Lesson plan 1 – 3: Physics preparation file

TERM 1

LESSON PLAN 4
PHYSICAL SCIENCES
CHEMISTRY GRADE 11

KNOWLEDGE AREA	MATTER AND MATERIALS	TOTAL TIME: 23 DAYS
Term	1	
Unit	**Atomic combination: Molecular structure** A chemical bond, bonding models, valence electrons Lewis structures, forming of bonds Simple covalent bonds Molecules with multiple bonds Dative covalent bonds VSEPR Electronegativity Forces between atoms, energy changes at the forming of a molecule Bond energy and -length	
Date	/ /20_ _	
Resources	**Doc Scientia Textbook and Workbook Physical Sciences Grade 11 Chemistry Book 2 P. 13 – 48**	
Time	**5 days**	
Core knowledge	The type of chemical bond in a compound determines the physical and chemical properties of that compound. Through studying the structures of atoms, molecules and ions, and the bonding in elements and compounds, learners will acquire knowledge of some basic chemical principles. By learning the properties of metals, giant ionic substances, simple molecular substances and giant covalent substances, you can appreciate the interrelation between bonding, structures and properties of substances. **A chemical bond** • Recall the role of models in science and describe the explanations of chemical bonding in this course as an application of a model. • Deduce the number of valence electrons in an atom of an element. • Represent atoms using Lewis diagrams. • Explain, referring to diagrams showing electrostatic forces between protons and electrons, and in terms of energy considerations, why - two H atoms form an H_2 molecule, but - He does not form He_2. • Draw a Lewis diagram for the hydrogen molecule. • Describe a covalent chemical bond as a shared pair of electrons.	

Core knowledge

- Describe and apply simple rules to deduce bond formation, viz.
  - different atoms, each with an unpaired valence electron can share these electrons to form a chemical bond.
  - different atoms with paired valence electrons called lone pairs of electrons, cannot share these four electrons and cannot form a chemical bond.
  - different atoms, with unpaired valence electrons can share these electrons and form a chemical bond for each electron pair shared (multiple bond formation).
  - atoms with an incomplete complement of electrons in their valence shell can share a lone pair of electrons from another atom to form a co-ordinate covalent or dative covalent bond (e.g. NH_4^+, H_3O^+).
- Draw Lewis diagrams, given the formula and using electron configurations, for
  - simple molecules (e.g. F_2, H_2O, NH_3, HF, OF_2, HOCℓ)
  - molecules with multiple bonds e.g. (N_2, O_2 and HCN)

The role of models in science is a very important issue; it must be handled very well.
Bonding is introduced in grade10.
The atom, the arrangement of electrons into core and valence electrons.

NB!!!
Increased stability due to lower potential energy (and higher entropy) to be used as the main reason for bonding.

The mainstay of Lewis diagrams is the "rule of two", that is two electrons for a bond rather than the "octet" rule which only applies rigorously to the second period. Learners start with the theory of chemical substances before they know anything about the chemistry thereof start with a known molecule like water, H_2O, and start with the concepts of two H-atoms bond to one O-atom. This leads to the octet rule of electrons. This can again lead to the Lewis electron pair presentation.

The "two electrons" per bond is just as untrue as the "octet" rule. Both are just USEFUL MODELS to explain chemical bonding.

The octet rule is only problematic if it is taught as an absolute. It is a useful rule of thumb for any but the 'd' block elements. Exceptions are for example BF_3. It is more useful than it is problematic if it is used as a general guideline rather than a rule.

Co-ordinate covalent or dative covalent bonds must NOT be done in detail, ONLY the definition and an example of the concept is required.

Activity
Draw Lewis structures of the elements and determine the number of bonds the element can make.

Activity
Describe the formation of the dative covalent (or co-ordinate covalent) bond by means of electron diagram using H_3O^+ and NH_4^+ as examples.

