes into a liquid but again turns into sulphur when cooled.
Arrives at conclusion

In the above examples we see that the changes are of size or shape of the object. This type of change can be called as physical change (BBW).

Explains

The features of physical change are reversibility, temporary change and non production of new substances.

defines

A physical change is a temporary change which does not involve the formation of a new substance.

A magnesium ribbon is taken and heated. What do you observe?

The magnesium ribbon burns with a dazzling light and a white ash is left behind. The product obtained is totally different from magnesium.

Notices relevant details

S

A piece of paper is burnt. What do you observe?

The paper burns and ash is produced. This product does not possess the properties of a paper.

writes equation

2Mg + O2 → 2MgO

What are the features of physical change?

What is a physical change?
There are some changes in which new substances are formed. Such changes are called chemical change.

When an electric current passes through acidified water hydrogen and oxygen are formed:

\[ 2H_2O \rightarrow 2H_2 + O_2 \]

Mercuric oxide is heated in a test tube. After heating it turns black, (silver beads of mercury)

\[ 2HgO \rightarrow 2Hg + O_2 \]

A silver nitrate solution is added to solution of sodium chloride in a test tube. A white precipitate is formed.

\[ AgNO_3 + NaCl \rightarrow AgCl + NaNO_3 \]

Few pieces of zinc is taken in a test tube containing dil. sulphuric acid. The zinc dissolves with bubbles of gas coming out is observed.

A burning candle is brought upto the mouth. What happens?

The gas ignites with a pop sound. The solution left is colourless and after evaporation white crystals of zinc sulphate is formed.
In all the above experiments what do you observe?

In the above reactions new substances are formed. Such types of changes are known as chemical change (BBW).

What is chemical change?

A chemical change is a permanent change which involves the formation of a new substance or substances.

What are the features of chemical changes?
Review

1. What are the features of physical change?
2. What is a physical change?
3. What are the features of chemical change?
4. What is a chemical change?

Assignment: Classify the following changes as physical change and chemical change.

1. A piece of wood when burnt.
2. Sugar crystals heated in a vessel.
3. Water when boils and becomes vapour.
4. A wooden stick broken into pieces.
5. Germination of seeds.
6. Drying of clothes in the sun.
7. Formation of curd from milk.
8. Burning of fuels.
LESSON PLAN NO. 2

Name of teacher : K. Rema Devi
Subject : Chemistry
Unit : Different Types of Chemical Reaction.
Topic : Simple Combination, Simple Decomposition.

Standard : VIII
Strength : 40
Duration : 45 minutes

CONTENT ANALYSIS

New terms : Simple Combination, Simple Decomposition

Facts :

1. When a magnesium ribbon is ignited, it burns with a dazzling white light and white powder is formed.
2. When iron combines with sulphur, ferrous sulphide is formed.
3. When water is added to quick lime, a paste of calcium hydroxide is formed.
4. When mercuric oxide is heated, mercury and oxygen are formed.
5. When lead nitrate is heated, lead monoxide, nitrogen dioxide and oxygen are formed.
6. When potassium permanganate is heated, potassium manganate, manganese dioxide and oxygen are obtained.
7. When KNO₃ is heated, KNO₂ and O₂ are formed.
8. When electric current is passed through acidified water, H₂ and O₂ are obtained.
Concepts:

1. Simple combination is a reaction in which the molecules of two or more substances combine to form molecules of a single substance.

2. Simple decomposition is a reaction in which the molecules of one substance break up to form molecules of two or more different substances.

Instructional objectives: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.

2. Understanding the above mentioned terms, facts and concepts.

3. Application of the acquired knowledge in familiar and unfamiliar situations.

4. Skill in experimentation and observation.

5. Scientific attitude and scientific interest.

Teaching Aids

Magnesium oxide, Spirit lamp, Sulphur, Iron powder, Calcium Oxide, Water, Test tubes, Lead nitrate, Potassium permanganate and usual classroom facilities

Previous knowledge

The pupil has the knowledge regarding various reactions and difference between physical and chemical change.
## Content

### Objectives/specifications

- **Introduction**: Classify the following changes as physical and chemical changes.

  1. A piece of wood when burnt
  2. Sugar crystals heated in a vessel
  3. Water vapour boils and becomes vapour
  4. Germination of seeds
  5. Formation of curd from milk
  6. Burning of fuels

### Learning Activities

- **A piece of magnesium ribbon is burnt in a flame. What happens?**
  - The ribbon burns with a dazzling light and a white powder is left behind.
  - **Equation**: $2 \text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
  - Magnesium combines with oxygen to form Magnesium oxide

- **Sulphur powder is taken in a test tube and it is fused. To it add a little iron powder and the**
Simple combination

Two substances combine to form a single substance

These type of reactions in which molecules of two or more substances combine to form molecules of a single substance is called simple combination. (B.B.Work)

Can you symbolically present the simple combination reaction between substances A and B?
<table>
<thead>
<tr>
<th>Experiments</th>
<th>Notice Relevant Details</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Pb(NO₃)₂ → 2PbO + 4NO₂ + O₂</td>
<td></td>
<td>Lead nitrate is taken in a test tube and burnt. What happens? A brown gas is evolved.</td>
</tr>
<tr>
<td>2KMnO₄ → K₂MnO₄ + MnO₂ + O₂</td>
<td></td>
<td>An yellow residue is seen in the test tube. When lead nitrate is heated lead monoxide, nitrogen dioxide and oxygen are formed.</td>
</tr>
<tr>
<td>2KNO₃ → 2KNO₂ + O₂</td>
<td></td>
<td>When KMnO₄ is heated Potassium Manganate, Manganese Dioxide and oxygen are formed.</td>
</tr>
</tbody>
</table>

A+B→AB

When potassium nitrate is heated what happens?
Potassium Nitrite and oxygen are formed.

What is the action of heat on mercuric Oxide.

Mercury and oxygen are formed.

What are the products obtained when acidified water is electrolysed?

Compare the reactions mentioned above.

In these reactions, molecules of one substance break up to form molecules of two or more different substances. These reactions are called simple decomposition reactions (B.B. work).

Can you symbolically represent the simple decomposition of the compound AB

\[
AB \rightarrow A + B
\]
Review:

1. Define simple combination reaction?
2. Give two examples for simple combination reactions?
3. Define simple decomposition reactions?
4. Give two examples for simple decomposition reactions

Assignment: identify the type of following reactions.

1. H₂ combines with Cl₂ to form HCl
2. When calcium carbonate is heated, calcium oxide and carbon dioxide are formed.
3. When water is electrolysed H₂ and O₂ are formed.
4. Sulphur is burnt in oxygen to form sulphur dioxide.
LESSON PLAN NO. 3

Name of teacher : K. Rema Devi  
Subject : Chemistry 
Unit : Different Types of Chemical Reaction. 
Topic : Simple Displacement, Double Decomposition 
Standard : VIII 
Strength : 42 
Duration : 45 minutes 

CONTENT ANALYSIS

Newterms : Simple Displacement, Double Decomposition 

Facts :

1. When silver nitrate is treated with sodium chloride, silver chloride and sodium nitrate are formed. 
2. When \( \text{H}_2\text{S} \) is passed through \( \text{CuSO}_4 \), copper sulphide and sulphuric acid are formed. 
3. When potassium iodide is added to lead nitrate solution, potassium nitrate and lead iodide are formed. 
4. When sodium sulphate solution is treated with barium chloride, a white precipitate of barium sulphate is obtained. 
5. When iron is treated with copper sulphate solution, Cu is precipitated and iron sulphate is obtained. 
6. When zinc is treated with sulphuric acid, \( \text{H}_2 \) gas is evolved and zinc sulphate is obtained. 

Concepts:

1. Simple displacement is a reaction in which the atoms of an element replace the atoms of one of the elements in the molecule of a compound.
2. Double decomposition is a reaction in which the molecules of two compounds exchange their component parts to form two different substances.

**Instructional objectives**: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.
2. Understanding in the above mentioned terms facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation and observation
5. Scientific attitude and scientific interest.

**Teaching aids**:

- AgNO₃, NaCl, Zinc, Iron Sulphate, Iron, Copper Sulphate, Lead nitrate, Potassium iodide, Sodium Sulphate,
- Barium Chloride, Test tubes, Spirit lamp and other class room facilities.

**Previous Knowledge**:

The pupil has acquired knowledge regarding Physical and chemical changes, simple combination and simple decomposition reaction etc.
<table>
<thead>
<tr>
<th>Content</th>
<th>Objectives/Specifications</th>
<th>Learning Activities</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Classify the following reactions into simple combination and simple decomposition reactions.</td>
<td>1. H₂ burns in chlorine to form hydrogen chloride.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Sulphur burns in oxygen to form sulphur dioxide.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. N₂ Combines with H₂ to form ammonia</td>
<td></td>
</tr>
<tr>
<td>K/recalls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Development</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immerse a clean iron nail in a solution of copper sulphate. What can you observe?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A red precipitate of copper can be seen deposited on the surface of the iron nails</td>
<td></td>
</tr>
<tr>
<td>S/experiments</td>
<td>S/notices relevant details</td>
<td>Fe+CuSO₄ → FeSO₄ + Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A few zinc pieces are added to dilute sulphuric acid taken in a test tube. What can you observe?</td>
<td></td>
</tr>
<tr>
<td>S/writes equations</td>
<td></td>
<td>Fe+CuSO₄ → FeSO₄ + Cu</td>
<td></td>
</tr>
</tbody>
</table>
A gas is evolved. When a burning splinter is shown to the mouth of the test tube, it is put off with a sound.

What is the gas that is evolved?

Hydrogen

Can you represent the above reactions in a symbolic form?

Zn + H₂SO₄ → ZnSO₄ + H₂

These type of reactions in which the atoms of an element replace the atoms of one of the elements in the molecule of a compound are called simple displacement reactions (B.B. Work)

Sodium chloride solution is taken in a test tube and it is treated with silver nitrate solution.

What change do you observe?

A white precipitate is formed. Silver chloride and sodium nitrate are the products obtained.

What are the products obtained when zinc is treated with dilute sulphuric acid.
Experiments

*S/notice relevant details

CuSO₄ + H₂S → CuS + H₂SO₄

*S/writes equation

Pb(NO₃)₂ + 2KI → 2KNO₃ + PbI₂

*S/writes equation

BaCl₂ + Na₂SO₄ → BaSO₄ + 2NaCl

*S/notices relevant details

AgNO₃ + NaCl → AgCl + NaNO₃

H₂S is passed through copper sulphate solution. What happens?

A black precipitate is formed. Copper sulphide and sulphuric acid are formed

CuSO₄ + H₂S → CuS + H₂SO₄

Lead nitrate solution is treated with potassium iodide solution

The products are potassium nitrate and lead iodide

Pb(NO₃)₂ + 2KI → 2KNO₃ + PbI₂

Barium chloride solution is treated with sodium sulphate solution

A white precipitate is obtained

BaCl₂ + Na₂SO₄ → BaSO₄ + 2NaCl

Can you represent the above reactions in a symbolic form?

Ax + By → Ay + Bx

These type of reactions in which the molecules of two compounds exchange their component parts to form two different substances are called **Double decomposition reactions** (B.B. Work)

What is the black precipitate formed when H₂S is passed through CuSO₄ solution?

What are the products formed when BaCl₂ is treated with Na₂SO₄?

Define double decomposition reactions?
Review:

1. Define simple displacement reactions?
2. Give two examples for simple displacement reactions?
3. Define double decomposition reactions?
4. Give two examples for double decomposition reactions?

Assignment: Classify the following reactions into simple displacement and double decomposition reactions?

1. NaCl + AgNO3 → AgCl + NaNO3
2. Zn + H2SO4 → ZnSO4 + H2
3. Fe + CuSO4 → FeSO4 + Cu
4. BaCl2 + Na2SO4 → BaSO4 + 2NaCl
LESSON PLAN NO. 4

Name of teacher : K. Rema Devi
Subject : Chemistry
Unit : Different Types of Chemical Reaction.
Topic : The law of conservation of mass

Standard : VIII
Strength : 45
Duration : 45 minutes

CONTENT ANALYSIS

New terms : The law of conservation of mass
Facts : The mass of sodium chloride and silver nitrate is same before and after the reaction between the two.
Concept : The mass of the reactants remains the same as the mass of the products.

Instructional objectives: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.
2. Understanding in the above mentioned terms, facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation and observation.
5. Scientific attitude and scientific interest.

Teaching aids : Conical flask, Test tube, Sodium chloride solution, Silver nitrate solution, Common balance and usual class room facilities.

Previous knowledge : The pupil has acquired knowledge regarding chemical and physical changes and different types of chemical reactions.
Classify the following reactions into various groups

1. \( \text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2 \)
2. \( \text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl} \)
3. \( 2\text{HgO} \rightarrow 2\text{Hg} + \text{O}_2 \)
4. \( 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \)

Sodium chloride solution is taken in a conical flask. Silver nitrate solution is taken in a test tube and it is tied to a string. It is hanged into the flask by means of a cork. The mass of the equipment is noted. The test tube is then tilted so that the silver nitrate is mixed with sodium chloride solution. What can you observe now? A white precipitate is formed in the flask.

Can you identify the precipitate formed in the flask?
S writes chemical equation

$$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$$

It is the precipitate of AgCl. The mass of the equipment is noted after the reaction. What can you infer from this. The mass remains the same.

A infers

The law of conservation of mass

That means the mass of the reactants and products remains the same in a reaction. This law is known as the law of conservation of mass (BBW)

It can be inferred that matter cannot be created or destroyed.

Review:

1. State the law of conservation of mass.

2. What changes occur during the reaction between sodium chloride and silver nitrate.

Assignment:

Set an experiment to prove the law of conservation of mass.
CONTENT ANALYSIS

New terms :- Oxidation, Reduction, Redox reaction, Oxidising agent and Reducing agent

Facts :
1. When carbon burns in air, Carbon dioxide is formed
2. When magnesium burns in air magnesium oxide is formed
3. When black cupric oxide is heated with carbon powder, a reddish brown powder of cu is obtained

Concepts :
1. The reaction in which any substance combines with oxygen is called oxidation
2. Chemical reaction in which a substance loses oxygen is called reduction
3. The substance which supplies oxygen to another substance is called an oxidising agent
4. Oxidising agent is reduced in a chemical reaction
5. A substance which removes oxygen from another substance is called a reducing agent.
6. Reducing agent is oxidised in a chemical reaction.
7. The combined process of oxidation and reduction is known as redox reaction.

**Instructional objectives**: The pupil develops,
1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation and observation
5. Scientific attitude and scientific interest.

**Teaching aids**: Magnesium, Carbon, Cupric oxide, test tube, spirit lamp and usual class room facilities.

**Previous knowledge**: The pupil has the knowledge about reactions and he knows that burning of substances in air is combining the substance with oxygen.

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<td>K/recalls</td>
<td>What are the gases present in air? What do you know about burning of substances in air?</td>
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<td></td>
<td></td>
<td>The pupil tries to answer the questions.</td>
<td></td>
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<tr>
<td><strong>Development</strong></td>
<td></td>
<td>What happens when carbon burns in air?</td>
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</table>
Carbon dioxide is formed.

\[ C + O_2 \rightarrow CO_2 \]

S/writes chemical equations

S/experiments

A piece of magnesium ribbon is ignited

\[ 2Mg + O_2 \rightarrow 2MgO \]

S/writes chemical equation

What do you observe? The ribbon burns and a white powder is obtained. **Magnesium oxide** is formed.

\[ 2Mg + O_2 \rightarrow 2MgO \text{ (B.B.W)} \]

S/identifies

The above reactions in which a substance combines with oxygen is called **Oxidation** (B.B.Work)

A mixture of black cupric oxide is heated with carbon in a test tube. What are the changes observing? A reddish brown powder is obtained.

\[ 2CuO + C \rightarrow 2Cu + CO_2 \]

S/experiments

The reddish brown powder obtained is copper.

What is the gas that is obtained?

A glass rod dipped in lime water is shown at the mouth of the test tube.

What is meant by oxidation?

What is the reaction between cupric oxide and carbon?
S/experiments What happens? dense white fumes are obtained.

What do you infer?

U/identifies The gas obtained may be carbon dioxide.

A/predicts What has happened to the carbon in the above reaction.

Carbon is oxidised. What has happened to Cupric oxide? It has lost oxygen. Cupric oxide is reduced (B.B.Work)

Chemical reaction in which a substance loses oxygen is called reduction (B.B.Work). In this reaction, which substance supplied oxygen for oxidation of carbon? Cupric oxide. Again cupric oxide is reduced to copper. Here cupric oxide acts as an Oxidising agent or Oxidiser (B.B.Work).

Any substance which supplies oxygen to another substance is called an oxidising agent. Oxidising agent is reduced in a reaction.

What is the test for carbon dioxide gas?
reducing agent is oxidised in a reaction. What happened to cupric oxide? It has been reduced to copper. Which is responsible for this reaction? Carbon.

Carbon is the **reducing agent** (B.B.Work)

Any substance which removes oxygen from another substance is called a reducing agent. Reducing agent is oxidised in a reaction.

In the above reaction both oxidation and reduction occur simultaneously. So the combined process of oxidation and reduction is called a **redox reaction** (B.B.Work)

**Review:**

1. Define oxidation and reduction
2. What is the difference between Oxidising agent and Reducing agent
3. What is meant by Redox reaction
4. What happens when Carbon is heated with cupric oxide?
5. What is the test for carbon dioxide?
6. What are the oxidising and reducing agent in the following reactions

   \[ 2CuO+C \rightarrow 2Cu+CO_2 \]

**Assignment:** Find out chemical reactions for oxidation and reduction
LESSON PLAN NO. 2

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanassery.
Unit : Oxidation - Reduction and Redox Reactions
Topic : Electronic Concept of Oxidation and reduction

Standard : IX
Strength : 46
Duration : 45'

CONTENT ANALYSIS

Facts :
1. When sodium combines with chlorine to form sodium chloride sodium loses one electron and chlorine gains one electron.
2. When magnesium combines with oxygen magnesium loses two electrons and oxygen gains two electrons

Concepts :
1. Oxidation is a process involving loss of electrons
2. Reduction is a process involving gain of electrons
3. Oxidiser gains electrons
4. Reducer loses electrons

Instructional Objectives : The pupil develops,
1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.

4. Skill in writing electronic equations

5. Scientific attitude and scientific interest.

Teaching Aids: Charts showing electronic distribution of various reactions

Previous knowledge: The pupil has the knowledge of Oxidation and Reduction reactions

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<td>Introduction</td>
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<td></td>
<td></td>
<td>You have felt the foul smell in the areas where</td>
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<td>wastes of gobar gas are dumped. Can you find out the reason for the foul smell. Define oxidation? Define reduction?</td>
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<td></td>
<td></td>
<td>Development</td>
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<tr>
<td></td>
<td></td>
<td>When magnesium burns in Oxygen Magnesium oxide is obtained. Which substance is oxidised? Magnesium. Which substance is reduced? Oxygen. Can you write the electronic configuration of Magnesium and oxygen in the equation?</td>
<td></td>
</tr>
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Prepared by BeeHive Digital Concepts Cochin for Mahatma Gandhi University Kottayam
Oxidation is a process involving loss of electrons. Reduction is a process involving gain of electrons. Oxidiser gains electrons. Reducer loses electrons.

can you define oxidation and reduction in terms of electrons?

Since Mg loses electrons, oxidation is a process involving loss of electrons. Oxygen gains electrons. Hence, reduction is a process involving gain of electrons.

What happens to the oxidiser and reducer in this reaction? Oxidiser gains electrons. Reducer loses electrons.

can you apply the electronic concept in the combination of Sodium and Chlorine?

Here sodium loses one electron, hence it is oxidised. Chlorine atom gains one electron, hence it is reduced. Sodium atom is oxidised to sodium ion. Chlorine atom is reduced to chloride ion.

What are the oxidiser and reducer in the combination of sodium and chlorine?
Review:
1. Define oxidation and reduction in terms of electronic concepts.
2. Define oxidiser and reducer in terms of electronic concepts.
3. In the reaction magnesium combines with oxygen to form magnesium oxide, which are the oxidiser and the reducer.

