**ACTIVITY ORIENTED LESSON PLAN - 3**

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| **I Preliminary Details**  Name of the Teacher : SHANAVAS K E Standard : XI Science Name of the Institution : JHSS Thandekkad Time : 45 Minutes Subject : Chemistry Unit : IV Chapter : Chemical Bonding & Molecular Structure Topic : Dipole moment, Fajan’s rule. |

**II Types of Knowledge**

(i) **Factual Knowledge:**

**Terms:** Polar bond, non-polar bond, Peter Debye,Dipole moment, polarizing power, Polarizability, Ionic character, Covalent character, Fajan’s rule.

**Facts:**

(1) The existence of hundred percent ionic or covalent bond represents an ideal situation.

(2) When covalent bond is formed between two similar atoms. The bond is called non-polar

covalent bond.

(3) When covalent bond is formed between different atoms. The bond is called polar

covalent bond.

(4) As a result of polarization, the molecule possesses the dipole moment.

**(ii) Conceptual Knowledge:**

**Concepts:** Dipole moment, polarizing power, Polarizability, Fajan’s rule.

**Definitions**:

(1) Dipole moment is the product of charge and distance between the centers of positive and negative charge.

(2) Polarizing power is the cation ability to distort an anion.

(3) Polarizability is defined as the anion tendency to become polarizes by the cation.

(4) The percent of covalent character of the ionic bond is discussed by Fajan’s Rules

**(iii) Procedural Knowledge:**

(1) Expression and calculation of Dipole moment.

**Steps**

1. Write the equation of Dipole moment.
2. Using this equation, calculate Dipole moment of polar molecules H2O, BeF2 , BF3
3. Give the structure of NH3 and NF3 and its resultant dipole direction.
4. Calculate Dipole moment of NH3 and NF3

(2) Calculation of covalent character of ionic bonds by Fajan’s rule.

**Steps**

1. Select polarizing power of cation based on size.
2. Polarizing power ᶑ 1/size of cation. The size of cation is smaller, polarizing power increases and hence covalent character increases.
3. Select polarizability of anion. The larger the size of anion, more will be its

Polarizability.

1. The greater the charge on the cation, greater the covalent character of ionic bonds.
2. The small cation, large anion, greater charge on ions and incomplete d or f subshell are the factors, which determine the percent covalent character of the ionic bond.

**(iv) Meta Cognitive Knowledge**

The students can acquire the awareness of knowledge, thinking and learning strategies in

dipole moment, polarizing power, polarizability, ionic character, covalent character and

Fajan’s rule.

**III Instructional objectives and Learning Outcomes**

1. Define the above-mentioned facts and concepts.
2. Explains, describes, summarises the above-mentioned facts and concepts.
3. Calculation of Dipole moment and Fajan’s rule.
4. Differentiating and analysing the structure of polar compounds.
5. Predict the Dipole moment and percent of ionic character of covalent bond by Fajan’s rule.
6. Create the Dipole moment of simple molecules and compounds.

**IV Previous knowledge**

The students have the knowledge about the polar and non-polar compounds based on

electronegativity.

**V Learning aids**

1. Chart showing definition of dipole moment, polarizing power, polarizability, Fajan’s rule.
2. Diagrams of H2O, NH3, NF3, BeF2, CO2 and its resultant dipole moment.
3. Expression and calculation of Dipole moment in the chart.
4. Photocopy of Dipole moment of selected molecules AB, AB2, AB3 and AB4 in the NCERT text.

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| **Constructivist Learning Design** | |
| Activity | Student response with Assessment |
| **Phase I Situation**  Can you give example of polar bond and non-polar bond ?  Who discovered dipole moment?  **Phase II Grouping**  Students are grouped on the basis of scientist who discover Dipole moment.  **Phase III Bridging**  Can you define Dipole moment?  **Phase IV Question**  Can you give the equation of Dipole moment?  What about dipole moment H2O  Calculate Dipole moment of BeF2 | Student share their experiences.  H-H bond Non-polar bond  Same electronegativity difference.    H-F bond polar bond  Different electronegativity difference.  F has highest electronegativity and acquires a small negative charge and H acquires a small positive charge.    Peter Debye, the Dutch chemist received Nobel prize in 1936 for his work on X-ray diffraction and dipole moments.  The students are grouped into two groups.  Peter group and Debye group.      Peter group hang the chart containing definition of Dipole moment. Dipole moment is the product of charge and distance between the centres of positive and negative charge.  Debye group hang the chart containing equation of Dipole moment  Dipole moment = charge q x distance of separation r  = q . r    Dipole Moment: Definition, Formula, and Examples    Two equal bond dipoles in opposite direction, cancel each other. Dipole moment of BeF2 is zero.    Dipole Moment - Overview, Structure, Properties & Uses |
| **Factual Knowledge**  The students recognise the Dipole moment on the basis of polarisation, polar and non-polar molecules. | |
| The Dipole moment of NF3 is lower than NH3. Can you explain | In NH3, dipole moment in same direction = +1.49 D In NF3, Lone pair of N in one direction and three N-F bonds in opposite direction. Some dipole cancels each other. Hence dipole moment of NF3 lower then NH3 |
| **Conceptual knowledge**  Students state the definition of Dipole moment. | |
| What is Fajan rules ?  What is polarizing power ?  What is Polarizability ?  **Phase V Exhibit**  Compare polarizing power of Noble gas, Alkali metals, Alkaline earth metals and Transition metals ? | The smaller the size of cation and larger the size of anion and the greater the charge on the cation, the greater is the covalent character of the ionic bond.  Polarizing power is the cation ability to distort an anion. The size of cation is smaller, polarizing power increases and hence covalent character increases.  Polarizability is defined as the anion tendency to become polarizes by the cation.  Larger the Anion, more will be its polarizability  Student group answer the question and exhibit for others. Transition Metal is more polarizing power than Noble gas, alkali or alkaline earth metals. |
| **Procedural knowledge**  Students calculate Dipole moment of molecules and compounds. Students calculate the covalent character of ionic bonds by Fajan’s rule. | |
| **Phase VI Reflection**  Can you students, give the summary chart of Fajan rules | Student group hang the chart of Fajan’s rules. |
| **Meta cognitive knowledge** The students can acquire the awareness of knowledge, thinking and learning strategies in in dipole moment, polarizing power, polarizability, ionic character, covalent character and  Fajan’s rule. | |
| **Follow up Activities**   1. Dipole moment is expressed in Debye unit, D. How it is converted into coulomb meter? 2. Predict the Dipole moments of some selected molecules of AB, AB2, AB3 and AB4. The data given below.   AB type: HF, HCl, HBr, HI, H2  AB2 type: H2O, H2S, CO2  AB3 type: NH3, NF3, BF3  AB4 type: CH4, CHCl3, CCl4 | Student group answer the assignment.  1D = 3.33564 x 10-30 C m  Student group answer the question by using referring the NCERT text. Take photocopy and shown to others. |