Core knowledge	Molecular shape as predicted using the Valence Shell Electron Pair Repulsion (VSEPR) theory State the major principles used in the VSEPR. The five ideal molecular shapes according to the VSEPR model. (Ideal shapes are found when there are NO lone pairs on the central atom ONLY bond pairs.) A is always the central atom and X are the terminal atoms. - linear shape AX_2 (e.g. CO_2 and $BeCℓ_2$) - trigonal planar shape AX_3 (e.g. BF_3) - tetrahedral shape AX_4 (e.g. CH_4) - trigonal bipyramidal shape AX_5 (e.g. $PCℓ_5$) - octahedral shape AX_6 (e.g. SF_6) Molecules with lone pairs on the central atom CANNOT have one of the ideal shapes e.g. water molecule. **Deduce the shape of** - molecules like CH_4, NH_3, H_2O, BeF_2, and BF_3 - molecules with more than four bonds like $PCℓ_5$ and SF_6, and - molecules with multiple bonds like CO_2 and SO_2 and C_2H_2 from their Lewis diagrams using VSEPR theory. Determine what learners know about VSEPR and what they are supposed to know. Definition: Valence shell electron pair repulsion (VSEPR) model: is a model for predicting the shapes of molecules in which structural electron pairs are arranged around each atom to maximize the angles between them. Structural electron pairs are bond pairs plus lone pairs. OR Valence shell electron pair repulsion (VSEPR) model: is a model for predicting the shapes of molecules in which the electron pairs from the outer shell of a reference atom are arranged around this atom so as to minimize the repulsion between them. Note: You only need Lewis diagrams of the molecule to be able to decide the shape of the molecules according to VSEPR. (Hybridization is NOT required.) **Activity** Build the five ideal molecular shapes with Atomic Model kits or with Jelly Tots and toothpicks. If you have a lone pair on the central atom, remove one of the toothpicks. The shape that remains represents the shape of the molecule. If you have two lone pairs on the central atom remove two tooth picks. What is the shape of the resulting structure? This structure represents the molecule (e.g. water) Note: If you have a lone pair on the central atom ONE “leg” of the ideal shape disappears (represented by the lone pair) and that will be the shape of your molecule.

Core knowledge	**Electronegativity of atoms to explain the polarity of bonds** • Explain the concepts - Electronegativity - Non-polar bond, with examples, e.g. H–H - Polar bond, with examples, e.g. H–Cℓ • Show polarity of bonds using partial charges δ^+ δ^- H–Cℓ • Compare the polarity of chemical bonds using a table of electronegativities. • With an electronegativity difference $\Delta EN > 2.1$ electron transfer will take place and the bond would be ionic. • With an electronegativity difference $\Delta EN > 1$ the bond will be covalent and polar • With an electronegativity difference $\Delta EN < 1$ the bond will be covalent and very weak polar • With an electronegativity difference $\Delta EN = 0$ the bond will be covalent and nonpolar • Show how polar bonds do not always lead to polar molecules. Link back to intermolecular forces. **Note** The indications about electronegativity differences are given NOT as exact scientific knowledge but as a guideline for learners to work with in deciding polarity of a molecule. (For teachers: All bonds have covalent and ionic characters.) **Activity** 1. Consider the ideal molecular shapes (build with atom model sets) with the same terminal atoms (look at electronegativity) and the bonding polarity and molecular polarity. 2. Consider ideal molecular shapes with DIFFERENT terminal atoms (look at electronegativity) and the bonding polarity and molecular polarity. **Bond energy and length** • Give a definition of bond energy. • Give a definition of bond length. • Explain what is the relationship between bond energy and bond length. • Explain the relationship between the strength of a bond between two chemically bonded atoms and - the length of the bond between them. - the size of the bonded atoms. - the number of bonds (single, double, triple) between the atoms. Link to potential energy diagram used to explain bonding above and point out the bond energy and bond length on the diagram

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Do not elevate the Lewis presentations as physical truths in chemical bonding. There are NO PHYSICAL BONDS; the chemical bond just represents an area of high electron density and low potential energy.</td></tr>
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