Assignment:
Pick out the oxidiser and reducer in the following reactions
1. C + O₂ → CO₂
2. H₂ + Cl₂ → 2HCl
3. Mg + H₂O → MgO + H₂
LESSON PLAN NO. 3

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanasserry.
Unit : Oxidation - Reduction and Redox Reactions
Topic : Oxidation state
Standard : IX
Strength : 46
Duration : 45'

CONTENT ANALYSIS

Newterms : Oxidation state, Oxidation number

Facts :
1. In H₂O, the shared electrons are shifted towards oxygen atom and acquires a (-2) oxidation state.
2. In HCl, the shared electrons are shifted towards chlorine atom and acquires (-1) oxidation state.
3. In CCl₄, the oxidation state of C is (+4) and that of Cl is (-1).
4. In CH₄, the oxidation state of C is (-4) and that of H is (+1).
5. The sum of Oxidation states of H, N, and O in HNO₃ is zero.
6. The sum of the Oxidation states of H, S, and O in H₂SO₄ is zero.

Concepts :
1. The oxidation state of an element is the number of electrons lost or gained by the atom during chemical reaction.
2. The oxidation state of an atom in a molecule of an element is zero.
3. The algebraic sum of the oxidation states will be zero in the case of any molecule.
**Instructional objectives**: The pupil develops,

1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in calculating the oxidation states of the atoms.
5. Scientific attitude and scientific interest.

**Teaching Aids**: Charts showing the Oxidation state of various atoms in different molecules

**Previous Knowledge**: The pupil has the knowledge about oxidation, reduction reactions and the electronic concept of oxidation and reduction reactions.

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<tr>
<td>What is meant by oxidation?</td>
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<td></td>
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</tr>
<tr>
<td>( S + O_2 \rightarrow SO_2 )</td>
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<td><strong>K/recalls</strong></td>
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<tr>
<td>In this reaction which is the oxidising agent?</td>
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<tr>
<td><strong>Development</strong></td>
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<tr>
<td>In forming sodium chloride, sodium atom loses one electron and chlorine atom gains one electron. What are the charges assigned to sodium and chlorine in sodium chloride?</td>
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In NaCl, Sodium has +1 oxidation state and Chlorine has -1 oxidation state.

In MgO, Mg has +2 Oxidation state and oxygen has -2 oxidation state.

In Sodium chloride, sodium atom possesses +1 and chlorine atom possesses -1 charges. These are the oxidation states of Sodium and Chlorine. (B.B.Work)

In MgO what are the oxidation States of Mg and Oxygen?

Mg loses two electrons and oxygen gains 2 electrons. So Mg has +2 Oxidation state and Oxygen has -2 Oxidation state.

How the electrons are distributed in covalent bonds?

Electrons are shared.

What is meant by electronegativity?

The tendency of an atom to attract electrons. In covalent bonds the electrons are not equally shared. They are attracted towards the more electronegative atom and acquires a negative oxidation state. On the other hand the other atom acquires a positive oxidation state.
How oxidation state can be assigned to HCl molecule?

Chlorine is more electronegative and acquires (-1) oxidation state and Hydrogen acquires (+1) oxidation state.

In HCl molecule H has +1 oxidation state and CI has -1 oxidation state.

In H₂O, Oxygen has (-2) oxidation state and Hydrogen has (+1) oxidation state.

Oxygen acquires 2 electrons from two hydrogen atoms. Hence Oxygen possesses -2 Oxidation State and Hydrogen acquires +1 oxidation state.

The algebraic sum of oxidation numbers in a molecule is zero.

From the above examples can we calculate the algebraic sum of oxidation numbers in a molecule?

The algebraic sum of oxidation numbers in a molecule is zero.

What are the oxidation numbers of C and H in CH₄?

No of H atoms = 4
Which is more electronegative, C or H?

Carbon. So Carbon has -4 oxidation state.

Sum of oxidation number = 0.

The oxidation number of H is +1.

What is Oxidation state of Chlorine atom in Cl₂? why?

Zero. Since the two atoms possess the same electronegativity.

What is the oxidation state of H in H₂ molecule? Zero.

Hence we can conclude that the oxidation state of an atom in a molecule of an element is zero.

Calculate the Oxidation state of Nitrogen in HNO₃.

The oxidation state of Oxygen is -2. The oxidation state of Hydrogen is +1. Number of Oxygen atoms is 3.

\[ \text{HNO}_3 = 0 \]
The oxidation state of Sulphur in $\text{H}_2\text{SO}_4$ is +6

$2x(+1) + S + 4x(-2) = 0$

$+2 + S - 8 = 0$

$S = +8 - 2 = +6$

The oxidation state sulphur in $\text{H}_2\text{SO}_4$ is +6

$\text{H} + \text{N} + 3x - 2 = 0$

$N = +6 - 1 = +5$

Calculate the oxidation state of sulphur in $\text{H}_2\text{SO}_4$?

The oxidation state of Oxygen $= -2$

The oxidation state of Hydrogen $= +1$

Number of Oxygen atoms $= 4$

Number of Hydrogen atoms $= 2$

$\text{H}_2\text{SO}_4 = 0$

What is the oxidation state of Nitrogen in $\text{HNO}_3$?

What is the oxidation state of $\text{Sulphur}$ in $\text{H}_2\text{SO}_4$?
Review :-

1. What is meant by oxidation state of an atom?
2. What is the algebraic sum of oxidation states of atoms in a molecule?
3. How the atoms in a covalent molecule possess positive and negative oxidation states?
4. What is meant by electronegativity?
5. What are the oxidation states of the following atoms? H, Cl, F, Group I, II, and III elements

Assignments :

Calculate the oxidation states of the following:-

1. Manganese in KMnO₄
2. Chromium in K₂Cr₂O₇
3. Oxygen in OF₂ and H₂O₂
LESSON PLAN NO. 4

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanasserry.
Unit : Oxidation - Reduction and Redox Reactions
Topic : Oxidation state, Concept of Oxidation and reduction and valency

Standard : IX
Strength : 46
Duration : 45'

CONTENT ANALYSIS

Newterms : Valency

Facts :

1. The Oxidation state of copper in CuO decreases from +2 to zero in the reaction between CuO and Carbon
2. Oxidation state of carbon increases from zero to +4 in the reaction between CuO and Carbon
3. The valencies of Group I, II and III elements are 1, 2 and 3 respectively and the corresponding oxidation states are +1, +2 and +3
4. In the case of halogens, they show a valency 1 and an oxidation state of -1
5. The predominant oxidation state of Group VI elements is -2 and they also show oxidation states upto +6
6. The common oxidation state of Group V elements is -3 and usual valency is 3
7. The Group IV elements show valency 4 and oxidation state +4 or -4
8. The transition elements like Iron shows a valency of 2 in ferrous compounds and 3 in ferric compounds. Manganese exhibits a valency of 2 in manganese chloride, 4 in manganese dioxide and 7 in potassium permanganate.

Concepts:

1. If the oxidation state of an element increases, the element is said to be oxidised.
2. If the oxidation state of an element decreases the element is said to be reduced.
3. Valency is the combining capacity of an element
4. Valency and oxidation states are mutually related.

Instructional objectives: The pupil develops,

1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation, calculation
5. Scientific attitude and scientific interest.

Teaching Aids: Test tube, Cupric oxide, Carbon, spirit lamp

Previous knowledge: The pupil has the knowledge about various oxidation, reduction reactions, the electronic concept of oxidation and reduction, oxidation states of elements in various compounds,
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<td>What is meant by oxidation state of an element? Calculate the oxidation state of Cr in K₂Cr₂O₇.</td>
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<tr>
<td><strong>Development</strong></td>
<td>Cupric oxide is heated with carbon in a test tube. What happens? The black colour is slowly turned to reddish brown colour.</td>
<td></td>
<td>Which is the oxidising agent in the reaction between CuO and C.</td>
</tr>
<tr>
<td>In the reaction, S/experiments 2CuO + C → 2Cu + CO₂ S/notices relevant details</td>
<td>Calculate the oxidation states of C, Cu, O in various stages.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CuO is reduced to, Cu and C is oxidised to CO₂ A/analysis</td>
<td>In CuO, the oxidation state of Cu is +2 and Oxygen is -2. The oxidation state of carbon is 0. In CO₂ the oxidation state of C is +4 and that of Oxygen is -2. The oxidation state of Cu is 0.</td>
<td></td>
<td>What is the oxidation state of Carbon?</td>
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</table>
If the oxidation state of an element increases in a chemical reaction, it is said to be oxidised, and if it decreases, it is said to be reduced.

1, 2, and 3 are the valencies of the group I, II, and III elements respectively.

What happens to CuO and C in the above reaction?

CuO is reduced and C is oxidised. In terms of oxidation states, how can we state oxidation and reduction?

The oxidation state of Cu is decreased from +2 to 0.

Oxidation state of C increases from zero to +4.

So we can conclude that if the oxidation state of an element increases in a chemical change, the element is said to be oxidised. Similarly, if the oxidation state of an element decreases in a chemical reaction, it is said to be reduced (B.B.Work).

How many electrons are there in the outer shell of group I element? Students test and verify that there is one electron in the outer shell of group I element. Similarly, how many electrons are present in group II and III elements?

2 and 3 respectively.
Valency is the combining capacity of an element. 1, 2 and 3 are the valencies of group I, II and III elements. So what is meant by valency of an element?

Valency is the combining capacity of an element and the electrons in the outermost shell are called valence electrons (B.B.Work) +1, +2 and +3 are the oxidation states of group I, II and III elements respectively. Hence it can be concluded that valency and oxidation states are mutually related.

Define valency?

What are valency electrons?

What are the oxidation states of group I, II and III elements?

Valency and oxidation states are mutually related.

Group IV elements show valency 4 but +4 and -4 oxidation states.

What will be valency and oxidation state of group IV elements?

Valency is 4. They show +4 and -4 oxidation states since they can either accept or lose 4 electrons in a chemical reaction.

What will be the valency and oxidation state of group VII elements? Valency will be 1.

Group VII elements show valency 1 but oxidation states -1 and upto +7 in various reactions.

What is the valency of Flourine atom.

Group IV elements show +4 and -4 oxidation states.
Group V elements show a valency 5 and common oxidation states is -3.

Valency and oxidation states are numerically equal.

The transition elements show variable valency.

What will be the valency and oxidation states of group V elements?
Since they accept three electrons in reactions they show a common oxidation state -3 and in certain reactions they show +ve oxidation state upto +5. Valency of group V elements is 3.

Thus it can be concluded that valency is a mere number and valency and oxidation states are numerically equal.

Iron shows a valency of 2 in ferrous compounds and 3 in ferric compounds.

Manganese exhibits a valency of 2 in manganese chloride and 4 in manganese dioxide and 7 in potassium permanganate.

The transition element show a variable valency? Why?

In transition elements both the electrons in the outermost and penultimate shell take part in reactions.

What is usual oxidation state of group V elements.

What is the relationship between valency and oxidation state?

The transition elements show a variable valency. Why?
Review:

1. Define Valency and valence electrons.
2. What is the relationship between valency and oxidation state?
3. Define oxidation and reduction reactions in terms of oxidation states.
4. Give an example for positive oxidation state.
5. Give an example for negative oxidation state.

Assignments:

Pick out the oxidiser and reducer in the following reactions

1. \( \text{Zn}^2+ + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2 \)
2. \( \text{Fe} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{FeSO}_4 \)
3. \( 2 \text{ZnO} + \text{C} \rightarrow 2 \text{Zn} + \text{CO}_2 \)
LESSON PLAN NO. 1

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanasserry.
Unit : Chemical Kinetics.
Topic : Fast and Slow reactions

Standard : X
Strength : 43
Duration : 45'

CONTENT ANALYSIS

Newterms : Fast reactions, Slow reactions, Chemical kinetics

Facts:
1. Magnesium reacts with dilute hydrochloric acid to form magnesium chloride
2. Hydrogen peroxide decomposes to water and oxygen
3. When sodium chloride reacts with silver nitrate, a white precipitate is formed.
4. Some polished iron nail when keep for some days they will rust

Concepts : Chemical kinetics deals with the changes in energy during reactions and the factors influencing them.

Instructional objectives : The pupil develops,
1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation
5. Scientific attitude and scientific interest.

Teaching Aids:
- Test tubes, Sodium chloride, Silver nitrate, Iron nails, Watch glass, Magnesium, Hydrochloric acid, Hydrogen peroxide
- and other usual class room facilities.

Previous Knowledge:
The pupil has the knowledge about science as it deals with the 'how' and 'why' of things and Chemistry deals with all the substances and that take place in these substances.

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<td>K/recalls</td>
<td>What is meant by science? what is Chemistry? Do you know how iron rusts? How food is cooked quickly in a pressure cooker? How plants manufacture the food for the living beings? The student tries to answer the above questions.</td>
<td></td>
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<tr>
<td>Sodium chloride reacts with silver nitrate solution</td>
<td>S/experiments</td>
<td>Take some sodium chloride solution in a test and add silver nitrate solution. What do you observe?</td>
<td>What happens when sodium chloride is treated with silver nitrate solution?</td>
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a white precipitate is formed. Note the time taken for the reaction.

Keep some iron nails on a watch glass. What happens? After a few days observe the change. The pupil observes that the iron nail rust. How long will it take to complete the reaction?

What do you infer from the two experiments mentioned above?

The first reaction is very fast and the second one is very slow (B.B.Work)

Magnesium is treated with dilute hydrochloric acid

\[
\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2
\]

What are the products obtained?

Magnesium chloride and hydrogen.

Hydrogen peroxide decomposes

\[
\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2
\]

What are the products obtained?

Hydrogen peroxide is decomposed.
What do you infer from the above two examples? These reactions take place at moderate speed (BBWORK).

From the above experiments we can conclude that the speed of the reaction varies for various reactions and the study that deals with it is called chemical kinetics. (B.B.Work)

Chemical kinetics deal with the changes in energy during reactions and the factors influencing them.

What is meant by chemical kinetics?

Review:

1. What happens when sodium chloride is treated with silver nitrate solution?
2. Give an example for slow reaction
3. What are the products obtained when magnesium reacts with hydrochloric acid?
4. What are the products obtained when hydrogen peroxide is decomposed?
5. What is meant by chemical kinetics?

Assignment:

Take equal volumes of dilute hydrochloric acid in three test tubes. Then put equal amount of magnesium, zinc and iron in each test tube. Find out which metal is more reactive in the acid.
LESSON PLAN NO. 2

Name of teacher : K. Rema Devi
Name of the School : S H S Changanassery.
Unit : Chemical Kinetics.
Topic : Rate of Reactions

Standard : X
Strength : 46
Duration : 45'

CONTENT ANALYSIS

Newterms : Rate of Reaction

Facts :
1. When hydrogen peroxide decomposes into water and oxygen, hydrogen peroxide is consumed while water and oxygen are obtained.
2. When magnesium reacts with dilute hydrochloric acid to form magnesium chloride and hydrogen, magnesium and dilute hydrochloric acid are consumed while magnesium chloride and hydrogen are obtained.

Concept: Rate of reaction is defined as the quantity of any one of the products obtained or the reactants consumed in unit time.

Instructional Objectives : The pupil develops,

1. Knowledge in the above mentioned facts and concepts.
2. Understanding in the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation
5. Scientific attitude and scientific interest.

**Teaching aids:** Magnesium ribbon, Dilute hydrochloric acid, Hydrogen peroxide, Conical flask, Manganese dioxide, one holed cork, injection syringe and usual classroom facilities.

**Previous knowledge:** The pupil has the knowledge about the decomposition reaction of hydrogen peroxide and the reaction between magnesium and dilute hydrochloric acid.

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<td>What is meant by chemical kinetics?</td>
<td>What are the products obtained when magnesium reacts with dilute hydrochloric acid? The pupil tries to answer the questions</td>
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<td><strong>K/recalls</strong></td>
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<tr>
<td><strong>Development</strong> : Take a small piece of magnesium ribbon. Measure its mass. Take some dilute hydrochloric acid in a test tube and put the magnesium into it. What happens? Magnesium reacts and disappears. Measure the time taken to complete the reaction.</td>
<td>Mass of magnesium = 1g.</td>
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<td><strong>U/explains</strong></td>
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</table>
Time taken = 10 seconds
The reaction rate = \( \frac{1}{10} \text{ g/s} \) (B.B Work)

Take 20 ml hydrogen peroxide in a conical flask and add one gram manganese dioxide. Close it with a one holed cork to which an injection syringe is attached. What is the position of piston? It is at the bottom of the syringe.

What do you observe after some time? The piston is pushed away. Why? Oxygen is collected in the syringe. What is the volume of oxygen collected in the syringe? Note the reading on the syringe. After 10 seconds what is the volume of oxygen in the syringe.

\[
\text{The Volume of Oxygen} \quad \frac{10}{10}
\]

will be the rate of the reactions.

From these experiments what do you infer?

The rate of a reaction is the amount of reactant consumed or the amount of products obtained in unit time. What is its unit?

What is meant by rate of reaction?
Review:

1. What is meant by the rate of reaction?
2. What are the units of rate of reaction?
3. Describe an experiment to measure the rate of reaction.

Assignment: Set the apparatus and conduct an experiment to measure the reaction rate.
LESSON PLAN NO. 3

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanasserry.
Unit : Chemical Kinetics.
Topic : Factors affecting reaction rate

Standard : X
Strength : 46
Duration : 45'

CONTENT ANALYSIS

New terms: Concentration, Activated complex, Threshold energy, Collision theory

Facts:

1. When sodium is treated with water NaOH and H2 are formed. When potassium is used in the place of sodium the reaction will be more vigorous.
2. When marble is treated with dilute hydrochloric acid it will disappear. When concentrated hydrochloric acid is used in the place of dilute hydrochloric acid, the reaction becomes faster.
3. N2 combines with H2 to form NH3. The amount of NH3 formed increases with increase in pressure.
4. Potassium peroxy sulphate is treated with potassium iodide solution. No reaction occurs. When the test tube is heated, iodine gas is liberated and the solution becomes brown.
5. The combination of hydrogen and iodine is very slow at room temperature, but its speed increases with increase in temperature.
Concepts:
1. The main factors that influence the rate of reactions are:
   1. Nature of the reactant
   2. Concentration of the reactant
   3. Pressure
   4. Temperature
2. Collision theory
3. Threshold energy
4. Activated complex

Teaching aids: Sodium, Potassium, Water, Test tubes, Potassium peroxy sulphate, Potassium iodide solution, chart showing collision of hydrogen and iodine molecules and usual classroom facilities

Previous knowledge: The pupil has the knowledge of reaction rates.

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<tr>
<td><strong>Introduction</strong></td>
<td>K/recalls</td>
<td>What is meant by the reaction? Put a small piece of Sodium into Water. What do you observe?</td>
<td></td>
</tr>
</tbody>
</table>
**Development**

The above experiment is repeated using potassium. What is the difference that you observe? The pupil sees that the second reaction is faster than the first. Write the chemical equations for the two experiments done?

<table>
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<tr>
<th>S experiments</th>
<th>S notices relevant details</th>
</tr>
</thead>
</table>

| What are the products obtained when sodium reacts with water? |

- $2 \text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
- $2 \text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$ (B.B. work)

What can you infer from the experiments?

- It can be concluded that rate of reactions depends on the nature of reactants.

<table>
<thead>
<tr>
<th>Rate of reactions depends on the nature of the reactants</th>
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</table>

| A infers |

| Take equal volumes of dilute hydrochloric acid and concentrated hydrochloric acid in two test tubes. |

| Put equal size of a marble chip in each test tube. The marble chips react and disappear. |

| Which one disappears first? The marble chip reacts faster in concentrated hydrochloric acid. What do you infer from this experiment? |

| What are the two factors that affect the reaction rate? |

<table>
<thead>
<tr>
<th>S experiments</th>
<th>S writes chemical equations</th>
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| The reaction rate increases with increase in concentration of reactants. |

| A infers |

Prepared by BeeHive Digital Concepts Cochin for Mahatma Gandhi University Kottayam
Collision theory

The reaction rate increases with an increase in concentration of the reactants.

Why this happens?

Why reaction takes place?

Because the molecules collide with one another. What happens when the concentration increases? The number of collisions also increases. What happens when the number of collisions increases?

The reaction rate increases. What happens when the solid is broken up into very small particles?

