Unit 1 The Diversity of Matter and Chemical Bonding
Chapter 2 Diversity of Matter
Solutions to Practice Problem Solutions

1.
Problem
Use VSEPR theory to predict the molecular shape for HCN(g).

What is Required?
You must draw the Lewis structure for HCN(g).

What is Given?
The chemical formula, HCN(g), tells you that there is one carbon atom, one hydrogen atom, and one nitrogen atom in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for HCN.
Step 1. The total number of valence electrons in this molecule is

$$(1 \text{ H atom} \times \frac{1 \text{e-}}{\text{H atom}}) + (1 \text{ C atom} \times \frac{4 \text{e-}}{\text{C atom}}) + (1 \text{ N atom} \times \frac{5 \text{e-}}{\text{N atom}} = 10 \text{ e}^-$$

Step 2. Select the atom with the most unpaired electrons. Hydrogen has one unpaired electron, nitrogen has three unpaired electrons, and carbon has four unpaired electrons. Therefore, carbon is the central atom. Draw a skeleton structure with one pair of bonding electrons between the hydrogen atom and the carbon atom, and one pair of electrons between the carbon atom and the nitrogen atom.
Step 3. Place lone pairs around the oxygen atom to form an octet. The skeleton structure has eight electrons.
Step 4. Since two of the valence electrons from Step 1 are unaccounted for, add a lone pair of electrons around the nitrogen atom. Since the nitrogen atom has only four valence electrons, move a lone pair from the carbon atom and a lone pair from the nitrogen atom to form a triple bond between the oxygen and nitrogen atoms. The structure now has the same number of electrons as in Step 1.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows a triple bond between the central carbon atom and the nitrogen atom. This triple bond counts as one electron grouping. A single bond is found between the carbon atom and the hydrogen atom.
Step 3. The Lewis structure shows two bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with two BPs around a central atom is linear.

Check Your Solution
This answer is in agreement with the shapes found in Table 1.

2.
Problem
Use VSEPR theory to predict the molecular shape for $PF_3(g)$.

What is Required?
You must draw the Lewis structure for $PF_3(g)$.

What is Given?
The chemical formula, $PF_3(g)$, tells you that there is one phosphorus atom and three fluorine atoms in this molecule.

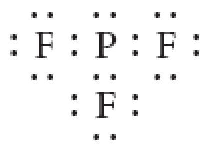
Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for PF_3.
Step 1. The total number of valence electrons in this molecule is

$$(1 \text{ P atom} \times \frac{5\text{e-}}{\text{P atom}}) + (3 \text{ F atoms} \times \frac{7 \text{ e}^-}{\text{F atom}}) = 26 \text{ e}^-$$

Step 2. Select the atom with the most unpaired electrons. Phosphorus has three unpaired electrons and fluorine has one unpaired electron. Therefore, phosphorus is the central atom. Draw a skeleton structure with one pair of bonding electrons between each fluorine atom and the central phosphorus atom.
Step 3. Place three lone pairs around each fluorine atom to form an octet. The skeleton structure has 24 electrons.
Step 4. Since two of the valence electrons from Step 1 are unaccounted for, add a lone pair of electrons around the central phosphorus atom.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows four electron groupings around the central phosphorus atom.
Step 3. The Lewis structure shows three bonding pairs (BP) and one lone pair (LP) around the central phosphorus atom.
Step 4. The predicted shape for a molecule with three BPs and one LP around a central atom is tetrahedral (pyramidal).



Check Your Solution

This answer is in agreement with the shapes found in Table 1.

3.

Problem

Use VSEPR theory to predict the molecular shape for SO_3(g).

What is Required?

You must draw the Lewis structure for SO_3(g).

What is Given?

The chemical formula, SO_3(g), tells you that there is one sulfur atom and three oxygen atoms in this molecule.

Plan Your Strategy

Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy

Determine the Lewis structure for SO_3.

Step 1. The total number of valence electrons in this molecule is

$$(1\text{ S atom} \times \frac{6\,e^-}{\text{S atom}}) + (3\text{ O atoms} \times \frac{6\,e^-}{\text{O atom}}) = 24\ e^-$$

Step 2. Sulfur and oxygen both have two unpaired electrons. The sulfur atom will be the central atom. Draw a skeleton structure with one pair of bonding electrons between the sulfur and each oxygen atom.

Step 3. Place lone pairs of electrons around the oxygen atoms to form octets.

Step 4. All 24 valence electrons from Step 1 have been accounted for but there are only six valence electrons around the sulfur atom. Move one lone pair of electrons from an oxygen atom to form a double bond with the sulfur atom. Since all three oxygen atoms are identical, resonance structures best represent the bonding between the sulfur and oxygen atoms. See the Lewis structure shown below.

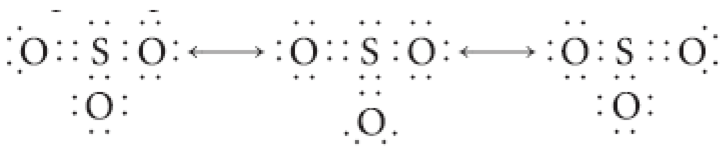
Determine the shape of the molecule.

Step 1. The double bond counts as one electron grouping.

Step 2. The Lewis structure shows three electron groupings around the central sulfur atom.

Step 3. The Lewis structure shows three bonding pairs (BP) around the central sulfur atom.

Step 4. The predicted shape for a molecule with three BPs around a central atom is trigonal planar.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

4.
Problem
Use VSEPR theory to predict the molecular shape for $COCl_2(aq)$.

What is Required?
You must draw the Lewis structure for $COCl_2(aq)$.

What is Given?
The chemical formula, $COCl_2(aq)$, tells you that there is one carbon atom, one oxygen atom, and two chlorine atoms in this molecule.

