Chem1311Ch10Ep2 Transcript

00:00:01

Hello and welcome to the second episode of molecular geometry and orbital hybridization.

00:00:13

Previously in molecular geometry and orbital hybridization.

00:00:18

We considered VSEPR and its implications for molecular geometry.

00:00:27

And we applied.

00:00:28

VSEPR to determine a molecule’s geometry from its Lewis structure.

00:00:39

In today's episode.

00:00:43

We will practice determining a molecular geometry from a Lewis structure.

00:00:51

We will consider.

00:00:53

A bond’s dipole and its effect on a molecule’s polarity.

00:01:00

And we will consider molecular geometry and its effect on a molecule’s polarity.

00:01:17

In our last episode, we learned to predict a molecule’s shape from its Lewis structure.

00:01:31

After drawing the Lewis dot structure.

00:01:36

The number of bonded electrons and lone pairs on the central atom are the key to determining the compound's molecular shape.

00:01:50

Valence electron pair repulsion is the guiding principle that we follow.

00:02:00

Let's practice drawing the Lewis structure of the following molecules and then write down the resulting molecular shape.

00:02:10

Pause the video.

00:02:12

Write down your answers and then come right back.

00:02:21

Welcome back.

00:02:24

The first molecule.

00:02:27

Arsenic trihydride

00:02:33

Has four electron pairs around the arsenic atom.

00:02:38

One of them is a lone pair.

00:02:47

Therefore, the electron pairs will have a tetrahedral arrangement.

00:02:55

But because one pair is a lone pair, the molecular shape will be trigonal pyramidal.

00:03:14

The second molecule also has four electron pair around the central atom.

00:03:22

Resulting also in a tetrahedral arrangement.

00:03:29

Because two of these electron pairs are lone pairs.

00:03:33

The result is a bent molecule.

00:03:50

The third molecule has four electron pair around the aluminum atom.

00:03:58

Resulting in a tetrahedral arrangement.

00:04:01

And because they are all bonding electrons.

00:04:06

The molecule stays tetrahedral.

00:04:17

The 4th molecule has six electron pair.

00:04:21

On the central iodide.

00:04:31

This results.

00:04:33

In a trigonal bipyramidal electron arrangement.

00:04:43

Because three of the electron pair are lone pairs that results in a linear molecule.

00:05:06

The 5th molecule has three electron pair around the central atom.

00:05:12

Either carbon can be considered the central atom in this molecule.

00:05:17

VSEPR considers double and triple bombs as if they were a single bond.

00:05:27

The arrangement is therefore trigonal planar and because all electron pairs are bonding.

00:05:34

The molecular shape is trigonal planar.

00:05:44

You may remember from Chapter 9 the bonds between atoms having a difference in electronegativity between zero and two are polar covalent.

00:05:56

That means that the molecule will have an electron rich region and an electron poor region.

00:06:07

The result is that the bond will have a dipole.

00:06:12

Which is represented by an arrow which points towards the electron rich region and the tail of the arrow will have a positive sign towards the electron poor region.

00:06:31

Diatomic molecules that have a dipole will be polar and will behave like small magnets.

00:06:39

In a magnetic field.

00:06:45

Turning so that their atoms face the opposite pole in the field.

00:06:51

This is why the molecule is said to be polar.

00:07:04

For a polyatomic molecule having a dipole is not enough to make the molecule polar.

00:07:12

Because the molecular shape plays a role.

00:07:29

We will look at a couple of molecules to illustrate the point.

00:07:35

Ammonia and nitrogen trifluoride.

00:07:45

Ammonia has a trigonal pyramidal shape.

00:07:49

Notice that the dipoles on the molecule all run along the bonds and point towards nitrogen.

00:07:56

Because nitrogen is more electronegative than hydrogen.

00:08:05

Consider each one of these dipole moments.

00:08:11

Each has a vertical.

00:08:14

And a horizontal component.

00:08:20

The horizontal components of the nitrogen hydrogen bonds are going to cancel each other out, as they're all pointing towards the center.

00:08:33

But the vertical components do not.

00:08:36

Because they build each other up.

00:08:40

The resulting molecular dipole is the sum of these vertical components.

00:08:48

If a molecule's resultant dipole is not zero.

00:08:52

Then the molecule is polar.

00:09:07

The dipole moments in the bonds of a molecule of nitrogen trifluoride are all pointing towards the fluorine atoms along the bonds.

00:09:23

The horizontal components.

00:09:25

Of these dipoles will cancel each other out again.

00:09:31

But the vertical components will not.

00:09:35

Resulting in another polar molecule.

00:09:50

We will now predict, based on the molecular shape, which of these molecules is polar.

00:09:57

Remember that the bond dipoles must not completely cancel to form a polar molecule.

00:10:08

Pause the video.

00:10:10

Write down your Lewis structures and then your answers, and then come right back.

00:10:24

Welcome back.

00:10:27

We will start by looking at the Lewis dot structure of carbon tetrachloride.

00:10:35

There are four bonding electron pair.

00:10:38

Around the central carbon atom.

00:10:41

So that the arrangement will be tetrahedral.

00:10:46

All the bonds are identical, so both their vertical and horizontal components will cancel out.

00:10:54

And the resultant dipole will be 0.

00:11:02

Making this molecule non-polar.

00:11:16

The next molecule.

00:11:18

Is diatomic.

00:11:22

And its only bond has a dipole.

00:11:32

Making the molecule polar.

00:11:43

Boron trifluoride has three bonding electron pair around the central atom and no lone pair making its geometry trigonal planar.

00:11:58

Although the boron fluorine bonds have a strong dipole, the three dipoles will cancel each other out.

00:12:10

And the molecule will have 0 resultant dipole.

00:12:20

For the 4th molecule.

00:12:26

The Lewis dot structure has 4 bonding electron pair.

00:12:34

And the structure is therefore tetrahedral.

00:12:46

However, because the bonds are not identical.

00:12:49

The dipole moments will not cancel.

00:12:53

And the molecules resultant dipole is not zero.

00:12:59

And we know what that means.

00:13:05

And this molecule is polar.

00:13:18

And that's all there is.

00:13:21

There isn't anymore.