The area of surface of contact increases. When powdering the reacting solids and agitating the reactants will increase the reaction rate.

What is the product obtained when N2 combines with H₂?, NH₃

What happens when pressure increases? The amount of NH₃ formed will increase.
Temperature influences the rate of reaction

How can this be explained? On the basis of collision theory. What happens when pressure increases?

Its volume decreases and concentration increases and the reaction rate also increases.

Take equal volumes of potassium peroxy sulphate in two test tubes. Add equal volumes dilute potassium iodide solution to each test tube. Heat one of them. What do you observe? The heated one becomes brown. What do you infer from this experiment? The reaction becomes faster when heated.

What are the products obtained when potassium peroxy sulphate is treated with potassium iodide solution?

N2+3H2 → 2NH3

K/recalls

A/extrapolates learning

S/experiments

S/notices relevant details

S/writes chemical equations

K2S2O8+2KI → 2K2SO4+I2

How does temperature influence the rate of reaction?

To react molecules not only collide, but enough force to disrupt the bonding in the

Explain the effect of pressure on a reacting system using collision theory.
Threshold energy

The minimum amount of kinetic energy that the molecules should possess for a chemical reaction is called **threshold energy**. Greater the energy of the molecules, faster will be the reaction. (B.B.Work)

Modern theory assumes the theory of **activated complex** produced during effective collisions. What are activated complexes?

During reaction before reaching the equilibrium some transition complexes are formed. They are called the **Activated Complexes** (B.B.Work)

H₂ combines with I₂

The first stage of the reactions

\[ H₂ + I₂ \rightarrow H₂I₂ \]

The second stage of the reaction is

\[ H₂I₂ \rightarrow 2HI \]
H$_2$I$_2^+$ is the activated complex. This has high potential energy and it immediately breaks into products.

When temperature increases, velocity of the molecules will increase. Many molecules will get the threshold energy and activated complexes are formed. So at higher temperature the reaction rate is faster than at lower temperature.

As temperature increases, the reaction rate also increases. Why?

U/explains

A/extrapolates

U/arrives at a conclusion

The reaction rate is faster at higher temperature. Why?

**Review:**

1. Small pieces of wood burn faster than big pieces. Why?
2. Why do gaseous reactions occur faster if the pressure of the reacting gases is increased?
3. Magnesium does not combine with oxygen at room temperature. But they combine vigourously at high temperature. Why?
4. All collisions of reacting molecules will not result in chemical reaction. Why?
5. Explain the activated complexes. How is it formed? What are their characteristics?
6. Define threshold energy?
8. Give an example in which temperature affects the rate of a chemical reaction?

Assignments:

1. Take some hyposolution in a glass trough and add some dilute hydrochloric acid to it. Observe the slow change. Pass a strong light through it while the change is going on and observe from the side at the right angle to the beam. You can see a play of colours as is seen during the sunset.

2. Explain the various factors that affect the rate of reactions using suitable examples.
LESSON PLAN NO. 4

Name of teacher : K. Rema Devi
Name of the School : S H H S Changanassery.
Unit : Chemical Kinetics.
Topic : Catalysis

Standard : X
Strength : 44
Duration : 45'

CONTENT ANALYSIS

New terms : Catalyst

Facts :
1. Decomposition of hydrogen peroxide to water and oxygen takes place speedier if a little manganese dioxide is added.
2. When iron is used, the formation of NH3 from N2 and H2 becomes speedier.
3. Sulphuric acid is manufactured using Vanadium pentoxide as catalyst.

Concept :
1. A substance that alters the rate of reaction without itself undergoing change is called a catalyst.
2. A catalyst is specific in its action.

Instructional objectives : The pupil develops,
1. Knowledge in the above mentioned facts and concepts.
2. Understanding the above mentioned facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation and observation
5. Scientific attitude and scientific interest.

Teaching aids: Hydrogen peroxide, Manganese dioxide, test tube, Chart showing the action of a catalyst and usual class room facilities

Previous knowledge: The pupil has the knowledge about chemical kinetics, factors influencing reaction rates, threshold energy, activated complexes etc.

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<td>K/recalls</td>
<td>Introduction: What are the various factors affecting reaction rates? Define activated complex?</td>
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<td></td>
</tr>
<tr>
<td>S/experiments</td>
<td>Development: Take hydrogen peroxide in a test tube and observe the decomposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/notices relevant details</td>
<td></td>
<td>2H₂O₂ → 2H₂O + O₂</td>
<td></td>
</tr>
<tr>
<td>A/verifies</td>
<td></td>
<td>What happens when a little manganese dioxide is added. The rate of reaction increases. But manganese dioxide remains unchanged. In this reaction manganese dioxide acts as a catalyst (B.B.Work)</td>
<td></td>
</tr>
</tbody>
</table>
A substance that alters the rate of a reaction without itself undergoing any change is called a catalyst.

When potassium chlorate is heated oxygen is evolved. Manganese dioxide acts as a catalyst. But when potassium permanganate is heated to obtain oxygen, manganese dioxide does not act as a catalyst. Hence it can be concluded that a catalyst used for one reaction may not be useful for catalysing another reaction. The catalysts are specific in their action.

$\text{N}_2$ combines with $\text{H}_2$ to form $\text{NH}_3$. Iron is used as the catalyst.

Vanadium pentoxide is used as the catalyst in the manufacture of sulphuric acid.

(B.B. work)

How can we explain the action of a catalyst? In order to form activated complexes, molecules must acquire the threshold energy.
Certain molecules cannot reach up to this level of energy. When catalyst is present it offers an easier path for the formation of the activated complex.

How the study of Chemical kinetics important?

Industry uses a large number of reactions to get best results these reactions must be conducted at optimum conditions. So the study of reaction rates and factors controlling the reactions become very relevant.

Review:

1. Define Catalyst?
2. Catalyst is specific in its action. Why?
3. Name the catalyst used in the manufacture of Ammonia and Sulphuric acid?
4. How can we explain the action of a catalyst?
5. Why the study of chemical kinetics is important?
Assignment:

1. Coat a sugar cube with cigarette ash and ignite it. Sugar burns. Find out the catalyst.
2. Take some Hydrogen peroxide in a beaker. Put a small piece of Manganese dioxide to it. Observe the violent decomposition. Find out the catalyst.
LESSON PLAN NO. 1

Name of teacher : K. Rema Devi
Subject : Chemistry.
Unit : Surface chemistry.
Topic : Adsorption

CONTENT ANALYSIS

Standard : XI
Strength : 62
Duration : 45'

Newterms :

Adsorption, Adsorbent, Physical adsorption, Chemical adsorption, Enthalpy or heat of adsorption, Desorption

Facts :

1. Absorption of a substance A by a substance B means A is uniformly distributed all over B, but the concentration of A in parts of B away from the surface is negligible.
2. If we expose active charcoal to chlorine gas, charcoal adsorbs chlorine.
3. Moisture in air is strongly adsorbed over silica gel.
4. Gases such as $H_2$, $O_2$, $N_2$ are adsorbed by transition metals (Nickel and Cobalt)
5. The amount of gas adsorbed varies with pressure as $\frac{X}{M} = K p^n$ where $X$ is the mass of the adsorbate, 'M' is the mass of the solid adsorbent and $P$ is the pressure, 'n' can take any value ranging from one to large number
6. Water solutions of row sugar are decolourised by passing them through beds of animal charcoal.
7. From a solution of acetic acid and water, charcoal adsorbs the acid on its surface.
Concepts:

1. The existence of a substance at surface in a different concentration than in the adjoining bulk is called adsorption.
2. The adsorbing bulk substance is called adsorbent and the substance being adsorbed is called the adsorbate.
3. The process of removing an adsorbed substance from a surface on which it is adsorbed is called desorption.
4. If the adsorbate is held on surface by weak Vander waals forces, the adsorption process is called physical adsorption or Physisorption.
5. If the forces holding the adsorbate are strong as experienced in chemical bonding, the adsorption process is called chemical adsorption or chemisorption.
6. In adsorption process, the enthalpy change for the adsorption of one mole of an adsorbate on an adsorbent surface is called enthalpy or heat of adsorption.
7. The amount of gas adsorbed increases with the surface area of the solid.
8. A plot between amount adsorbed versus temperature at constant pressure is called an adsorption isobar.

Instructional Objectives: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.
2. Understanding the above mentioned terms, facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in plotting graph
5. Scientific attitude and interest.
Teaching Aids: Charts and usual classroom facilities

Previous Knowledge: The pupil has the knowledge about absorption and certain surface phenomena like corrosion of metals.

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<td>Introduction</td>
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<td>Look at this figure.</td>
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</tr>
<tr>
<td>Absorption</td>
<td>U/defines</td>
<td></td>
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<tr>
<td>Adsorption</td>
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<tr>
<td>Adsorbent</td>
<td>U/defines</td>
<td></td>
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<tr>
<td>Adsorbate</td>
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</tbody>
</table>

Development

What is meant by adsorption?
when a substance is uniformly distributed into another substance it is called absorption.
(B.B.Work)

But in adsorption the substance is concentrated on the surface. The adsorbing bulk is called adsorbent and the substance being adsorbed is called adsorbate.
(B.B.Work).

Define adsorption

How adsorption differs from absorption
The process of removing substance from a surface on which it is adsorbed is called Desorption.

If the adsorbate is held on the surface by weak vanderwaals forces, the process is called Physical adsorption. If the forces holding the adsorbate are as strong as experienced in chemical bonding the adsorption process is called Chemical adsorption. Adsorption results in a release of energy. It is called enthalpy or heat of adsorption. (B.B.Work)

What are the differences between Physical adsorption and chemical adsorption?

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<thead>
<tr>
<th>Physical adsorption</th>
<th>Chemical adsorption</th>
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<tr>
<td>1. Attraction due to vanderwaals forces</td>
<td>Attraction due to chemical bond forces.</td>
</tr>
<tr>
<td>2. Low enthalpy</td>
<td>High enthalpy</td>
</tr>
<tr>
<td>3. Occurs at low temperatures</td>
<td>Occurs at high temperatures</td>
</tr>
<tr>
<td>4. Reversible</td>
<td>Irreversible</td>
</tr>
</tbody>
</table>

What is meant by adsorbent.

Define desorption?

What is the difference between Physical and chemical adsorption?
5. The adsorption is related to the ease of liquifation of the gas
   Nocorrelation
6. Not specific
   Highly specific
7. Forms
   Forms
   multimolecular layers
   monomolecular layers.

How chlorine gas is adsorbed on the surface of charcoal?

The gases already present on the surface of charcoal are replaced by chlorine.

Similarly Moisture in air can be adsorbed by Silica gel.

Gases like $\text{H}_2$, $\text{O}_2$, $\text{N}_2$ and $\text{CO}$ are adsorbed by the transition metals like Nickel and Cobalt.

If we plot a graph between the amount of gas adsorbed against pressure it will be like this.

\[ \frac{x}{m} \]

\[ 0 \rightarrow P \rightarrow Px \]
Here 'X' is the mass of the adsorbate 'M' is the mass of the adsorbent. This graph is called an adsorption isotherm. The \( \frac{X}{M} \) varies as pressure according to the relation

\[ \frac{X}{M} = K P^n \]

where 'n' can have values from 1 to a large number.

or, \( \log \frac{X}{M} = \log K + \frac{1}{n} \log P \)

This plot will be a straight line with a slope of \( \frac{1}{n} \)

The quantity of gas adsorbed increases with the surface area of the solid. The specific surface area of a solid is defined as the surface area per gram of the adsorbent.

What happens when temperature increases?

In physical adsorption as the temperature increases the amount adsorbed decreases. But in chemical adsorption \( \frac{X}{M} \) initially increases and then decreases.

Define specific area of a solid.
Adsorption isobar

A plot between $\frac{X}{M}$ versus temperature at constant pressure is called adsorption isobar. (B.B.Work)

Water solutions of row sugar are decolourised by passing them through beds of animal charcoal. Student also learns that from a mixture of acetic acid and water charcoal adsorbs the acid on its surface. The adsorption isotherm for adsorption of solutes from solutions also show similar behaviour, i.e

$\frac{X}{M} = KC^n$, where $C$ is the concentration of the solute.

U/writes example

A/relates facts

S/draws figure

Adsorption isotherm for physical and chemical adsorptions
Review:

1. Define adsorption, adsorbate and adsorbent.
2. Distinguish between physical and chemical adsorption.
3. What is meant by desorption?
4. Define enthalpy or heat of adsorption.
5. What is meant by specific surface area of a solid?
6. What is the relation between the amount adsorbed with pressure?
7. What is meant by adsorption isotherm?
8. Define adsorption isobar?

Assignment

Draw sketches of adsorption isobars and adsorption isotherm.
LESSON PLAN NO. 2

Name of teacher : K. Rema Devi
Subject : Chemistry.
Unit : Surface chemistry.
Topic : The Colloidal State

Standard : XI
Strength : 62
Duration : 45'

CONTENT ANALYSIS

New terms:
Colloidal state, Colloidal system, Dispersed phase, Dispersion medium Foam, Aerosol Emulsion, Gel, Sol, Hydrosol, Lyophilic, Lyophobic, Reversible sol, Multimolecular and macromolecular colloids, Micelles, Associated colloid, Peptization, Collodion, Electrodialysis.

Facts:
1. Soap suds, lemonade etc are formed when gas is the dispersed phase and liquid is the dispersion medium.
2. Pumice stone, styrene foam, foam rubber etc are formed when gas is the dispersed phase and solid is the dispersion medium.
3. Fog, cloud, insecticide sprays etc are aerosols formed when liquid is the dispersed phase and gas is the dispersion medium.
4. Milk, emulsified oils and medicines are emulsions formed when liquid is both the dispersed phase and the dispersion medium.
5. Cheese, butter, bootpolish, table jellies etc. are gels formed when liquid is the dispersed phase and solid is the dispersion medium.
6. Smoke is an aerosol formed when solid is the dispersed phase and gas is the dispersion medium.
7. Paints, starch in water, gold sol, muddy water etc are sols formed when solid is dispersed phase and liquid is the dispersion medium.
8. Ruby glass and gem stones etc. are solid sols when both the dispersed phase and dispersion medium are solids.
9. Sols of metals, metal sulphides and oxides are lyophobic sols.
10. Proteins in water, high polymer in organic solvents are lyophilic sols.
11. Gold sol, sulphur sol, etc are multimolecular colloids
12. The dispersions of polymers are macromolecular colloids.
13. Soaps, detergents, sodium stearate etc. are micelles.
14. When oxygen is bubbled through H2S solution, sulphur sol is formed.
15. Sols of silver, gold, platinum etc. are prepared by reduction of their compounds with hydrozine or formaldehyde.
16. Sols of hydrons oxide are prepared by precipitating them from solutions of soluble salts.
17. When a dilute solution of ferric chloride is poured into boiling water, we get the ferric hydroxide sol.
18. Gelatin, gum arabic, starch and soaps are peptised by water.
19. Cellulose nitrate is peptised by Ethyl alcohol.
Concepts:

1. Colloidal system is heterogeneous and consists of at least two phases, Dispersed phase and dispersion medium.
2. Lyophobic colloids are prepared by chemical method or by dispersion method.
3. Micelles are associated colloids.

Instructional objectives: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.
2. Understanding the above mentioned terms, facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in drawing, experimentation
5. Scientific attitude and scientific interest.

Teaching aids: Charts, ferric chloride, spirit lamp, test tube, and usual class room facilities

Previous knowledge: Pupil has acquired the knowledge regarding adsorption phenomenon.
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<td>Introduction</td>
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<tr>
<td></td>
<td></td>
<td>What is meant by adsorption? What is the difference between true solution and suspensions?</td>
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<td>K/recalls</td>
<td>Development</td>
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<tr>
<td></td>
<td></td>
<td>The size of the colloidal particle ranges from 1 to 100 nm. It is in between true solution and suspension.</td>
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<td></td>
<td></td>
<td>What is the nature of solute and solvent in a true solution?</td>
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<td></td>
<td>U/explains</td>
<td>They form one phase and they are randomly mixed.</td>
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<td></td>
<td></td>
<td>In colloids it contains two phases dispersed phase and dispersion medium and the surface area of colloids is very large.</td>
<td></td>
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<tr>
<td>Common colloidal system</td>
<td>U/classifies</td>
<td>Based on the dispersed phase and dispersion medium the colloidal solutions are classified as follows(Chart showing)</td>
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<tr>
<td></td>
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<td>What are emulsions?</td>
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<td>What is meant by gel?</td>
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Hydrosol

Can you name the colloid in water? Hydrosol?

Then what will be alchosols? Colloid in alcohol (B.B. Work)

Lyophilic and lyophobic colloids.

What is the difference between lyophilic and lyophobic colloids?

Lyophilic are solvent loving and lyophobic are solvent hating colloids (B.B. Work)

What is meant by solvation?

What are the properties of lyophilic and lyophobic colloids?

Lyophilic sol

1. Self-stabilized

2. Reversible sols and easily precipitated after evaporation can be brought back to the colloidal state.

What are the properties of lyophilic and lyophobic sols?

Lyophobic sol

1. Less stable

2. More difficult to precipitate and the coagulated mass cannot be brought back to the colloidal state.

Examples for lyophilic sols are sols of proteins in water, high polymers in organic solvents.

Examples for lyophobic sols are sols of metal, metal sulphides and oxides.

What are the properties of lyophilic and lyophobic sols?

Nature of lyophilic, lyophobic sols.

Lyophilic and lyophobic colloids.

What is the difference between lyophilic and lyophobic colloids?

Lyophilic are solvent loving and lyophobic are solvent hating colloids (B.B. Work)

What is meant by solvation?

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Examples for lyophilic sols are sols of proteins in water, high polymers in organic solvents.

Examples for lyophobic sols are sols of metal, metal sulphides and oxides.

What are the properties of lyophilic and lyophobic sols?
Multimolecular and macrocolloids.

Another classification of colloids is:

1. Multimolecular colloids
2. Macromolecular colloids

Multimolecular colloids:
- Aggregates of atoms
- Dispersed particles
- With diameters of less than 1 micrometer
- Large molecules
- Differentiates from macrocolloids

Macromolecular colloids:
- Ultrasound sol
- Sol/sol
-多cornered aggregates
- Ultrafine colloids

Have you heard of Micelles?

Micelles- associated colloids:
- They are colloids which behave as normal electrolytes at low concentrations,
- But exhibit colloidal properties at higher concentrations.
- They are also called associated colloids due to the formation of aggregated particles.
- Examples: Soap, detergent, sodium stearate.

Preparation of colloids:

1. Chemical method
2. Dispersing method

Multimolecular colloids:

What is the difference between multimolecular and macromolecular colloids?

Micelles:
- Associated colloids
- Explain the formation of aggregated particles
- With colloidal properties at higher concentrations,
- Soap, detergent, sodium stearate.

Have you heard of Micelles?

They are colloids which behave as normal electrolytes at low concentrations,
- But exhibit colloidal properties at higher concentrations.
- They are also called associated colloids due to the formation of aggregated particles.
- Examples: Soap, detergent, sodium stearate.

Preparation of colloids:

1. Chemical method
2. Dispersing method
Dispersion method

What happens when Oxygen is bubbled through \( \text{H}_2\text{S} \) solution?

Sulphur is formed.

Sulphur sol is prepared like this. Sols of Gold, Silver, Platinum etc are prepared by the reduction of their compounds by hydrazine or formaldehyde.

When a dilute solution of ferric chloride is poured into boiling water, ferric hydroxide sol is obtained.

How sulphur sol is prepared?

In dispersion method, a lump of substance is broken into small particles by mechanical or electrical means in the presence of the dispersion medium. It also breakup certain substances into colloidal state. This process is called **Peptization** (B.B.Work)

What is meant by dispersion method?

What is menat by peptization?

Peptization

Gelatin, gumarabic, starch and soaps are easily peptized by water. Cellulose nitrate is peptized by ethyl alcohol. This product is called **Collodion** (B.B.Work)

What is Collodion?
Review:

1. What is meant by Lyophilic colloid?
2. What is meant by Lyophobic colloid?
3. What are Emulsions?
4. What is meant by Gel?
5. What are Micelles?
6. How Sulphur sol is prepared?
7. What is meant by peptization?

