

SCH4U – VSEPR Theory

Draw the Lewis structure and structural formula for CH₄

A structural formula represents the _____ structure of a molecule.

Explain why the structural formula of a molecule does not represent the true picture of what a molecule looks like:

The type of bonds in a molecular structure (ionic, covalent, metallic) play a role in the properties of that substance such as:

-
-
-

The 3-D structure of a substance has an impact on the properties of a substance such as:

-
-

VSEPR Theory

VSEPR theory allows chemists to predict _____.

VSEPR is an acronym for:

V _____ S _____ E _____ -P _____ R _____

Explain VSEPR theory:

What is a bond angle?

Steps for Applying VSEPR Theory:

1. Draw the structural formula for BeCl_2 :
2. Draw the simplified Lewis structure of the molecule.
3. Count the electron pairs surrounding the central atom including both bonded and lone pair electrons.
4. Arrange the surrounding atoms and any lone electron pairs around the central atom to minimize the repulsion between them by placing them as far apart as possible in **3-D space**.
5. Determine the name and bond angles of the structure from the positions of the atoms and the lone pairs of electrons.

Draw the 3-D shape of BeCl_2 predicted by VSEPR

Name: _____; Bond angles _____

Draw the structural formula of BF_3 (*Note in this molecule, boron does not have a stable octet.)

Does this structure minimize the repulsion between bonded electron pairs?

To minimize the repulsion of bonding electrons, BF_3 forms a 3-D shape known as _____ . Which has bond angles of: _____

Look at the structural formula for CH_4 . What are the bond angles in this structure _____

Does this arrangement minimize repulsion of bonding electrons?

Using 3-D space the bond angles can be _____ and the bonding pairs can be placed even further away from each other.

Draw the 3-D structure for CH₄ as predicted by VSEPR:

Structure name: _____ Bond angles _____

Rules for drawing VSEPR shapes:

| | |
|---|--|
| Bond is in the plane of the paper (or screen) | |
| Bond extends backwards into the paper (or screen) | |
| Bond extends outwards (out of the paper or screen) | |

VSEPR Theory – Lone Pairs

Only lone pairs on the _____ affect the 3-D shape of a molecule.

Draw the structural formula for NH₃:

Predict the 3-D shape and bond angles of this molecule:

Name: _____; Bond Angles _____

Draw the structural formula for H₂O

Predict the 3-D shape and bond angles of this molecule:

Name: _____ ; **Bond angles:** _____

Using the VSEPR Simulator (https://phet.colorado.edu/sims/html/molecule-shapes/latest/molecule-shapes_en.html) Complete the following table by adding bonds and lone pairs of electrons.

Note: in the "Model" tab, not all bond angles are incorrect, consider the bond angles already included in the table the correct ones.

| Total # of e ⁻ pairs | # of lone pairs | Name of Structure | Bond Angle | 3-D Shape |
|---------------------------------|-----------------|-------------------|------------|-----------|
| 2 | 0 | Linear | 180° | X-A-X |
| 3 | 0 | | | |
| | 1 | | 120° | |
| 4 | 0 | | | |
| | 1 | | 107° | |
| | 2 | | 104.5° | |

| Total # of e ⁻ pairs | # of lone pairs | Name of Structure | Bond Angle | 3-D Shape |
|---------------------------------|-----------------|-------------------|------------|-----------|
| 5 | 0 | | 90°, 120° | |
| | 1 | | 90°, 180° | |
| | 2 | | 90°, 180° | |
| 6 | 0 | | | |
| | 1 | | | |
| | 2 | | | |