Colloidal solutions generally contain electrolytes and other impurities. It destablises the sols. This impurities can be removed by dialysis. In dialysis the sol is taken in a bag made of parchment or cellophane and the bag is suspended in pure water. Small molecules and ions pass through the membrane but the sol is retained. When electric field is applied it is called electrodialysis (B.B.Work)
8. Explain dialysis?

9. What is the difference between multimolecular and macromolecular colloids?

10. What is meant by dispersion method of preparing sols.?

Assignment:
What do you meant by the term ‘Colloidal state’. How are colloids classified?
LESSON PLAN NO. 3

Name of teacher : K. Rema Devi
Subject : Chemistry.
Unit : Surface Chemistry.

Standard : XI
Strength : 61
Duration : 45'

CONTENT ANALYSIS

New terms : Brownian movement, Tyndall effect, Electrophoresis, Emulsion

Facts: I Colloidal particles, exhibit the following properties

1. Measurable Osmotic pressure
2. Elevation in boiling point
3. Brownian movement
4. Tyndall effect
5. Electrophoresis

II Milk is an emulsion

Water in oil is another emulsion.

Emulsifying properties of soap are exploited in washing clothes. Digestion of fats in the intestines is aided by emulsification.
Instructional Objectives: The pupil develops,

1. Knowledge in the above mentioned terms, facts and concepts.
2. Understanding the above mentioned terms, facts and concepts.
3. Application of the acquired knowledge in familiar and unfamiliar situations.
4. Skill in experimentation, observation
5. Scientific attitude and interest.

Teaching Aids: Charts showing Brownian movement, Torch Nacl solution, boiling tubes, pollen grains, water, beaker.

Previous knowledge: The pupil has the knowledge about adsorption different types of colloids and their method of preparation.

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<td>Introduction</td>
<td>How Sulphur sol is prepared? What about the molecular weight of colloidal particles? pollen grains are suspended in a beaker containing water. Observe the movement of pollen grain.</td>
<td>Development.</td>
<td></td>
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<tr>
<td>K/recalls</td>
<td>Robert brown discovered one important property of colloidal particles quite similar to the Zig - Zag movement exhibited by</td>
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</table>
Brownian movement

U/explains pollengrain in water (Chart showing)

U/defines This property is called **Brownian movement** (B.B.Work)

Why colloidal particles show elevation in boiling points?

A/reasons out Because of high molecular mass. It shows Osmotic pressure.

What is the reason behind Brownian movement?

A/finds reason It is due to the collision between the colloidal particles and the moving molecules of dispersion medium.

What is the reason behind Brownian movement?

A/experiments When light passes through a sol, its path becomes visible (demonstrating using NaCl solution in a boiling tube. This phenomena is called Tyndall effect and it is due to the scattering of light by colloidal particles.

Tyndall Effect

U/defines

A/finds reasons

What is the reason for Tyndall effect?

Electrophoresis

U/experiments When current is passed through colloidal solution, depending on the charge, the colloidal
Emulsion

What type of colloid is milk?

It is an emulsion of small drops of fat dispersed in water. Emulsions are liquid-liquid colloidal dispersions.

Emulsification

The process of making emulsion from an oil is called emulsification (B.B. Work).

How are emulsions formed?

By agitating a mixture of relevant liquid or by subjecting the mixture to ultrasonic vibrations.

A stabilising substance called emulsifying agent is added to stabilise the emulsion (B.B. Work).

What is meant by electrophoresis?

Electrophoresis refers to the movement of particles bearing opposite charge towards electrodes. Electrophoresis (B.B. Work).

Emulsifying agent

What is an emulsifying agent?

An emulsifying agent is added to stabilise the emulsion.
What happens when the emulsifying agent is absent? The emulsion breaks into two separate layers.

eg. Soap, detergent, proteins, gums and agar.

The soap and detergents emulsify the grease along with adhering dirt and carry them away in the wash water.

How soap removes dirt from clothes?

How digestion of fats in the intestine is aided?

A little of the fat forms a sodium soap with the alkaline solution of the intestine and making it easier for the digestive enzymes to carry out their functions.

Other examples for the emulsions are lotion, creams, ointments etc.

What are the applications of emulsions?

For concentrating ores, finely pulverized ore is treated with an oil emulsion and the particles of the desired mineral are carried to the surface.

What are the applications of emulsions.
Some oil wells yield emulsified petroleum and they are deemulsified to yield the constituent liquids by freezing, filtration precipitation or centrifugation. Milk cream is separated from milk by centrifugation.

Review:

1. Define Tyndall effect.
2. What is meant by Brownian movement?
3. What is meant by electrophoresis?
4. What are emulsions?
5. What are the two types of emulsions?
6. Give an example for emulsion.

Assignment: Explain what is observed when:

1. A beam of light is passed through a colloidal solution of arsenious sulphide
2. An electric current is passed through a colloidal solution.
LESSON PLAN NO. 4

Name of teacher : K. Rema Devi
Subject : Chemistry.
Unit : Surface chemistry.
Topic : Catalysis.
Standard : XI
Strength : 62
Duration : 45'

CONTENT ANALYSIS

New terms :
Catalyst, homogeneous catalysis, heterogeneous catalysis activity, selectivity, Zeolite

Facts :
1. In the manufacture of SO3, Nitric oxide acts as a catalyst and increases the speed of the reaction.
2. Vanadium pentoxide acts as a catalyst in the manufacture of sulphuric acid by contact process.
3. Iron is the catalyst in the manufacture of NH3 from N2 and H2.
4. Platinum is the catalyst in the oxidation of CO in automoblie.
5. (ZnO+CuO) acts as the catalyst in the synthesis of CH3OH from CO and H2.
6. Manufacture of hydrocarbons from CO and H2 uses Cobalt catalyst.
7. Zeolite acts as the catalyst in the cracking of hydrocarbons.
8. Pure H2 and O2 mixture can be stored without any reactions but in presence of Platinum the reaction becomes explosive.
9. n-heptane selectivity gives toluene on a platinum catalyst.

10. Propylene +O2 give acrolein selectively over bismuth molybdate catalyst.

11. Zeolites are oxide catalyst.

12. ZSM-S converts alcohol to gasoline

Concepts:

1. When the catalyst mixes homogeneously with the reactants and forms a single phase, the catalyst is said to be homogeneous and this kind of catalysis is homogeneous catalysis. When it forms a separate phase, it is said to be heterogeneous and catalysis is heterogeneous catalysis.

2. Activity is the ability of the catalyst to accelerate chemical reactions and selectivity is the ability of the catalyst to direct the reaction to yield particular products.

3. Zeolites are microporous aluminosilicates of the general formula Mx/n [Al2O]x (SiO2)y MH2O and the important feature of which is the shape selectivity.

Instructional objectives: The pupil develops,

1. Knowledge in the above-mentioned terms, facts and concepts.

2. Understanding the above-mentioned terms, facts and concepts.

3. Application of the acquired knowledge in familiar and unfamiliar situations.

4. Scientific attitude and scientific interest.
**Teaching Aids:** Usual class room facilities

**Previous knowledge:** The pupil has the knowledge about catalytic activity, adsorption etc.

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<td><strong>Introduction</strong></td>
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<td></td>
<td>In the Oxidation of $\text{SO}_2$ to $\text{SO}_3$, NO is used as the catalyst. In the manufacture of $\text{NH}_3$ from $\text{N}_2$ and $\text{H}_2$, iron is used as the catalyst. What is the difference between the two reactions? What is a Catalyst? What is the modern theory behind the catalytic action?</td>
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<td><strong>Development</strong></td>
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<td>The student understands that the above two reactions differ in the nature of catalyst and state of phases. In the <em>first reactants and catalyst are in the same phase but in the second reaction, the reactants in the gaseous state, but catalyst in the solid state. The first type of Catalysis is called Homogeneous catalysis and the second type heterogeneous catalysis</em> (B.B.Work)</td>
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<td><strong>U/comparres</strong></td>
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Can you cite any other examples? In contact process oxidation of $SO_2$ to $SO_3$ is taking place in presence of Vanadium pentoxide. It is a heterogeneous Catalysis. Similarly the student learns that synthesis of $CH_3OH$ from $CO$ and $H_2$ using $(ZnO+CuO)$ as catalyst, oxidation of Co in automobile exhaust by platinum catalysts, Cracking of hydrocarbon in the presence of hydrogen by Zeolite Catalyst, Polymerisation of ethylene on $TiCl_4$ and trialkyl - aluminium, and reaction of producing hydrocarbons by $CO$ and $H_2$ on Cobalt catalyst etc. are examples for heterogeneous catalysis. Here the surface of the solid catalyst is utilised for reaction and are called Surface catalysis (A.B.Work).

What is meant by surface catalysis?

What are the different solid catalysts used?
Metals, alloys metal oxides, metal sulphides, clays etc.
Activity and Selectivity of the catalyst.

Activity is the ability of the catalyst to accelerate chemical reaction. Selectivity is the ability of the catalyst to direct reaction to yield particular products. For example, n-heptane selectivity gives toluene (\(n\)-C\(_7\)H\(_6\) → C\(_6\)H\(_5\)CH\(_3\)) on a platinum catalyst. CH\(_3\)CH\(_2\)CHO (acrolein) selectivity over bismuth molybdate catalyst. What are the steps involved in heterogeneous catalysis?

1. Chemisorption of reactants on the surface.
2. Diffusion and chemical reaction at the surface.
3. Desorption of the products from the surface.

The mixture of H\(_2\) and O\(_2\) does not react in normal conditions, but the reaction becomes explosive in presence of platinum. The catalytic reaction is the ability of the catalyst to direct reaction to yield particular products (B.B.Work).

Steps involved in heterogeneous catalysis:

- Define activity of the catalyst?
- Define selectivity of the catalyst?
Zeolites are microporous alumino silicates of the general formula 

\[ M_{x/m}[(\text{AlO}_2)_x(\text{SiO}_2)_y] \cdot \text{MH}_2\text{O} \]

They are used in petro chemical industries for craking of hydrocarbon and isomerisation. Reactions depend on the size of cavities and pores present in them. Shape selectivity is another feature of zeolites. It depends on the pore structure. The pore size in zeolite varies between 260 pm and 740 pm. ZSM-5 is a zeolite catalyst which converts alcohol to gasoline.
Review:

1. What is meant by homogeneous catalysis? Give an example.
2. What is meant by heterogeneous catalysis? Give an example.
3. Define surface catalysis.
4. What is meant by activity and selectivity of catalyst.
5. What are Zeolites? Describe some of their features.
6. What is shape selective catalysis?

Assignment:

Give five examples for heterogeneous catalysis.
CONTENT ANALYSIS

1. **Newterms**: Natural Radioactivity, Artificial Transmutation, Artificial Radioactivity, Particle Accelerators.

2. **Facts**:
   
   1. On placing a crystal of potassium uranyl sulphate on a photographic plate placed on total darkness, the photographic plate is affected by some radiations from the crystal of potassium uranyl sulphate.

   2. The bombardment of $\text{^14}_7\text{N}$ with alpha and with neutrons, results in the formation of another element, $\text{^23}_{11}\text{Na}$ is also converted to another element when bombarding with protons.

   3. When $\text{^24}_{12}\text{Mg}$ is bombarded with alpha particle a radioactive element $\text{^27}_{11}\text{Si}$ is formed and the disintegration of this element gave a positron which is having the same mass as that of an electron.

3. **Concepts**

   1. **Natural Radioactivity**: It is the process by which a naturally occurring nucleus spontaneously changes into the nucleus of another element by emitting certain radiations.
2. Artificial Transmutation : The process of conversion of one element into another is called artificial transmutation.

3. Particle Accelerators: They are devices used for impacting high energies to sub-atomic particles like alpha particles or heavier nucleides.

4. Artificial Radioactivity : The process by which a new radioactive isotope of a known element is prepared is called artificial radioactivity.

4. Instructional Objectives

1. Pupils develop knowledge about terms like Artificial radioactivity, Natural radioactivity, artificial transmutation, particle accelerators, and facts like photographic plate placed in darkness is affected by the crystal of potassium uranyl sulphate, the bombardment of alpha particles and neutrons with $^{14}_7$N and bombardment of $^{24}_{12}$Mg with alpha particle gave anew radioactive element and the disintegration of this element emit a positron and concepts like the process by which a naturally occurring nucleus spontaneously changes into nucleus of another element by emitting certain radiations called natural radioactivity. The process of conversion of one element into another called artificial transmutation, devices used for impacting high energies to sub atomic particles like alpha particles or heavier nucleides called particle accelerators, the process by which a new radioactive isotope of a known element is prepared called artificial radioactivity.

2. Pupils develop understanding in the above mentioned terms, facts and concepts.

3. Pupils apply the acquired knowledge in familiar and unfamiliar situations like chemical research, medicine, biology, industry etc.
4. Pupils develop skill in writing equations for nuclear reactions, drawing figures.

5. Pupils develop scientific attitude and interest

5. Teaching aids

Charts showing the nuclear reactions, emission of alpha, beta and gamma rays.

6. Previous knowledge.

In nuclear reactions there is a change in the structure of nucleus occurs and this change in the nucleus result in the change of one element into a completely different element. They also knew that these reactions are called nuclear reactions.

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<td>Introduction</td>
<td>What happens when some crystals of potassium uranyl sulphate, placed over a wrapped photographic plate placed in total darkness.</td>
<td>Pupil observes the above experiment and says that some background marks are produced on the plate</td>
<td>S. notices relevant details</td>
</tr>
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</table>
Natural radioactivity is the process by which a naturally occurring nucleus spontaneously changes into the nucleus of another element by emitting certain radiations.

How this background marks are produced on the plate?

Observing the above experiment pupil says that certain rays having penetrating properties similar to X-rays are produced from the crystal of potassium uranyl sulphate, these rays cause ionization of air and these rays produce background marks on the plate.

Development

The above experiment is repeated with thorium salts also emit similar rays and possess the above type of property.

From the above experiments pupils define what is natural radioactivity?
S. notices relevant details
What happens when $^{14}_7\text{N}$ is bombarded with alpha particles.

U. identifies
Noticing the above reaction pupil says that some amount of oxygen is formed by bombarding the $^{14}_7\text{N}$ with alpha particles and the reaction was found very slow.

U. explains
S. writes the equations
$^{14}_7\text{N} + ^4_2\text{He} \rightarrow ^{17}_8\text{O} + ^1_1\text{H}$
because of the repulsion between the positively charged alpha particles used for bombardment and the target nucleus.

A. reasons out
How will this repulsion overcome?

U. identifies
Pupil says that to overcome this repulsion the bombarding particles must have high energy and several types of particle accelerators have been used to impact high energies to sub atomic particles like alpha particles or heavier nucleids.

U. compares
Pupil observes the reaction
$^{14}_7\text{N} + ^1_0\text{n} \rightarrow ^{14}_6\text{C} + ^1_1\text{H}$
The process of conversion of one element into another is called artificial transmutation. The product of artificial transmutation may be a stable or a radioactive nuclei.

U. generalises and says which is the bombarding particle in this reaction and why it is used.

Observing the above reaction pupil realises that neutrons are the bombarding particle and they are used in this reaction because they donot have any charge and hence are not repelled by the positive charge of the target nucleus.

What is artificial transmutation?
Give some examples.

Pupil says that in all the above reactions neutrons, alpha particles and protons are used as bombarding particles in the conversion of one element to another.

U. identifies Pupil says that in all the above reactions neutrons, alpha particles and protons are used as bombarding particles in the conversion of one element to another.

Pupils define artificial transmutation

U. defines Pupils define artificial transmutation

U. explains Pupil observes the reaction when a light element Mg bombarded with alpha particle. On noticing the above reaction pupil says that Mg is changed in to isotope of another element\(^{27}\text{Si}\) and this isotope will undergo disintegration by emitting a positron.
Which element is formed in the disintegration of $^{27}_{14}\text{Si}$ and what is the nature of the position emitted.

Pupil says that $^{27}_{14}\text{Al}$ is formed in the disintegration of $^{27}_{14}\text{Si}$ and this positron is having a unit positive charge and it has the same mass as an electron.

S. writes equation

$$^{24}_{12}\text{Mg} + ^{4}_{2}\text{He} \rightarrow ^{27}_{14}\text{Si} + ^{1}_{0}\text{n}$$

$$^{27}_{14}\text{Si} \rightarrow ^{27}_{13}\text{Al} + ^{0}_{1}\text{e}$$

The process by which a new radioactive isotope of a known element is prepared is called artificial radioactivity.

U. defines artificial radioactivity.

U. compares artificial transmutation and artificial radioactivity.

Pupils say artificial transmutation is the process by which the conversion of one element to another takes place and in artificial radioactivity a new radioactive isotope of a known element is prepared.
7. Review

1. What is natural radioactivity? Give some examples for the naturally occurring radioactive elements.
2. What is artificial transmutation
3. Define artificial radioactivity with some examples?
4. What is meant by particle accelerators?

8. Assignment

Complete the nuclear reactions.

1. \[ ^{24}_{12}\text{Mg} + ^{4}_{2}\text{He} \rightarrow \_\_\_ + ^{1}_{0}\text{n} \]
2. \[ ^{27}_{14}\text{Si} \rightarrow ^{27}_{13}\text{Al} + \_\_\_ \]
LESSON PLAN NO. 2

Name of teacher : K. Rema Devi
Name of school  : Govt. Higher Secondary School, Kalavoor
Subject        : Chemistry
Unit           : Nuclear Chemistry
Topic          : Nuclear Fission and Nuclear Fusion

Standard  : XII
Strength   : 60
Date       :
Time       : 45'

CONTENT ANALYSIS

1. Newterms  Nuclear fission, Chain reaction, Nuclear fusion, Atomic Bomb, Nuclear reactors and Breeder reactors.

2. Facts: 1 (a) An atom of $^{235}_{95}\text{U}$ when bombarded with neutrons, the nucleus of the uranium atom splits unevenly into a barium nucleus, a krypton nucleus and in addition 3 neutrons and a large amount of energy is released.

   (b) An atom of $^{235}_{92}\text{U}$ when bombarded with neutrons, the nucleus of the uranium atom splits unevenly into a xenon nucleus, a strontium nucleus 2 neutrons and large amount of energy is released.
(c) Similarly when $^{235}\text{U}$ atom is bombarded with neutrons, the nucleus of $^{135}\text{U}$ splits unevenly into a cesium and rubidium nucleus and in addition 2 neutrons and large amount of energy is released.

2. When $^{235}\text{U}$ undergoes fission several neutrons may be released. One neutron sustains the chain reaction.

3. When uranium atom undergoes fission, a huge amount of energy is released. This principle is used in atomic bomb.

4. When chain reaction is left uncontrolled, the process continues and results in explosion. So to control the chain reaction and use the energy when needed nuclear reactors are used.

5. Suppose 3 neutrons are emitted per fission. One of these neutrons is used to keep the chain reaction going and the other two may be used to convert non-fissionable material into fissionable. Thus more fissionate material will be produced than consumed.

6. (a) A single Helium nucleus formed by the fusion of two deuterium nuclei
(b) A single helium nucleus and a neutron is formed by the fusion of one deuterium and a tritium nucleus.
(c) Four hydrogen nuclei, under conditions of high temperature and pressure combine to form one helium nucleus

3. Concepts

1. In a nuclear fission reaction, a heavy nucleus breaks up into two fragments consisting of lighter nuclei and several neutrons
2. A single neutron can cause the fission of a single atom of $^{235}\text{U}$ and produces 2 or 3 neutrons. These extra neutrons can cause still more $^{235}\text{U}$ atoms to split and this in turn still produces more neutrons and the process continues. This process is called a chain reaction.

3. A large amount of energy is released in a nuclear fusion reaction in which two or more light nuclei combine to form a heavy nucleus.

4. The equipment used to carry out the fission reaction in a controlled manner is called reactor.

5. A breeder reactor is one which produces more fissionable nuclei than it consumes.

4. Instructional Objectives

1. Pupil develops knowledge about the above terms and concepts like nuclear fission, chain reaction, nuclear fusion etc. Facts like fission of $^{235}\text{U}$ atom, principle behind atom bomb, production of more fissionable material than consumed etc.

2. Pupil develops understanding in the above terms, facts and concepts.

3. Pupil applies the acquired knowledge in familiar and unfamiliar situations like broad study of nuclear energy.
4. Pupil develops skill in improvising models and writing chemical reactions.

5. Pupil develops scientific attitude and interest.

5. **Teaching Aids**: Chart showing nuclear reactions

6. **Previous Knowledge**: The pupil know the natural and artificial radioactivity and about artificial transmutation.

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<td>K. recalls</td>
<td><strong>Introduction</strong>&lt;br&gt;You might have heard of the places of Hiroshima and Nagasaki. What is the importance of these places? What is the principle behind it?</td>
<td><strong>Development</strong>&lt;br&gt;When a $^{235}_{92}$U is bombarded with a neutron. What happens?</td>
<td></td>
</tr>
<tr>
<td>U. explains</td>
<td>Pupil understands that uranium atom splits unevenly into two fragments. A barium and a krypton nucleus and 3 neutrons and a large amount of energy is released.</td>
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</table>
In a nuclear fission reaction a heavy nucleus breaks up into two fragments consisting of lighter nuclei and several neutrons.

Similarly uranium atom splits in a different way to form a xenon and a strontium nucleus and in addition 2 neutrons and large amount of energy is released.

\[ ^{235}\text{U} + ^{1}\text{n} \rightarrow ^{140}\text{Ba} + ^{93}\text{Kr} + 3 ^{1}\text{n} + \text{energy} \]

Uranium atom when bombarded with neutrons it splits in a different form to form, acesium and rubidium nucleus along with 2 neutrons and large amount of energy is released.

\[ ^{235}\text{U} + ^{1}\text{n} \rightarrow ^{144}\text{Xe} + ^{90}\text{Sr} + 2 ^{1}\text{n} + \text{energy} \]

What similarity can we see in these reactions?

The child will say that when a uranium atom is bombarded with a neutron it splits into two nuclei and neutrons and a large amount of energy is released.

Thus, the child is able to define nuclear fission heavy nucleus breaks up into two...
fragments consisting of lighter nuclei and several neutrons.

What difference can we see in the sum of the masses of the reacting particles and one neutron and sum of these masses of the products? What happens to the loss of mass?

Child understands that large amount of energy released during fission because of loss in mass. Mass is converted into energy and also the sum of the mass of the reacting material and neutron is more than the sum of the mass of the products.

What is the mass energy equation as suggested by Einstein?

Pupil says $E = mc^2$

Where $E =$ Energy $m =$ mass $c =$ velocity of light

Pupil understands that the energy released in nuclear fission is calculated by the above equation.
The neutrons emitted during the fission may be further captured by the remaining \( ^{235}\text{U} \) nuclei causing further fission and ejection of more neutrons. This process continues and is called chain reaction.

How can we utilize the nuclear energy from the fission reaction?

Child understands that release of more than one neutron for every neutron initiates the fission.

U. explains

How the extra neutron initiate the fission?

Child understands that neutrons emitted during the fission may be further captured by the remaining \( ^{235}\text{U} \) nuclei causing further fission and ejection of more neutrons. This process continues and is called chain reaction.

In a chain reaction, not only does the fission sustain itself, but also the reaction increases in magnitude. The rate of fission will

The energy released in nuclear reactions is expressed in mega electronvolts.

\[
1\text{Mev} = 1.622 \times 10^{-13} \text{ joules}
\]

\[
1\text{amu} = 931.48 \times 10^6 \text{ cv}
\]

\[
= 931.48\text{Mev}
\]
A. gives reason

An equipment used to carry out fission in a controlled manner is called a Nuclear reactor.

increase with each stage and is completed in a very short time.

What would happen if the chain reaction is not controlled?

Large amount of energy is released within a short span of time and which will cause explosion.

The child understands that this is what happens in an atomic bomb. This is the destructive use of nuclear energy.

How can we use nuclear energy for constructive purposes?

Child understands that, it can be done by controlling the chain reaction.

An equipment used to carry out fission in a controlled manner is called a nuclear reactor.

There are many types of nuclear reactors, there are certain essentials common to all-

(1) Fissionable Material (Uranium enriched...
(2) in U 235) (2) moderator (graphite or heavy water.) to slow down the neutrons, thereby increasing the efficiency to bring about a fission reaction and (3) Control rods made up of boron steel or cadmium to capture some of the neutrons so that the chain reactions does not become violent. It can be done by inserting or by drawing the control rods.

What is the constructive purpose of nuclear energy?

Child understands that large amount of energy released in the form of heat is converted into electrical energy.

Name such nuclear power plant set up in India? The child says Tarapur, Narora, Kalpakkom, and Kotah.

In order to sustain a chain reaction, a sufficient amount of fissionable material is
A breeder reactor is one that produces more fissionable nuclei than it consumes. U. defines this as a reactor where 

\[ ^{235}\text{U} \] 

is used as fuel needs to be enriched later. But there are reactors that produce more fissionate nuclei than it consumes. Such reactors are known as Breeder Reactors.

When \( ^{238}\text{U} \) is bombarded with fast neutrons it produces plutonium - 239, a fissionable nuclei.

\[
^{238}\text{U} + ^{1}\text{n} \rightarrow ^{239}\text{U} \rightarrow ^{239}\text{NP} + ^{0}\text{e}
\]

\[
^{239}\text{NP} \rightarrow ^{239}\text{Pu} + ^{0}\text{e}
\]

\[
^{239}\text{Pu} + ^{1}\text{n} \rightarrow \text{fission products} + 20r3 (^1\text{n})
\]

Similarly, the naturally more abundant thorium -232 isotope can be used to breed the fissionable isotope-uranium -233.

What happens in a nuclear fission? The child will say that a heavy nucleus undergoes splitting into two smaller fragments. What is the difference between nuclear fission and nuclear fusion?
In nuclear fusion, two or more light nuclei combine to form a heavy nucleus. U. defines or illustrates these processes. Pupil understands that nuclear fusion is opposite to fission and is used as a method of releasing energy.

By the fusion of two deuterium nuclei, a single helium nucleus is formed:

\[ ^2H + ^2H \rightarrow ^4He \]

By the fusion of a deuterium nucleus and a tritium nucleus, a single helium nucleus is formed:

\[ ^1H + ^3H \rightarrow ^2He + ^0n \]

By the fusion of four hydrogen nuclei, one helium nucleus is formed under conditions of high pressure and temperature:

\[ ^1H + ^1H + ^1H + ^1H \rightarrow ^4He + ^0e \]

The energy of the sun and stars is produced by the fusion of hydrogen nuclei.
Nuclear reactions are thermo nuclear reactions. A. reasons out why nuclear fusion reaction requires very high temperature to overcome the electrostatic repulsion between the nuclei when they come together to fuse. So it is referred to as thermonuclear reaction.

U. cites example

Give an example for a device in which the fusion principle is used?

U. explains why nuclear fusion is referred to as 'thermonuclear reactions'?

Why nuclear fusion is referred to as 'thermonuclear reactions'?

7. Review

(1) Explain nuclear fission reaction with examples?
(2) What is a chain reaction?
(3) Name a device in which nuclear energy is produced by controlling the chain reactions?
(4) Name the common essentials of a nuclear reactor?
(5) What is a breeder reactor?
(6) What is nuclear fusion?

8. Assignment Describe nuclear fission and nuclear fusion with illustrations.
LESSON PLAN NO 3

Name of teacher : K. Rema Devi
Name of school : Govt. Higher Secondary School, Kalavoor
Subject : Chemistry
Unit : Nuclear Chemistry
Topic : Properties of alpha, beta, gamma rays and Group displacement law

Standard : XII
Strength : 60
Date : 
Duration : 45'

CONTENT ANALYSIS

1. **Newterms**  
   Alpha Rays, Beta Rays, Gamma Rays, Group displacement law, Radioactive series

2. **Facts**  
   1. $^{238}\text{U} _{92}$ on radioactive disintegration gives $^{234}\text{Th} _{90}$ by gamma rays emission

   $^{238}\text{U} _{92} \rightarrow ^{234}\text{Th} _{90} + ^{4}\text{He} _{2}$

   $^{234}\text{Th} _{90} \rightarrow ^{234}\text{Pa} _{91} + ^{0}\text{e} _{-1}$

   $^{238}\text{U} _{92} \rightarrow ^{206}\text{Ph} _{82} + ^{4}\text{He} _{2} + ^{0}\text{e} _{-1}$

3. **Concepts**  
   1. Alpha rays consist of helium atoms that have lost two electrons
2. Alpha particles are positively charged and are deflected strongly by electrostatic field.

3. Alpha rays can penetrate an Aluminium sheet of 0.02 cm thickness.

4. Beta rays are made of streams of electrons.

5. Beta rays are heavily deflected in an electric field.

6. Beta rays penetrate Aluminum sheet of up to 0.2 cm thickness.

7. Gamma radiations are high energy electromagnetic radiations with a very short wavelength of the order 10 pm.

8. Gamma rays are not deflected by an electric field.

9. Gamma rays can penetrate up to 100 cm thick Aluminium sheet.

10. The emission of an alpha particle results in the formation of an element which lies two places to the left and the expulsion of a beta particle results in the formation of an element which is one place to the right of the parent element in the periodic table. This is known as Group displacement law.

11. Spontaneous disintegration of a nuclear species ultimately leads to a more stable species from a less stable one through a series of steps. The chain of successive disintegrations continue until one finally arrives as a stable isotope. All the nuclei from the initial element to the final element constitute a series which is called disintegration series.

12. The mass numbers of all elements in a given set fit into one of the formulas $4n$, $4n+1$, $4n+2$, $4n+3$ of these four series.

4. Instructional objectives

1. Pupil develops knowledge in the above mentioned terms, facts and concepts.

2. Pupil develops understanding in the above mentioned terms, facts and concepts.
3. Pupil applies the acquired knowledge in familiar and unfamiliar situations.
4. Pupil develops skill in writing nuclear equations
5. Pupil develops scientific attitude and scientific interest.

5. Teaching Aids charts showing disintegration series
6. Previous knowledge Pupils know about natural and artificial radicativity and artificial transmutation

<table>
<thead>
<tr>
<th>Content</th>
<th>Objective/Specification</th>
<th>Learning activities</th>
<th>evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td>You might have seen watches which have hands that glow in the dark? This help to determine time even in the dark. What is this due to? Why does radium glow?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K. recalls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>We know that nucleus of certain elements like radium with atomic weight greater than that of lead are unstable breaking down with the emission of radioactive radiations</td>
<td>With the help of chart explains the separation of the radiation emitted by radioactive element in the presence of a strong electric field.</td>
<td></td>
</tr>
<tr>
<td>K. recalls</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How many separate bands do we obtain on the photographic film?

Students observe that the radiation is split into 3 components, one deflected towards the positive plate, one deflected towards the negative plate, and a third one remaining undeflected.

What does this deflection in radiation show?

The student points out that the deflection shows the presence of positively and negatively charged particles in the radiation which are attracted towards the oppositely charged plates in a strong electric field.

In the chart we can see a third type of radiation which is not at all deflected even in the strongest electric field. How can this be explained?
<table>
<thead>
<tr>
<th>The radiations from a radioactive nucleus consists of positive, negative and neutral components</th>
<th>The student explains that the third type of rays are neutral and hence remain undeflected in an electric field.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. reasons out</td>
<td>From the chart displayed the student defines that the positively charged particles are called the alpha particles, the negatively charged particles are termed the Beta particles and the neutral ones the ( \gamma ) rays.</td>
</tr>
<tr>
<td>U. defines</td>
<td>Compare the paths followed by the alpha and beta rays?</td>
</tr>
<tr>
<td>S. notices relevant details</td>
<td>Why are the beta rays deflected more than alpha rays in an electric field?</td>
</tr>
<tr>
<td>A. reasons out</td>
<td>The student notices that Beta rays are deflected more from the initial path than the Alpha rays in an electric field. From this the student infers that alpha particles are heavier than beta particles.</td>
</tr>
<tr>
<td>Alpha rays consists of helium atoms that have lost two electrons.</td>
<td>Explain the properties of alpha rays?</td>
</tr>
<tr>
<td>U. explains</td>
<td>Alpha rays consists of helium atoms that have lost two electrons and are designated as ( \frac{4}{2} ) He when allowed to fall on an aluminium sheet of .02 cm thickness.</td>
</tr>
</tbody>
</table>
Beta rays are streams of electrons. U. explains that Deflection of beta rays in electric fields were identical with that of cathode rays.

What can we assume from this?
The student assumes that Beta rays are streams of electrons. Beta rays are denoted as $-1^e$. The wider deflection shows that they have relatively smaller momentum compared to alpha rays, beta rays can penetrate an aluminium sheet of up to 0.2 cm thickness.

Gamma rays emitted by radioactive substance are not deflected by an electro static field. What do you understand from this?
The student understands that rays are not deflected because of the absence of charge and mass associated with them.

Gamma rays are high energy electromagnetic radiations with a very short wavelength of the order of 10 pm. U. explains that the gamma radiations are nothing, but high energy electromagnetic radiations with a very short wavelength of the order of 10 pm.
Gamma rays can penetrate up to 100 cm thick aluminium sheet.

Consider the decay of $^{238}\text{U}$ nucleus by the emission of an alpha particle. What will be the daughter nucleus obtained?

The student explains that since alpha particles are helium nuclei with mass number 4 and atomic number 2, when the nucleus of an atom loses two protons and thus the atomic number of the remaining nucleus is two less than the atomic number of the original atom and its mass number is 4 less than the original one.

Thus $^{238}\text{U} \rightarrow ^{234}\text{Th} + ^{4}\text{He}$

The emission of an alpha particle transforms uranium nucleus into a thorium nucleus.

What is the position of Thorium in the periodic table relative to that of Uranium?
The student notices that Thorium occupies a position two places to the left of Uranium in the periodic table.

Similarly $^{244}_{88}$Ra also emits alpha rays? Which is the daughter element formed?

The student explains the formation of $^{220}_{86}$Ru from $^{224}_{88}$Ra by the emission of an alpha particle:

$^{224}_{88}$Ra $\rightarrow$ $^{220}_{86}$Ru + $^{4}_{2}$He

The $^{220}_{86}$Ru formed is also radioactive and emits alpha rays, which is the daughter element formed.

Students explain that $^{220}_{86}$Ru by the emission of an alpha particle loses two protons and thus the atomic number of the remaining nucleus is two less than that of Ru, i.e., the atomic number is 84. The element formed is $^{216}_{84}$Po. Polonium occupies a position two places to the left of Uranium in the periodic table.

What happens to the $^{220}_{86}$Ru nucleus when it emits an alpha particle?
When a radioactive element emits an alpha particle its atomic number is reduced by four, thus the daughter element produced will occupy a position in the periodic table two places to the left of the parent element.

S. generalises

From the above three examples students understand that when a radioactive element emits an alpha particle its atomic number is reduced by four and its mass number is reduced by two. Thus, the daughter element formed will occupy a position in the periodic table two places to the left of the parent element.

Consider the emission of beta rays from $^{234}_{90}$Th. How many protons and how many neutrons are there in the nucleus?

Consider $^{234}_{90}$Th. How many protons and how many neutrons are there in the nucleus?

The students know that the nucleus does not contain any free electrons and explain the formation of electrons by the conversion of neutrons in the nucleus into protons. The electron formed during this conversion is lost as a Beta particle.

The electron formed during this conversion is lost as a Beta particle.

From the above three examples students understand that when a radioactive element emits an alpha particle its atomic number is reduced by four and its mass number is reduced by two. Thus, the daughter element formed will occupy a position in the periodic table two places to the left of the parent element.

What change will you observe in the atomic number and mass number of the parent element during alpha ray emission?
Students say that there are 90 protons and 144 neutrons. What are neutrons?
Neutrons are particles which carry no charge, it is conveniently considered as a combination of a proton and an electron. Thus the student understands that an electron is obtained by the conversion of the neutral neutron to a positively charged proton. This electron is emitted as Beta ray. What happens to the nuclear constitution when an electron is ejected as a result of the conversion of a neutron to a proton?

The student observes that the number of protons in the nucleus is increased by one and the number of neutrons is decreased by one.

But the total mass number remains the same. Thus in case of Thorium ($^{234}_{90}$Th) the atomic number is increased to 9, while the mass number of the new element formed remains the same $(91 + 143)$. 
S. writes chemical equation

\[ ^{234}\text{Th} \rightarrow ^{234}\text{Pa} + ^{0}\text{e} \]

90 \hspace{1cm} 91 \hspace{1cm} -1

In the same way \(^{234}\text{pa}\) also emits beta rays. Which is the daughter element formed.

\[ ^{234}\text{Pa} \rightarrow ^{234}\text{U} + ^{0}\text{e} \]

91 \hspace{1cm} 92 \hspace{1cm} -1

Which position does \(^{92}\text{U}\) occupy in the periodic table relative to \(^{91}\text{Pa}\).

The student notices that \(^{92}\text{U}\) occupy a position in the periodic table which is one group to the right of that of \(^{91}\text{Pa}\).

From the above examples the student understands that when a Beta particle is emitted, the daughter element will not have any change in the mass number? But its atomic number is increased by one unit and it will occupy a position in the periodic table which is one group to the right of that of the parent element.
What happens to the nuclei of an element when it emits radiations?

Gamma rays are electromagnetic radiations and do not possess any charge or mass so emission of rays does not bring about any change in either the mass number or the atomic number of the nucleus. Gamma rays are emitted in all nuclear reactions from nuclei which are left in an excited state by an earlier emission of an alpha or beta particle.

The above two change in the parent element as a result of alpha and beta particle emission are defined by the students as follows.

The emission of an alpha particle results in the formation of an element which lies two places to the left and the expulsion of a beta particle results in the formation of an element which lies one place to the right in the periodic table.

What is group displacement law?
This is known as the **Group displacement law** of Soddy. In the case of $^{228}_{92}\text{U}$, we saw that the daughter element $^{234}_{90}\text{Th}$ formed as a result of ray emission is also unstable. It further undergoes transformation to $^{234}_{91}\text{Pa}$ by the emission of beta rays. This $^{234}_{91}\text{Pa}$ is itself radioactive. It further decays to $^{234}_{92}\text{U}$ by beta ray emission, which is radioactive.

\[ ^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} \rightarrow ^{234}_{91}\text{Pa} \rightarrow ^{234}_{92}\text{U} \rightarrow ^{206}_{82}\text{Pb} \]

The chain of the successive disintegration continues until one finally arrives at a stable isotope, lead-206. The student understands that all nuclei from the critical element to the final stable element constitute a series which is called Disintegration series or Radioactive series.

The student explains the nuclear reactions involved in the conversion of $^{238}_{92}\text{U}$ to the stable $^{206}_{82}\text{Pb}$. A total of 14 separate steps...

What is disintegration series?

Which is end product of $^{238}_{92}\text{U}$ series?
are involved in the Uranium series. Eight of these occur by alpha emission and six by beta emission.

\[ 238_{\text{U}} \xrightarrow{\alpha} 234_{\text{Th}} \xrightarrow{\beta} 234_{\text{Pa}} \xrightarrow{\beta} 230_{\text{Th}} \xrightarrow{\alpha} 226_{\text{Ra}} \]

\[ \alpha \xrightarrow{222_{\text{Ru}}} 218_{\text{Po}} \xrightarrow{\beta} 214_{\text{B}} \xrightarrow{\beta} 210_{\text{Po}} \xrightarrow{\alpha} 206_{\text{Pb}} \text{ (stable)} \]

In the above series, is there any similarity among the mass numbers of the different elements formed when divided by four.

The student notices that all the mass numbers when divided by 4 gives a remainder. Hence this series is called the 4n+2 series.

There are other similar radioactive series with their parent elements as Thorium-232 and Uranium-235 found occurring in nature. They are the Thorium series and the...
Actinium series and are also called the $4n$ series and $4n+3$ series respectively.

Since elements of these series have mass numbers which on division by 4 gives remainders 0 and 3 respectively.

Neptunium on artificially produced element also undergoes radioactivity. The Neptunium series consists of man-made elements and the mass number of all the elements upon division by four gives a remainder one. Hence it is called $4n+1$ series.

Thus student notices that all elements in a given series fit into one of the formulas $4n$, $4n+1$, $4n+2$, $4n+3$ of these four series.
These series are summarised by the students as follows:

<table>
<thead>
<tr>
<th>Series</th>
<th>Name of the series</th>
<th>Initial element</th>
<th>Last stable element</th>
<th>Value of n for initial element</th>
<th>Value of n for the stable element</th>
</tr>
</thead>
<tbody>
<tr>
<td>4n</td>
<td>Thorium</td>
<td>Thorium 232</td>
<td>Lead 208</td>
<td>58</td>
<td>52</td>
</tr>
<tr>
<td>4n+1</td>
<td>Neptunium</td>
<td>Neptunium 237</td>
<td>Bismuth 209</td>
<td>59</td>
<td>52</td>
</tr>
<tr>
<td>4n+2</td>
<td>Uranium</td>
<td>Uranium 238</td>
<td>Lead 206</td>
<td>59</td>
<td>51</td>
</tr>
<tr>
<td>4n+3</td>
<td>Actinium</td>
<td>Uranium 235</td>
<td>Lead 207</td>
<td>58</td>
<td>51</td>
</tr>
</tbody>
</table>
7. Review

1. What are the properties of alpha rays?
2. What are the properties of beta rays?
3. What are the properties of gamma rays?
4. Explain group displacement law
5. What is 4n+3 series
6. What are the different naturally occurring radioactive series?

8. Assignment

Complete the following nuclear reactions

1. \[ ^{238}_{92} \text{U} \rightarrow ^{4}_{2} \text{He} \]
2. \[ ^{234}_{91} \text{Pa} \rightarrow ^{234}_{92} \text{U} + \_ \]
3. \[ ^{218}_{84} \text{Po} \rightarrow ^{4}_{2} \text{He} \]
LESSON PLAN NO 4

Name of teacher : K. Rema Devi
Name of school : Govt. Higher Secondary School, Kalavoor
Subject : Chemistry
Unit : Radioactivity
Topic : Application of radioactivity and Radio Isotopes

Standard : XII
Strength : 60
Duration : 45'

CONTENT ANALYSIS

1. New terms
   Radio carbon, Radio carbon dating, Radio therapy

2. Facts
   1. Age of rocks, and minerals can be determined by measuring the radioactive element like uranium in a sample.
   2. Age of object of animal or vegetable origin can be determined by radiocarbon dating method.
   3. Radio isotopes can be used for different purposes in the field of medicine such as curing cancer, finding blood circulation disorder, locating tumours etc.
   4. In agriculture radio isotopes are used to raise crop fields, to prevent sprouting and spoilage of vegetables etc.
   5. In industry using radioactive rays faults or cracks in metallic casting or welds in oil pipe lines can be detected.

3. Concepts: Radioactive elements and radioisotopes have found wide application in research, medicine, agriculture and industry. They also find in Radio carbon dating.

4. Teaching aids: Useful classroom facilities.
5. Instructional objectives:

1. Pupil develops knowledge in new terms like radio carbon, radiocarbon dating, and radiotherapy and facts like determination of the age of the rocks, minerals and animal or vegetable origin which contain radiocarbon. Radio isotopes can be used in the field of medicine, in agriculture and industry, and concept like of radio isotopes wide application in research, medicine etc. 2. Pupil develops understanding in the above mentioned new terms, facts and concepts. 3. Pupil applies the acquired knowledge in familiar and unfamiliar situations like the determination of age of archeological findings. 4. Pupil develops skill in writing equations of number reactions, solving problems etc. 5. Pupil develops scientific attitude and scientific interest.

6. Previous knowledge

The pupils know the principle behind Natural Radioactivity, about Artificial Radioactivity, Radioactive Decay, Principle of nuclear reactors, Breeder reactors Nuclear fusion and fission.

<table>
<thead>
<tr>
<th>Content</th>
<th>Objectives / Specification</th>
<th>Learning Experience</th>
<th>Evaluation</th>
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</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
<td>How many of you have gone to forest?</td>
<td></td>
</tr>
<tr>
<td>K. recalls</td>
<td></td>
<td>Suppose you have got a piece of rotten wood which is a part of an old tree lies in that place for many years. How will you determine the age of it</td>
<td></td>
</tr>
</tbody>
</table>

Prepared by BeeHive Digital Concepts Cochin for Mahatma Gandhi University Kottayam
The age of rock samples and minerals can be determined by measuring the ratio of uranium to lead in that sample.

Development
All of you have seen big rocks and mountains. Haven't you?
How can you determine the age of a mountain?
What are the common elements present in rocks? Pupil says that uranium is one of the elements present in rocks let us suppose that we wish to find the age of a rock containing $^{238}\text{U}$ which is a radio active isotope. What is the end product of uranium disintegration series?
Pupil says that lead is the end product. All the $^{238}\text{U}$ disintegrated would have been converted into $^{206}\text{Pb}$. Making a further assumption that initially the rock did not contain any lead, the age of the rock can be determined by measuring the ratio of $^{238}\text{U}$ and $^{206}\text{Pb}$, using the relation

How will you determine the age of the rocks and minerals?
\[ N_t = N_0 e^{-\lambda t} \]

where

\( N_0 \) - Amount of \( ^{238}U \) initially present

\( N_t \) - Amount of \( ^{238}U \) after the lapse of time

\( \lambda \) - disintegration constant

Pupil understands that by measuring the ratio of uranium to lead in a sample, the age of that sample can be determined.

BBW: Age of rocks and minerals

The radioactive nature is exhibited by one isotope of C. What is the At.wt of that carbon?

Pupil says that \(^{14}C\) is radioactive.

How radio carbon is formed? KS pupil says that it is formed by the action of cosmic rays. Pupil understands that when cosmic rays react with earth's atmosphere, they smash several different kinds of atoms in...
Radio carbon dating is used to determine the age of objects of animal or vegetable origin such as wood, charcoal etc. K. recalls

U. sees relationship

S. writes equation for nuclear reactions

Radio carbon dating is used to determine the age of objects of animal or vegetable origin such as wood, charcoal etc.

How it is formed?

Radio carbon dating is used to determine the age of objects of animal or vegetable origin such as wood, charcoal etc.

U. sees relationship

S. writes equation for nuclear reactions

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K. recalls

Radio carbon dating is used to determine the age of objects of animal or vegetable origin such as wood, charcoal etc.
additional C-14 is taken in and that within the plant body begins to decay without being replaced.

Pupil understands that measurements of the relative amounts of C-14 and C-12 in an organic archeological sample provides sensitive method of dating.

Radio isotopes can be used for different purposes in the medical field and this is known as radio therapy.

Do you know how a cancer patient is treated? Pupil says that radiation from a radioactive isotope is used in the treatment of cancer. Pupil understands that in the treatment of cancer Radiocobalt and radio gold are used. Also, pupil understands that Radio isotopes are used to diagnose the nature of blood circulatory disordfers, defects of bone metabolism, to locate tumors etc. Pupil also understands that Radio iodine (I -131) is employed to...
Radio isotopes help to raise crop-yields. The radiations emitting from radio isotopes are used for testing of materials. Also certain perishable cereals exposed to radiations remain fresh beyond their normal life span.

Also radio isotopes are widely used for sterilization of surgical instruments.

From all the above explanations pupil understands that radio isotopes can be used for medical purposes and this type application of radioactivity in medicine is termed as radiotherapy. Pupil defines radiotherapy.

BBW: Application in medical field: Radiotherapy.

What is the use of radio isotopes in the field of agriculture? Pupil says that the radio isotopes help to raise crop-yields. The radiations emanating from radio isotopes are used for testing of materials. Vegetables and food items coming from large distances remain fresh after 2 or 3 weeks. Why? Pupil says that certain perishable cereals remain fresh beyond their normal life span.
Using gamma rays the faults or cracks in metallic casting or welds in oil pipelines can be detected.

U explains

Exposed to radiations remain fresh beyond their normal life span. Very small doses of radiation prevent sprouting and spoilage of onions, potatoes, and gram.

BBW: application in the field of agriculture.

Can you say some of the applications in the field of industry? Pupil says gamma rays emitting from radio isotopes are used to identify the faults or cracks in metallic casting or welds in oil pipelines.

Ripil understands that when rays passing through the metal are caught on a photographic film and thus the faults are identified.

Application: Industry

From all the above mentioned explanations pupil understands that as tracers, radioisotopes have found wide application in agriculture, medicine, industry and research.

What are the uses of radio isotopes in the field of agriculture?

What are the uses of radio isotopes in the field of industry?
7. Review

1. Name the radio isotope that is used in the treatment of cancer?

2. What is meant by radiocarbon dating?

3. What is the principle behind radio carbon dating?

8. Assignment

A wood specimen from an archeological find shows a $^{14}_{6}C$ activity of 3.8 counts per minute per gram of carbon. Calculate the age of the specimen (t$_{1/2}$ for $^{14}_{6}C$ is 5770 years and a freshly cut wood gives 15.3 counts per minute of per gram of carbon).
APPENDIX: III

ACHIEVEMENT TESTS IN CHEMISTRY
ACHIEVEMENT TEST IN CHEMISTRY

Class : VII
Unit : Different Types of Chemical Reactions.

Time : 45'
Marks : 25

NOTE : (a) Detailed instructions have not been given with every question. The student should simply select the choice which seems to him correct or most nearly correct.

(b) Each question carries one mark.

(c) Choose the correct or most correct answer by writing the letter of your choice on the response sheet.

(d) For the assertion/reason type questions mark 'A' 'B' 'C' or 'D' corresponding to the most accurate statement

1. When steam is allowed to cool, it changes to water. This is an example for ———
   (A) Chemical Change
   (B) Catalysis
   (C) Neutralisation
   (D) Physical Change.

2. NaOH + HCl → NaCl + ———
   (A) H₂
   (B) H₂O₂
   (C) H₂O
   (D) O₂

3. Formation of day and night is an example for ———
   (A) Physical change
   (B) Chemical change
   (C) Energy change
   (D) Temperature change

4. AgNO₃ + NaCl → AgCl + NaNO₃. This is an example for ———
   (A) Double decomposition.
   (B) Simple combination
   (C) Simple displacement
   (D) Simple decomposition
5. \(2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2\). This is an example for
   (A) Simple Combination
   (B) Simple Composition
   (C) Simple Displacement
   (D) Double Decomposition

6. The reaction, simple displacement can be noted as
   (A) \(A + B \rightarrow AB\)
   (B) \(A + Bx \rightarrow Ax + B\)
   (C) \(AB \rightarrow A + B\)
   (D) \(Ax + By \rightarrow Ay + Bx\)

7. When Hydrogen sulphide gas passes through Copper sulphate solution,—
   (A) A white precipitate is formed
   (B) A black precipitate is formed
   (C) Hydrogen gas is evolved
   (D) Sulphur is precipitated

8. The law of conservation of mass states—
   (A) Matter can be destroyed
   (B) Energy can be created
   (C) Matter cannot be created
   (D) Energy can be destroyed

9. A permanent change which involves the formation of a new substance is known as —
   (A) Physical change
   (B) Neutralisation
   (C) Simple Combination
   (D) Chemical Change.

10. The compound that is formed, when a piece of magnesium ribbon is ignited is —
    (A) Magnesium Chloride
    (B) Magnesium Hydride
    (C) Magnesium Oxide
    (D) Magnesium Carbonate

11. Which of the following is not a feature of physical change.
    (A) Temporary Change
    (B) Permanent change
    (C) Ready reversibility
    (D) Non-production of new substance.

12. When acidified water is electrolysed, the products formed are
    (A) \(\text{H}_2\) and \(\text{N}_2\)
    (B) \(\text{H}_2\) and \(\text{O}_2\)
    (C) \(\text{H}_2\) and \(\text{H}_2\text{O}\)
    (D) \(\text{O}_2\) and \(\text{H}_2\text{O}\)
13. When HgO is heated, the products formed are——
   (A) HgO₂+O₂  
   (B) Hg+O₂  
   (C) Hg  
   (D) Hg+HgO₂
14. The white precipitate formed when silver nitrate is added to sodium chloride is that of ———
   (A) Sodium Nitrate  
   (B) Sodium Hydroxide  
   (C) Silver Chloride  
   (D) Silver Hydroxide
15. When Zinc is treated with dilute sulphuric acid, the gas obtained is ———
   (A) O₂  
   (B) H₂  
   (C) CO₂  
   (D) N₂
16. Mg. burns in Oxygen is an example for
   (A) Simple Combination  
   (B) Simple Displacement  
   (C) Double Decomposition  
   (D) Simple Decomposition
17. 2Pb(NO₃)₂ → 2PbO + 4NO₂ +O₂ is an example for
   (A) Simple Combination  
   (B) Simple Displacement  
   (C) Double Decomposition  
   (D) Simple Decomposition
18. Which of the following is a representation for simple decomposition,
   (A) A+B→AB  
   (B) AB→A+B  
   (C) AX+B→A+Bx  
   (D) Ax+By→AY+BX
19. Sulphur burns in O₂ to form Sulphur dioxide is an example for
   (A) Simple Combination  
   (B) Simple Displacement  
   (C) Double Decomposition  
   (D) Simple Decomposition
20. Which of the following reactions represents double decomposition:
   (A) 2H₂O → 2H₂+O₂  
   (B) S+O₂→SO₂  
   (C) Fe+CuSO₄ → FeSO₄+Cu  
   (D) BaCl₂+Na₂SO₄ → BaSO₄+2NaCl
21. \( Ax+By \rightarrow AY+BX \) represents,
   (A) Simple Combination  
   (B) Simple Displacement  
   (C) Double Decomposition  
   (D) Simple Decomposition

22. The change that is observed when sodium chloride is treated with silver nitrate is the formation of a ________
   (A) White precipitate  
   (B) Black precipitate  
   (C) gas  
   (D) Yellow precipitate.

23. Statement I. In double decomposition the molecules of two compounds exchange their component parts.
   Statement II. In simple displacement, the atoms of an element replace the atoms in another molecule.
   (A) Both the statements I and II are correct.
   (B) Both the statements I and II are wrong.
   (C) Statement I is correct, but statement II is wrong.
   (D) Statement I is correct, but statement II is wrong.

24. Statement I: In simple decomposition the molecules of one substance break up to form different molecules.
   Statement II: In simple decomposition, the molecules of two or more substances combine to form a single substance.
   (A) Both the statements I and II are correct.
   (B) Both the statements I and II are wrong.
   (C) Statement I is correct, but statement II is wrong.
   (D) Statement II is correct, but statement I is wrong.
25. **Statement I**: Physical change is a temporary change

**Statement II**: New substances are formed in chemical changes.

(A) Both the statements I and II are correct.

(B) Both the statements II and I are wrong.

(C) Statement I is correct, but statement II is wrong

(D) Statement I is wrong, but statement II is correct.
ACHIEVEMENT TEST

Class : IX                                           Time : 45'
Unit : Oxidation Reduction and Redox Reactions       Marks : 25

NOTE : (a) Detailed instructions have not been given with every question. The students should simply select the choice which seems to him correct and most nearly correct.
(b) Each question carries one mark
(c) Choose the correct or most correct answer by writing the letter of your choice on the response sheet.
(d) For the assertion/reason type questions mark ‘A’, ‘B’, ‘C’ or ‘D’ corresponding to the most accurate statement.
(e) For the matching type questions write the correct answer against each item in the question.

1. The substance which supplies Oxygen to another substance in a chemical reaction is ———
   (A) Catalyst                      (B) Reducing agent
   (C) Neutralising Agent            (D) Oxidising agent

2. \(2\text{CuO} + \text{C} \rightarrow 2\text{Cu} + ———
   (A) \text{CuC}                     (B) \text{CO}
   (C) \text{CO}_2                    (D) \text{CuC}_2

3. Reduction is a chemical reaction in which a substance ———
   (A) Loses Hydrogen                (B) Loses Oxygen
   (C) Gains Oxygen                  (D) Loses Carbon
4. In a reduction reaction, Oxidising agent is ——
   (A) Reduced  (B) Neutralised  
   (C) Decomposed (D) Oxidised

5. \(2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}\) represents
   (A) Neutralisation  (B) Reduction  
   (C) Redox Reaction (D) Oxidation

6. In Oxidation reaction, electrons are ——
   (a) Added  (B) Removed  
   (C) Doubled (D) Neither gained or lost

7. The Oxidation state of H in \(\text{H}_2\text{O}\) is ——
   (A) +1  (B) +2  
   (C) -1  (D) -2

8. The Oxidation state of an element is said to be the number of electrons ——
   (A) Lost  (B) Gained  
   (C) Lost or Gained (D) Doubled

9. In covalent compounds electrons are ——
   (A) Gained  (B) Lost  
   (C) Shared (D) Doubled

10. The combining capacity of an element is termed as ——
    (A) Oxidation  (B) Reduction  
     (C) Neutralisation (D) Valency

11. The Oxidation number of N in \(\text{HNO}_3\) is ——
    (A) +5  (B) +1  
    (C) +3  (D) +6
12. The Oxidation number of a compound is ——
   (A) +2  (B) +1
   (C) 0    (D) -2

13. If the Oxidation state of an element increases, the element is said to be
   (A) Reduced  (B) Oxidised
   (C) Decomposed (D) Neutralised

14. The Oxidiser in the reaction, Mg+H₂O → MgO+H₂ is ——
   (A) Mg  (B) H₂O
   (C) MgO (D) H₂

15. Manganese exhibits a valency of —— in Manganese Chloride
   (A) +2  (B) -2
   (C) 4    (D) -4

16. The ability to attract electrons by atoms is called ——
   (A) Valency  (B) Oxidation
   (C) Electronegativity (D) Electropositivity

17. The Combined process of Oxidation and reduction is known as
   (A) Catalysis  (B) Neutralisation
   (C) Decomposition (D) Redox Reaction

18. Cl⁺ → Cl⁻. This reaction is an example for ——
   (A) Oxidation  (B) Redox Reaction
   (C) Reduction  (D) Double Decomposition

19. Oxidiser is a substance whose atoms ——
   (A) Lose electrons  (B) Gain electrons
   (C) Share electrons (D) Transfer electrons
20. \([\text{Na}] + [\text{Cl}] \rightarrow \text{Na}^+ + \text{Cl}^-\) This is an example for

2,8,1 2,8,7 2,8 2,8,8

(A) Oxidation  (B) Reduction
(C) Redox reaction  (D) Covalent bonding.

21. --- is not a gas at ordinary temperature

(A) Carbon  (B) Nitrogen
(C) Hydrogen  (D) Carbon dioxide

22. If a glassrod dipped in clear lime water is shown at the mouth of the test tube, it turns milky showing that the gas evolved is

(A) Carbon dioxide  (B) Nitrogen
(C) Hydrogen  (D) Carbon monoxide

23. Statement I : - Magnesium combines with Oxygen to form Magnesium Oxide

Statement II : - In a reaction usually an oxidising agent is reduced.

(A) Both statements are correct
(B) Both statements are wrong
(C) Statement I is correct but statement II is wrong
(D) Statement I is wrong but statement II is correct.

24. Statement I:- If the oxidation state decreases .it is said to be reduced

Statement II : - The Oxidation state of Copper in \(\text{CuO}\) decreases from +1 to zero

(A) Both statements are correct
(B) Both statements are wrong
(C) Statement I is correct but statement II is wrong
(D) Statement I is wrong but statement II is correct.
25. Statement I: - Transition elements show variable valency

Statement II: - The electrons of the outermost and penultimate shells take part in chemical reactions in transition elements.

(A) Statement I is correct but statement II is wrong
(B) Statement I is wrong but statement II is correct.
(C) Both statements are correct and Statement II is the reason for statement I
(D) Both statements are correct but are not related as cause and effect.
ACHIEVEMENT TEST IN CHEMISTRY

Class : X 
Unit : Chemical Kinetics.

Time : 45' 
Marks : 25

NOTE : (a) Detailed instructions have not been given with every questions. The student should simply select the choice which seems to him correct or most nearly correct.
(b) Each question carries one mark.
(c) Choose the correct or most correct answer by writing the letter of your choice on the response sheet.
(d) For the assertion/reason type questions mark 'A' 'B' 'C' or 'D' corresponding to the most accurate statement.
(e) For the matching type questions write the correct answer against each item in the question.

1. Nitrogen combines with hydrogen to form ——
   (A) Nitride                  (B) Ammonium Hydroxide
   (C) Ammonia                  (D) Nitroxide

2. In the decomposition of hydrogen peroxide, the catalyst used is ——
   (A) Platinum                (B) Manganese Dioxide
   (C) Vanadium Pentoxide       (D) Iron

3. In the formation of hydrogen iodide, the activated complex formed is ——
   (A) H\textsubscript{2}I              (B) H\textsuperscript{+}I\textsuperscript{+}
   (C) H\textsubscript{2}I\textsubscript{2}\textsuperscript{+}  (D) H\textsuperscript{2+}I\textsubscript{2}\textsuperscript{+}
4. The potential energy of activated complex is
   (A) More than the reactants
   (C) Same as the reactants
   (B) Same as the products
   (D) Lesser than the reactants

5. When the temperature increases, the velocity of the colliding molecules
   (A) Decreases
   (C) Increases
   (B) Does not change
   (D) Increases first and then decreases

6. The amount of ammonia formed will increase with increase in
   (A) Temperature
   (C) Pressure
   (B) Energy
   (D) Catalyst concentration

7. \( K_2S_2O_8 + 2KI \rightarrow 2K_2SO_4 + \) ——
   (A) S
   (C) I_2
   (B) O_2
   (D) K

8. \( H_2 + I_2 \rightarrow \) ——
   (A) H_2I_2
   (C) 2HI
   (B) 2H_2I
   (D) HI_2

9. The minimum amount of energy required for a chemical reaction is
   (A) Potential Energy
   (C) Threshold Energy
   (B) Collission Energy
   (D) Kinetic Energy

10. \( 2Na + 2H_2O \rightarrow 2NaOH + \) ——
    (A) O_2
    (C) NaH
    (B) H_2
    (D) H_2O_2

11. \( Mg + 3HCl \rightarrow \) ——
    (A) MgCl_2 + H_2
    (C) MgCl_2 + H_2Cl
    (B) MgCl_2 + H_2
    (D) MgH_2 + Cl_2
12. When sodium chloride is added to silver nitrate solution, ——
   (A) It will darken
   (B) An yellow precipitate is formed
   (C) A white precipitate is formed
   (D) It turns milky

13. Chemical kinetics deals with
   (A) Rate of reactions
   (B) Effect of catalysts
   (C) Substances
   (D) Manufacture of chemicals

14. The reaction rate increases with ——
   (A) Increase in concentration of reactants
   (B) Decrease in concentration of reactants
   (C) Increase in concentration of catalysts
   (D) Decrease in concentration of catalysts

15. The combination of hydrogen and iodine at room temperature is ——
   (A) Fast
   (B) Slow
   (C) Moderate
   (D) Explosive

16. The factor that does not influence reaction rate
   (A) Pressure
   (B) Temperature
   (C) Catalyst
   (D) Concentration
   (E) None of the above

17. When the particles reacting are small
   (A) The area of surface of contact will be less
   (B) The area of surface of contact will be more
   (C) The concentration of the reactants increase
   (D) The concentration of the reactants decrease

18. The unit of the rate of reaction is
   (A) Mole/litre
   (B) Gram/cm3
   (C) Mole/second
   (D) Joules/second
19. Effective Collission produce ——
   (A) Energy                                (B) Increased pressure
   (C) Activated Complex                      (D) Catalyst

20. The activated complex has ————
   (A) Low potential energy                   (B) High concentration
   (C) More potential energy                   (D) Low concentration

21. In the manufacture of sulphuric acid, the catalyst used is
   (A) Iron                                  (B) Platinum
   (C) Vanadium pentoxide                     (D) Hydrogen peroxide

22. Statement I : Increase in the concentration of a reactant produces an increase in the reaction rate.
   Statement II : Increase in the frequency of collisions results in an increase in the reaction rate.
   (A) Both statements are correct
   (B) Both statements are wrong
   (C) Both statements are correct and are related as cause and effect
   (D) Both statements are correct and but are not related as cause and effect

23. Statement I : The rate of reaction depends on the kinetic energy of the molecules
   Statement II : To react the molecules must not collide
   (A) Both statements are correct
   (B) Both statements are wrong
   (D) Statement I is correct, but statement II is wrong
   (C) Statement I is wrong, but statement II is correct.

24. Statement I : The speed of a reaction depends on the amount of reactants consumed.
Statement II: When Hydrogen peroxide decomposes, Hydrogen and Oxygen are formed.

(A) Both statements are correct
(B) Both statements are wrong
(C) Statement I is correct but statement II is wrong
(D) Statement I is wrong but statement II is correct

25. Statement I: Mole can be unit of quantity of reactants and products in a chemical reaction

Statement II: Rate of reaction is the quantity of products obtained in unit time.

(A) Both statements are correct
(B) Both statements are wrong
(C) Statement I is correct, but statement II is wrong
(D) Statement I is wrong, but statement II is correct.
ACHIEVEMENT TEST IN CHEMISTRY

Class : XI
Unit : Surface Chemistry.

Time : 45'
Marks : 25

NOTE : (a) Detailed instructions have not been given with every questions. The student should simply select the choice which seems to him correct or most nearly correct.
(b) Each question carries one mark.
(c) Choose the correct or most correct answer by writing the letter of your choice on the response sheet.
(d) For the assertion /reason type questions mark 'A' 'B' 'C' or 'D' corresponding to the most accurate statement.
(e) For the matching type questions write the correct answer against each item in the question.

1. The migration of colloidal particles under the influence of an electric field is correctly known as ______
   (A) Cataphoresis  (B) Electrophoresis
   (C) Electrodialysis  (D) Electrodispersion

2. When a freshly precipitated substance is converted into a colloidal solution with the help of a third substance, the process is known as ______
   (A) Coagulation  (B) Peptization
   (C) Electro dispersion  (D) Dialysis

3. The emulsion is a colloidal system consisting of ______
   (A) Two liquids  (B) Two solids
   (C) One gas and one solid  (D) One gas and one liquid.
4. In which of these processes is platinum used as a catalyst?
   (A) Oxidation of Ammonia to form Nitric Acid   (B) Hardening of oils
   (C) Production of synthetic rubber   (D) Synthesis of methanol

5. The effect of a catalyst in a chemical reaction is to change the ——
   (A) Equilibrium concentration   (B) Activation energy
   (C) Heat of reaction   (D) Final products

6. Which one of the following statements is universally correct?
   (A) A catalyst remains unchanged at the end of the reaction
   (B) A catalyst takes part in the chemical reaction
   (C) A catalyst physically changes at the end of the reaction
   (D) A catalyst can induce chemical reaction

7. Difference between colloids and crystalloids is of ——
   (A) Diameter of the particle   (B) Particle size
   (C) Radius of the particle   (D) The first is soluble and second is in soluble

8. When a strong beam of light is focussed on a colloidal solution the path of the beam is visible. This phenomenon is due to ——
   (A) Absorption of light by particles
   (B) Reflection of light by particles
   (C) Scattering of light by particles
   (D) The energy change in the particles

9. The zig-zag motion of colloidal particles is due to the ——
   (A) Small size of colloidal particles
   (B) Large size of colloidal particles
   (C) The conversion of potential energy into kinetic energy
   (D) The unequal bombardment of colloidal particles by the molecules of dispersion medium.
10. **Statement I**: In physical adsorption easily liquifiable gases are adsorbed more easily.

**Statement II**: In chemical adsorption easily liquifiable gases are not adsorbed.

(A) Both the statements I and II are correct.
(B) Both the statements I and II are wrong.
(C) Statement I is correct but statement II is wrong.
(D) Statement I is not correct but statement II is correct.

11. Which one of the following reactions leads to the formation of a substance in the colloidal state?

(A) \( \text{Cu} + \text{HgCl}_2 \rightarrow \text{CuCl}_2 + \text{Hg} \)

(B) \( 2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C} \)

(C) \( 2\text{HNO}_3 + 3\text{H}_2\text{S} \rightarrow 3\text{S} + 4\text{H}_2\text{O} + 2\text{NO} \)

(D) \( \text{Cu} + \text{CuCl}_2 \rightarrow \text{Cu}_2\text{Cl}_2 \) (in the presence of excess of HCl)

12. An aerosol is a colloidal system consisting of ______

(A) A liquid dispersed in a solid
(B) A liquid dispersed in a gas
(C) A gas dispersed in a liquid
(D) A solid dispersed in a gas

13. Catalyst poisons (Temporary poisoning) act by ______

(A) Chemically combining with catalyst.
(B) Getting absorbed on the active centres on the catalyst's surface.
(C) Chemical combination with any one of the reactants.
(D) Coagulating the catalyst.

14. At very low pressures, the adsorption isotherm of a gas shows:

(A) A steady decrease in the amount of gas absorbed
(B) A steady increase in the amount of gas adsorbed.
(C) An increase in the amount of gas adsorbed first and then reaches a constant value.
(D) An increase in the amount of gas adsorbed reaches a constant value and then decreases.
15. The colloidal solution of gold prepared by different methods have different colours due to ———

(A) Difference in the size of colloidal particles.
(B) Fact that gold exhibits variable valency
(C) Different concentration of gold
(D) Presence of different types of foreign particles.

16. The stability of a lyophilic colloid is due to ————

(A) Charge on their particles.
(B) A layer of medium of dispersion on their particles.
(C) The smaller size of their particles
(D) The larger size of their particles.

17. Match the description statements in group X with the technical words mentioned in group Y

<table>
<thead>
<tr>
<th>GROUP X</th>
<th>GROUP Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher polymers in organic solvent.</td>
<td>Aerosol</td>
</tr>
<tr>
<td>Cellulose nitrate peptised by organic solvent.</td>
<td>Colloidion</td>
</tr>
<tr>
<td>A Colloidal system with liquid as dispersed phase and solid as dispersion medium.</td>
<td>Miscelle</td>
</tr>
<tr>
<td>Aluminosilicates used as a catalyst.</td>
<td>Zeolite</td>
</tr>
<tr>
<td></td>
<td>Sol</td>
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<td></td>
<td>Lyophilic sol</td>
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<td></td>
<td>Gem stone</td>
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</tbody>
</table>

18. **Statement**
Gelatin is used as an ingredient in the manufacture of icecream

**Reason**
Gelatin stabilise the colloid and prevent crystal growth.
(A) Both the statement and reason are true and are related as cause and effect.

(B) Both the statement and reason are true and but are not related as cause and effect.

(C) The statement is true but the reason is not an accepted fact.

(D) Both the statement and reason are false.

19. **Statement**
   When light passes through a sol its path becomes visible. **Reason**
   Colloidal particles are charged.

(A) Both the statement and reason are true and are related as cause and effect.

(B) Both the statement and reason are true but are not related as cause and effect.

(C) The statement is false but the reason is not an accepted fact.

(D) Both the statement and reason are false.

20. **Statement**
   The adsorption isobar for chemisorption shows an initial activation energy increase in \( \frac{x}{y} \) and then decreases. **Reason**
   Chemisorption requires some chemisorption shows an initial activation energy increase in \( \frac{x}{y} \) and then decreases.

(A) Both the statement and reason are true and are related as cause and effect.

(B) Both the statement and reason are true but are not related as cause and effect.

(C) Both the statement and reason are false.

(D) The statement is true but the reason is not an accepted fact.

21. **Statement I:** Digestion of fats in the intestine is aided by emulsification. **Statement II:** A little of the fat forms a sodium soap with alkaline solution of the intestine and this soap forms an emulsion with rest of the fat.

(A) Both the statements I and II are true and statement II is the correct explanation of the statement I.
22. **Statement I:** The heat of adsorption for chemisorption is greater than that of physical adsorption

**Statement II:** In physical adsorption, the adsorbate is held on a surface by weak vanderwaals forces but in chemisorption it is due to chemical bond forces.

(A) Both the statements are true and statement II is the correct explanation of statement I
(B) Both the statements are true but statement II is not the correct explanation of statement I
(C) Statement I is correct but statement II is false
(D) Statement I is not correct but statement II is correct.

23. **Statement I:** Water is not very good at wetting things particularly greasy things

**Statement II:** High surface tension of water and oil prevents water from wetting things.

(A) Both the statements are true and statement II is the correct explanation of the statement I
(B) Statement I and II are true, but they are not related as cause and effect
(C) Statement I is correct but statement II is not a universal truth
(D) Statement II is accepted as a universal truth but statement I is a false statement

24. **Statement I:** The quantity of an adsorbed gas increases with the surface area of the solid

**Statement II:** Highly active solids with large surface area are used as Catalysts.

(A) Statements I and II are true and statement I is the correct explanation of statement II
(B) Statements I and II are true and statement I is not the correct explanation of statement II
25. Statement I: Sols of metals are highly unstable and they are easily coagulated.

Statement II: In hyophobic sols there is not any attractive forces operating between the suspended particles and the dispersion medium.

(A) Both statements I and II are correct and can be related as cause and effect.
(B) Both statements I and II are correct and but they are not related as cause and effect.
(C) Statement I is correct but statement II is not correct.
(D) Statement I is not correct but statement II is correct.
ACHIEVEMENT TEST IN CHEMISTRY

Class : XI1
Unit : Nuclear Chemistry

Time : 45'
Marks : 25

NOTE : (a) Detailed instructions have not been given with every question, the students should simply select the choice which seems to him correct and most nearly correct.
(b) Each question carries one mark
(c) Choose the correct or most correct answer by writing the letter of your choice on the response sheet.
(d) For the assertion/reason type questions mark 'A', 'B', 'C' or 'D' corresponding to the most accurate statement.
(e) For the matching type questions write the correct answer against each item in the question.

1. A beta particle is ________
   (A) Helium nucleus (B) Hydrogen nucleus
   (C) Negatively charged particle (D) Proton

2. Out of the following the one which has no charge is ______
   (A) Gamma Rays (B) Beta Rays
   (C) Alpha rays (D) Cathode Rays

3. Gamma rays are ______
   (A) High energy electromagnetic waves (B) High energy electrons
   (C) High energy protons (D) Low energy electrons.
4. Which of the following is used in dating archeological findings?
   (A) $^{235}\text{U}$ 92  (B) $^{14}\text{C}$ 6  (C) $^{1}\text{H}$ 1  (D) $^{56}\text{Fe}$ 26

5. A device used for the measurement of radioactivity is a ______
   (A) Mass spectrometer  (B) Cyclotron
   (C) Nuclear Reactor  (D) G.M.Counter

6. The equation $^{6}\text{Li} + ^{2}\text{H} \rightarrow ^{2}\text{He} + \text{energy}$ represents ______
   (A) Synthesis of helium  (B) Transmission of element
   (C) Fusion reaction  (D) Nuclear Fission

7. The reaction $^{235}\text{U} + ^{1}\text{H} \rightarrow ^{141}\text{Ba} + ^{92}\text{Kr} + ^{2}\text{He} + ^{0}\text{n}$ represents ______
   (A) Nuclear Fission  (B) Nuclear fusion
   (C) Artificial radio activity  (D) Artificial disintegration

8. In a fission reaction nucleus of an element ______
   (A) Loses only some elementary nuclear particles from another nucleus
   (B) Captures some elementary nuclear particles from another nucleus
   (C) Breaks up into several smaller nuclei
   (D) Breaks up into two smaller nuclei with the loss of some elementary nuclear particles.

9. The difference in the isotopes of $^{35}\text{Cl}$ and $^{37}\text{Cl}$ is in the ______
   (A) Number of electrons  (B) Number of neutrons
   (C) Number of protons  (D) Atomic number

10. When a radio active substance is subjected to a vacumm, the rate of disintegration per second ______
    (A) Increases considerably  (B) Increases only if products are gaseous
     (C) Is not affected  (D) Suffers a slight decrease.
11. On bombarding $^{14}\text{N}$ with alpha particles the nuclei of the product formed after the release of a proton will be ________

(A) $^{17}\text{O}$  (B) $^{17}\text{B}$  (C) $^{18}\text{F}$  (D) $^{18}\text{O}$

12. An element with atomic number 84 and mass number 218 loses one alpha particle and two Beta particles in three successive stages, the resulting element will have,

(A) Atomic number 84 and mass number 214
(B) Atomic number 82 and mass number 214
(C) Atomic number 84 and mass number 218
(D) Atomic number 82 and mass number 218

13. If Uranium (mass number 238, atomic number 92) emits alpha particle the product has mass number and atomic number.

(A) 234 + 90  (B) 234 + 92
(C) 238 + 90  (D) 236 + 90

14. When $^{226}\text{Ra}$ emits an alpha particle, a new element is formed. In which of the groups in periodic table does it fall

(A) Ill group  (B) Zero group
(C) IV group  (D) II group

15. Positron emission results from the transformation of one nuclear proton into an electron. The isotope thus produced possesses ________

(A) Same mass number  (B) Nuclear charge higher
(C) Intense radioactivity  (D) No radio activity.

16. The $\beta$-decay of $^{24}\text{Na}$ produces an isotope of ________

(A) Mg  (B) N
(C) Al  (D) Ne
17. If $^{235}\text{U}$ is bombarded with neutrons, atom will split into ________

(A) Sr + Pb  
(B) Cs + Rb  
(C) Kr + Cd  
(D) Ba + Xe

18. Match the symbolic items in group X with the technical word in Group Y.

<table>
<thead>
<tr>
<th>GROUP X</th>
<th>GROUP Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiotherapy</td>
<td>Cancer</td>
</tr>
<tr>
<td>C-14</td>
<td>Man made radio isotope</td>
</tr>
<tr>
<td>I-131</td>
<td>Archeological dating</td>
</tr>
<tr>
<td>D$_2$O</td>
<td>Moderator</td>
</tr>
<tr>
<td>P - 30</td>
<td>Hyper thyroidism</td>
</tr>
</tbody>
</table>

19. Statement
Control rods made up of boron, steel or cadmium are used in nuclear reactors.

Reason
Moderators slow down the neutrons and increases the efficiency of their capture to bring about a fission reaction.

(A) Both the statement and reason are true and are related as cause and effect.
(B) Both the statement and reason are true but are not related as cause and effect.
(C) The statement is false but the reason is an accepted fact.
(D) Both the statement and reason are false.

20. Statement I
Fusion reaction requires high temperature.

statement II
There is a great electrostatic repulsion between the fusing nuclei.
21. Statement I

Neutrons can be used as projectiles in artificial radio activity.

Statement II

Neutrons are not repelled by the positive charge of the target nucleus.

(A) Both the statements I and II are correct and are related as cause and effect.
(B) Both the statements I and II are correct but are not related as cause and effect.
(C) Statement I is correct but statement II is not correct.
(D) Statement I is false but statement II is correct.

22. Large energy released in an atomic bomb's explosion is mainly due to:

(A) Conversion of heavier nucleus to lighter nuclei.
(B) Products having a lesser mass than initial substance.
(C) Release of neutrons.
(D) Release of protons.

23. A radio active isotope having a half life of three days was received after 12 days. It was found that there were 3g of the isotope in the container. The initial weight of the isotope when packed was __________

(A) 12g  (B) 24g
(C) 36g  (D) 48g

24. The half life of radio active element is 50 days. How long will it take for its activity to reduce to 1/4 of its original value?

(A) 25 days  (B) 50 days
(C) 75 days  (D) 100 days
25. When the quantity of a radio active substance is increased two times, the number of atoms disintegrating per unit time is ________

(A) doubled
(B) increased by square of two
(C) Increased, but not to a great extent
(D) Not affected.
A TEST OF SCIENTIFIC ATTITUDE FOR SECONDARY STUDENTS-DRAFT FORM FOR THE PILOT TEST
A TEST OF SCIENTIFIC ATTITUDE FOR SECONDARY STUDENTS

(DRAFT FORM FOR THE PILOT TEST)

Some statements regarding science and concerned activities are given below. Please read each statement carefully and make a mark (x) some where along each line in the column provided which best represents your own feelings about each statement.

Note:  strongly agree (SA)  
       Agree (A)  
       Undecided (U)  
       Disagree (D)  
       Strongly disagree (SD)

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement</th>
<th>SA</th>
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<th>U</th>
<th>D</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Many of the scientific theories of the past have been discarded or modified as they have been found inadequate. However, the theories and laws of modern science are essentially accurate and are likely to endure in their present form.</td>
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<td>2.</td>
<td>Science is responsible for much of the evils in the world today because of its application to the production of weapons of war.</td>
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<td>3.</td>
<td>Scientist is a highly intelligent man characterised as almost a genius, dedicated patient, devoted and having other desirable traits.</td>
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</table>
1. Scientists often make errors and waste much time exploring "blind alleys".

2. The knowledge given by the scientist pave the way for technological development and the same in its turn provide for improvement in the quality of life.

3. It is very essential to study it scientifically to understand how the chain reaction of nuclear fission occurs in atom bomb.

4. The anger of God showers upon the mankind in the form of famine, earthquake, floods etc.

5. Motion pictures, radio and television programmes always help the promotion of scientific knowledge.

6. The invention of electronic instruments has done much harm to modern life.

7. It is interesting to conduct research in science.

8. It is preferable to conduct art competition in the place of science competitions.

9. It is necessary to believe in a cause for the occurrence of any event that is happening.

10. It is good to avoid the use of carbon powder for cleaning teeth.
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<tr>
<th>No.</th>
<th>Statement</th>
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<th>SD</th>
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<td>14.</td>
<td>Man can one day free the world from diseases.</td>
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<td>15.</td>
<td>Science can control all forces of nature.</td>
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<td>16.</td>
<td>Science fails in giving life to the dead.</td>
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<td>17.</td>
<td>It will never be possible for man to prevent cancer.</td>
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<td>18.</td>
<td>In order to forecast the future of an individual it is not good to rely on the horoscope.</td>
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<td>19.</td>
<td>Scientific research should be planned and directed to meet the immediate demands of the society.</td>
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<td>20.</td>
<td>The real advances in science consists of the production of such useful things as radios, automobiles and drugs.</td>
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<td>21.</td>
<td>The observations and measurements involved in scientific experiments are seldom erroneous and interpretation of results involves little chance of error.</td>
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<td>22.</td>
<td>The one primary purpose of science in human society (is to increase man's control over nature) and to increase his ability to use natural resources so as to make life more comfortable.</td>
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</tbody>
</table>
23. Science is a difficult subject and can really be pursued profitably only by those of better than average ability.

24. The exactness and impartiality of the scientist in performing and reporting laboratory experiments is probably due in large part to the knowledge that his work will be examined by other competent workers rather than to the fact that scientists are more impartial and objective than other men.

25. A scientist is likely to be unbiased and objective not only in his own field of work but in other areas as well.

26. The great scientists of the past often made use of lucky guesses.

27. History will show that when scientists make mistakes they are quick to admit their error when these errors are pointed out to them.

28. I won't believe even if others will prove that there is no God.

29. I will try to get a job in the field of science only if I don't get one in any other field.

30. Science and its inventions created a lot of harm to the mankind.
1. If the teacher says, it is possible to find out the age of archeological findings one should believe it.

2. It was with the blessing of god that man could land safely on other planets.

3. It is better to study nuclear physics to understand the theories of nuclear chemistry.

4. It is a truth that when snakes bite a person the snake will die if the person used to eat the leaves of 'Vep'.

5. During night at some places it can be seen that fire is burning and this is due to the presence of evil spirit at that surroundings.

6. It is good to use 'black magic' to cure diseases.

7. Persons who had an unnatural death visit their close friends and relatives in a disembodied form.

8. The reembodiment of soul in successive human vehicle is to be accepted as a universal truth.

9. I won't believe even if scientists prove with sufficient evidence that there is life after death.
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<th>No.</th>
<th>Statement</th>
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<tbody>
<tr>
<td>40</td>
<td>I am ready to reject my concept if it is proved through experiment.</td>
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<tr>
<td>41</td>
<td>When there is doubt about the influence of a catalyst in chemical reaction, an experiment should be conducted in using the catalyst.</td>
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<td>42</td>
<td>I am very much interested in exhibitions based on scientific and technological subjects.</td>
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<tr>
<td>43</td>
<td>I believe in God only because of the fact that science could not be able to give life to a dead.</td>
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<tr>
<td>44</td>
<td>It is not advisable to follow false means in research to arrive at right results.</td>
</tr>
<tr>
<td>45</td>
<td>When there is doubt about the result of a research investigation it is better to repeat the experiment through the right track to clear it.</td>
</tr>
<tr>
<td>46</td>
<td>In order to know more about evil spirits, it is better to approach persons who handle 'black magic'</td>
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<tr>
<td>47</td>
<td>The positions of the stars at the time of birth are responsible for all those events happening in our lives.</td>
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<tr>
<td>48</td>
<td>There is no harm in changing the results of our observation to get correct result in scientific investigations.</td>
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<tr>
<td>No.</td>
<td>Statement</td>
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<tr>
<td>49.</td>
<td>It is better to change our belief if it is proved to be wrong.</td>
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<tr>
<td>50.</td>
<td>The garden lizard appears red at some time since it can change the colour of its body according to the surroundings.</td>
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</tbody>
</table>
APPENDIX: V

A TEST OF SCIENTIFIC ATTITUDE FOR SECONDARY STUDENTS
(FINAL FORM)
A TEST OF SCIENTIFIC ATTITUDE FOR SECONDARY STUDENTS

1. Prepare to conduct the test of scientific attitude for secondary students. Following are the objectives:
   (a) To assess the scientific attitude of the students.
   (b) To identify the areas where the students need improvement.
   (c) To enhance the students' understanding of scientific concepts.

2. The test consists of 20 questions, each carrying one mark. The questions are designed to assess the students' knowledge of:
   (a) Basic scientific principles.
   (b) Scientific method.
   (c) Scientific equipment.

Prepared by BeeHive Digital Concepts Cochin for Mahatma Gandhi University Kottayam
3. സ്കൂൾ പാട്ടുകാർഡുകൾക്കാരെ കെട്ടിവരണ്ടും. ഉദ്യോഗസമാധാനം
ഒനു പഠിക്കുന്നവർ ലക്ഷ്യങ്ങളിന് താഴ്വരയില്ലാത്തതും.
4. ചോദ്യം: കുട്ടികൾ കാഴ്ചപ്പാട് ചെയ്യുന്നതോടനുബന്ധം അവരുടെ ക്ഷേത്രം പിന്തുണയ്ക്കുകയോ മാത്രമെ നടത്തി വന്നുകൊണ്ടോ?
5. സാംസ്കാരികമാണ്. പണികഴിപ്പിച്ചെടുക്കുക എന്നതു എന്താണെങ്കിൽ അങ്ങനെയാണ്. അതോടെ അർത്ഥം കാണിക്കാം.
6. സാമൂഹികത മെയ്ൻ പാസഫീൽഡുകളെ സാമൂഹികസമ്മാനവും കാണിക്കുക.
7. കാര്യമേളയും സാമൂഹികപരിഷ്കരണവും ചെയ്യുന്ന പദവി എന്താണ് മാത്രമേ മാത്രമേ പ്രായപ്പെടുന്നതും
8. സമാപ്തികമായി സ്കൂൾപാട്ടുകാർഡുകൾ പാട്ടുകാർഡുകൾ നടത്തുന്നു. ഇവിടത്തെ ഭരണമാരും അന്നുമായിരിക്കും.
9. സാമൂഹികപരിഷ്കരണമാണ്. സ്കൂൾപാട്ടുകാരിക്ക്, ജനങ്ങൾ സാമൂഹികപരിഷ്കരണമാണ് സാമൂഹികപരിഷ്കരണമാണ്.
10. സിസ്റ്റം തെളിയിച്ച് എന്തെങ്കിലും ഹിറ്റിൽ ഇത് സാമൂഹികപരിഷ്കരണമാണ്.
11. സാമൂഹികപരിഷ്കരണം തെളിയിക്കുന്നു. സ്കൂളും സാമൂഹിക്കോശം അതുപോലെ പിന്തുണയുള്ളു. സ്കൂളിനും പരിഷ്കരണവും സാമൂഹികപരിഷ്കരണം.
12. പുനർനിർമ്മാണം. സാമൂഹികപരിഷ്കരണം അവകാശം പാടിത്തുക. മാത്രമേ മാത്രമേ പ്രസ്തുതമാണ്
13. സാമൂഹികപരിഷ്കരണം കൊത്തിയില്ല. സാമൂഹികപരിഷ്കരണം തെളിയിക്കുന്നവർ പലകൊണ്ട് അവകാശം നൽകുന്നു. മാത്രമേ മാത്രമേ പ്രസ്തുതമാണ്.
15. സംസ്കാരം പാടു രാസാപ്പെടുന്ന കാഴ്ച്ചയുടെ കാണ്ഡത്തിൽ ഭാവിയെ സാക്ഷ്യിക്കുന്ന വിശിഷ്ടമായ വസ്തുമായി രാസാപ്പെടുന്ന കാഴ്ച്ചയുടെ ഭാവി രൂപം പ്രാപ്തമാക്കാൻ സാധ്യതയുണ്ടാകും.

16. സംസ്കാര ഉത്തരവും സംസ്കാരം ആളുകൾ മുഖ്യമായി അഭിമുഖീകരിക്കുന്ന ചെറുതിനു അനുസ്വർണ്ണ ഭാവിയും പ്രാപ്തമായിരിക്കുന്ന ഉത്തരവും പ്രാപ്തമാക്കാൻ സാധ്യതയുണ്ടാകും.

17. ഭാഗ്യത്തിന്റെ സാമ്പത്തിക സ്രോതസ്സ് ആൽട്ടോമാറ്റഡ് സ്ഥലത്തിൽ പ്രതിഭാവിക്കുന്ന ഭാഗ്യസ്രോതസ്സിന്റെ ഭാഗ്യത്തിന് പ്രാപ്തപ്പെടുന്നത് ഭാഗ്യാവശ്യമായതിന്റെ ഭാഗികവിശേഷതയാണ്.

18. അന്തരീക്ഷത്തിന്റെ ഭാഗ്യസ്രോതസ്സിൽ പ്രതിഭാവിക്കുന്ന ഭാഗ്യസ്രോതസ്സും ഭാഗ്യത്തെ അന്തരീക്ഷത്തിന്റെ ഭാഗികവിശേഷതയാണ്.

19. ഭാഗ്യത്തിന്റെ പ്രതിഭാവിക്കുന്ന ഭാഗ്യസ്രോതസ്സും പ്രാപ്തമായ ഭാഗ്യസ്രോതസ്സും അതിന്റെ ഭാഗികവിശേഷതയാണ്.

20. ഭാഗ്യാവശ്യമായ ഭാഗ്യസ്രോതസ്സിന്റെ അവസ്ഥയിൽ അതിന്റെ ഭാഗികവിശേഷത പ്രാപ്തമാകുകയും ഉപയോഗിക്കാം.

21. ഭാഗ്യസ്രോതസ്സിൽ പ്രതിഭാവിക്കുന്ന ഭാഗ്യാവശ്യമായ ഭാഗ്യസ്രോതസ്സിന്റെ ഭാഗികവിശേഷതയാണ്.
## TEST OF SCIENTIFIC ATTITUDE

### ANSWER SHEET

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*APPENDIX : VI*

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Batch ........ No ......................
# Test of Intelligence

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APPENDIX: VIII

OBSERVATION SCHEDULE OF CAM
This guide is designed to help you analyze the process of teaching as you practice the Reception Model of Concept Attainment. The analysis focuses on aspects of teaching that are important to the syntax of the model, the teacher's role, and specific teaching skills.

The Guide consists of a series of questions and phrases as you observe a practice session (whether peer teaching or microteaching), analyze the teaching using the rating scale that appears opposite each question and statement. This scale uses the following items:

**Thoroughly**: This item signifies that the teacher engaged in the behaviour to the point where students were responding comfortably and fluently. Appropriateness varies from situation to situation. For example, young children may need more assistance in describing the exemplars than older ones.

**Partially**: This item signifies that the teacher engaged in appropriate behaviour, but not as thoroughly as possible. There is some doubt about whether the students are responding fully.

**Missing**: The teacher did not engage in the behaviour; there appears to be a loss in student response or probably will be one.

**Not needed**: The teacher did not explicitly manifest the behaviour, but there is no loss. Either the behaviour was included in others or the students began to respond appropriately without being led to.

For each question or statement in the guide, circle the term that best describes the teacher's behaviour.
PHASE ONE: Presentation of Data and Identification of Concept

1. Did the teacher state the purpose of the game?  
   T P M NN

2. Did the teacher explain the procedure of the game (how the "yeses" and 'no" function)?  
   T P M NN

3. Did the initial "yes" clearly contain the essential attributes?  
   T P M NN

4. In teaching a conjunctive concept, did the teacher begin with a "yes" exemplar?  
   or  
   In teaching a disjunctive concept, did the teacher begin with a "no" exemplar followed by a "yes"  
   T P M NN

5. Did the teacher ask questions that focussed students' thinking on the essential attributes?  
   T P M NN

6. Did the teacher ask the students to compare the "yes" exemplars?  
   T P M NN

7. Did the teacher ask the students to contrast the attributes of the "yes" exemplars with those of the "no" exemplars.  
   T P M NN

8. Did the teacher present labelled exemplars?  
   T P M NN

9. Did the teacher ask the students to generate and test hypothesis about the identity of the concept?  
   T P M NN

PHASE TWO: Testing Attainment of the Concept

10. After the concept was agreed upon, did the teacher present additional exemplars and ask whether they contained the concept?  
    T P M NN

11. Did the teacher ask the students to justify their answers?  
    T P M NN
12. Were the students able to, supply their own exemplars to fit the concept?  
   T P M NN

13. Did the teacher ask the students to justify their exemplers by identifying the essential attributes?  
   T P M NN

14. Did the teacher ask the students to name the concept?  
   T P M NN

15. Did the teacher ask the students to state the essential attributes of the concept?  
   T P M NN

PHASE THREE: Analysis of Thinking Strategies

16. Did the teacher ask the students to describe the thinking process they used in attaining the concept?  
   T P M NN

17. Did the teacher ask the students to reflect on the roles of attributes and to concept in their thinking strategies?  
   T P M NN

18. Did the teacher ask the students to evaluate the effectiveness of their strategies?  
   T P M NN

<table>
<thead>
<tr>
<th>T</th>
<th>Thoroughly</th>
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<tr>
<td>NN</td>
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APPENDIX : IX

OBSERVATION SCHEDULE OF ITM
TEACHING ANALYSIS GUIDE (TAG)
(Inquiry Teaching Model)

This guide is designed to help you analyze the process of teaching as you practice the Inquiry Training Model. The analysis focuses on aspects of teaching that are important to the syntax of the model, the teacher's role, and specific teaching skills.

The Guide consists of a series of questions and phrases. As you observe a practice session (whether peer teaching or microteaching), analyze the teaching using the rating scale that appears opposite each question and statement. This scale uses following items:

- **Thoroughly**: This item signifies that the teacher engaged in the behavior to the point where students were responding comfortably and fluently. Appropriateness varies from situation to situation. For example, discrepant events need to be presented differently to learners of different ages.

- **Partially**: This item signifies that the teacher engaged in appropriate behavior but not as thoroughly as possible. There is some doubt about whether the students are responding fully.

- **Missing**: The teacher did not engage in the behavior; there appears to be a loss in student response or probably will be one.

- **Not Needed**: The teacher did not explicitly manifest the behavior, but there is no loss. Either the behavior was included in others or the students began to respond appropriately without being led to.

For each question or statement in the guide, circle the term that best describes the teacher's behavior.
1. SYNTAX

A. Phase One : Encounter with the Problem.
   1. Did the teacher present a discrepant event?  

   2. Were the inquiry procedures explained to the students?  

   3. Was the problem (discrepancy) clear to the students?  

B. Phase Two : Data Gathering : Verification

   4. Was the inquiry directed towards verification of conditions, events, objects and property?  

   5. Did the teacher insure that the students ask only "yes" or "no" questions, by asking students to reformulate their questions, and by refusing to answer open ended questions?  

   6. Did the teacher press students to clarify the terms and conditions of their questions?  

   7. If necessary, was there a summary of inquiry upto this point?  

   8. Was there a formulation or redefinition of the problem?  

B. Phase three : Data Gathering : Experimentation

   9. Did the teacher invite testing (experimenting) of relationships and/or isolation of relevant variables?  

   10. Where appropriate, did the teacher use the language of the inquiry process - for instance, identifying students' questions as "theories" and inviting "experimentation" or "testing"
D: Phase Four: Formulation of an Explanation

11. If necessary, did the teacher induce students to formulate a rule or explanation of the discrepant event? T P M NN

12. Did the teacher press for clearer statement of the theories and support for generalizations? T P M NN

Phase Five: Analysis of Inquiry

13. Was there a recapitulation of the steps of inquiry? T P M NN

14. Was there a discussion of the elements of inquiry, such as data gathering, testing, hypothesizing? T P M NN

II. THE TEACHER’S ROLE

15. Were all inquiries accepted in a non-evaluative manner? T P M NN

16. Were interactions among students encouraged? T P M NN

17. Was the language inquiry introduce? T P M NN

III. TEACHING SKILLS

18. Paraphrasing student’s ideas T P M NN

19. Summarising, or inviting summaries T P M NN

20. Focussing T P M NN

T: Thoroughly
P: Partially
M: Missing
NN: Not needed
APPENDIX: X

OBSERVATION SCHEDULE OF AOM
TEACHING ANALYSIS GUIDE (ADVANCE ORGANIZER MODEL)

Name: ___________________________  Sex: ________________
Date: ___________________________  Topic: ___________________________

INSTRUCTION

This guide is designed to help you analyse the process of teaching as you practice the Advance Organizer Model. The analysis focuses on aspects of teaching that are important to the syntax of the model, the teachers' role and specific teaching skills.

The guide consists of a series of questions and phrases. As you observe practice session (whether peer teaching or micro teaching), analyse the teaching using the rating scale that appears opposite each question and statement. This scale uses the following items:

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<td>Average</td>
<td>Below Average</td>
<td>Not at all</td>
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Categories

4. **Very Large Extent**

   This signifies that the teacher is engaged in the behaviour to a point where students responded comfortably and fluently.

3. **Large Extent**

   This category signifies that the teacher was engaged in the behaviour which was appropriate to the situation but not as thoroughly as possible.
2. Average

This category signifies that the teacher was trying to engage in the appropriate behaviour but could not elicit comfortably and fluent responses of the students in natural way.

1. Below Average

This category signifies that the teacher was trying to engage in the appropriate behaviour artificially and that could not elicit comfortably and fluent response from the students.

0. Not at all

This category signifies that the appropriate behaviour on the part of the teacher was missing.

Keeping in mind the above categories for each statement, in the guide encircle the term that best describes the teacher’s behaviour.

For each question or statement in the Guide, encircle the term that best describes the teacher’s behaviour.

Phase one: Presentation of the Organizer

1. Did the teacher clarify the aims of the presentation?  
   4 3 2 1 0

2. Was an Advance Organizer presented?  
   4 3 2 1 0

3. Did the organizer presentation identify, clarify, or explain the essential characteristics of the concept or proposition that serves as the organizer?  
   4 3 2 1 0

4. Did the organizer presentation include examples of the organizer?  
   4 3 2 1 0
5. Was the language or terms of the subsumer (Organizer) repeated or otherwise emphasized?  
   4 3 2 1 0

6. Did the teacher prompt awareness of relevant knowledge or experience in the learners' backgrounds?  
   4 3 2 1 0

Phase Two: Presentation of the Learning Task or Material

7. Was the learning material presented?  
   4 3 2 1 0

8. Did the teacher develop the material in the logical order of the learning material and make the order explicit to the student, for instance, the rough outlines and explanations?  
   4 3 2 1 0

9. Did the teacher use procedures that enhanced the organisation of the presentation, such as rule-example-rule, explaining links diagrams, and verbal makers of importance?  
   4 3 2 1 0

10. Did the teacher use procedures for maintaining attention, such as varying audio stimuli, using supplemental media, and inserting questions into the presentation?  
    4 3 2 1 0

Phase Three: Strengthening Cognitive Organization

11. Did the teacher use principles of integrative reconciliation (reminding students of "the larger picture" summarizing the major attributes of the new material repeating precise definitions, asking for the difference between parallel subsumers, relating learning material to subsumer)?  
    4 3 2 1 0

12. Did the teacher ask questions and make explanations that prompted active reception learning?  
    4 3 2 1 0
13. Did the teacher facilitate a critical approach to information (the recognition of assumptions, inferences and contradictions)?

14. Did the teacher attempt to clarify students' misunderstandings or confusions?