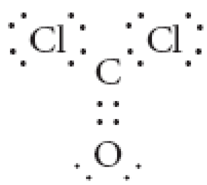
Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for $COCl_2$.
Step 1. The total number of valence electrons in this molecule is

$$(1\ \text{C atom} \times \frac{4\ e^-}{\text{C atom}}) + (1\ \text{O atom} \times \frac{6\ e^-}{\text{O atom}}) + (2\ \text{Cl atoms} \times \frac{7\ e^-}{\text{Cl atom}}) = 24\ e^-$$

Step 2. Select the atom with the most unpaired electrons. Carbon has four unpaired electrons, oxygen has two unpaired electrons, and chlorine has one unpaired electron. Carbon will be the central atom. Draw a skeleton structure with one pair of bonding electrons between the oxygen atom and the central carbon atom, and one pair of bonding electrons between each chlorine atom and the central carbon atom.
Step 3. Place lone pairs around the chlorine atoms and the oxygen atom to form octets. The skeleton structure has 24 electrons.
Step 4. All of the valence electrons from Step 1 have been accounted for, but there are only six valence around the carbon atom. Move one lone pair of electrons from the oxygen atom to form a double bond with the central carbon atom.

Determine the shape of the molecule.
Step 1. The double bond counts as one electron grouping.
Step 2. The Lewis structure shows three electron groupings around the central carbon atom.
Step 3. The Lewis structure shows three bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with three BPs is trigonal planar.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

5.
Problem
Use VSEPR theory to predict the molecular shape for $AsCl_3(g)$.

What is Required?
You must draw the Lewis structure for $AsCl_3(g)$.

What is Given?
The chemical formula, $AsCl_3(g)$, tells you that there are three chlorine atoms and one arsenic atom in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

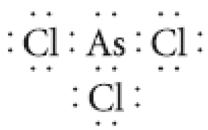
Act on Your Strategy
Determine the Lewis structure for $AsCl_3$.
Step 1. The total number of valence electrons in the molecule is

$$(1 \text{ As atom} \times \frac{5\,e^-}{\text{As atom}}) + (3 \text{ Cl atoms} \times \frac{7\ e^-}{\text{Cl atom}}) = 26\ e^-$$

Step 2. Arsenic has three unpaired electrons, and each hydrogen has one unpaired electron. Therefore, arsenic is the central atom. Draw a skeleton structure with one pair of bonding electrons between each chlorine atom and the central arsenic atom.
Step 3. Place lone pairs around the chlorine atoms to form octets. The skeleton structure has 24 electrons.
Step 4. There are two electrons not accounted for from Step 1, and the arsenic atom has only six valence electrons. Add a lone pair of electrons to the arsenic atom. The skeleton structure now has 26 electrons, which is the same as the total number of valence electrons in Step 1. The number of electrons is correct.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows four electron groupings around the central sulfur atom.
Step 3. The Lewis structure shows three bonding pairs (BP) and one lone pair (LP) around the central arsenic atom.

Step 4. The predicted shape for a molecule with three BPs and one LP around a central atom is pyramidal.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

6.
Problem
Use VSEPR theory to predict the molecular shape for SI_2(g).

What is Required?
You must draw the Lewis structure for SI_2(g).

What is Given?
The chemical formula, SI_2(g), tells you that there are two iodine atoms and one sulfur atom in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for SI_2.
Step 1. The total number of valence electrons in the molecule is

$$(1\text{ S atom} \times \frac{6\,e^-}{\text{S atom}}) + (2\text{ I atoms} \times \frac{7\,e^-}{\text{I atom}}) = 20\ e^-$$

Step 2. Sulfur has two unpaired electrons, and each iodine atom has one unpaired electron. Therefore, sulfur is the central atom. Draw a skeleton structure with one pair of bonding electrons between each iodine atom and the central sulfur atom.
Step 3. Place lone pairs of electrons around the iodine atoms to form octets. The skeleton structure has 16 electrons. Four electrons are not accounted for from the total in Step 1.
Step 4. Add two lone pairs of electrons to the central sulfur atom. The skeleton structure now has 20 electrons, which is the same as the total number of valence electrons in Step 1. The number of electrons is correct.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows four electron groupings around the central sulfur atom.
Step 3. The Lewis structure shows two bonding pairs (BP) and two lone pairs (LP) around the central sulfur atom.

Step 4. The predicted shape for a molecule with two BPs and two LPs around a central atom is bent.

Check Your Solution
This answer is in agreement with the shapes found in Table 1.

7.
Problem
Use VSEPR theory to predict the molecular shape for CH_3F(g).

What is Required?
You must draw the Lewis structure for CH_3F(g).

What is Given?
The chemical formula, CH_3F(g), tells you that there is one carbon atom, three hydrogen atoms, and one fluorine atom in this molecule.

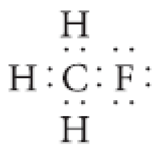
Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for CH_3F.
Step 1. The total number of valence electrons in the molecule is

$$(1\text{ C atom} \times \frac{4\ e^-}{\text{C atom}}) + (1\text{ F atom} \times \frac{7\ e^-}{\text{F atom}}) + (3\text{ H atoms} \times \frac{1\ e^-}{\text{H atom}}) = 14\ e^-$$

Step 2. Carbon is the central atom. Draw a skeleton structure with one pair of bonding electrons between the fluorine atom and the carbon atom, and one pair of bonding electrons between each hydrogen atom and the central carbon atom.
Step 3. Place lone pairs around the fluorine atom to form octets. The skeleton structure has 14 electrons, which is the same as the total number of valence electrons in Step 1. The number of electrons is correct.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows four electron groupings around the central carbon atom.
Step 3. The Lewis structure shows four bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with four BPs around a central atom is tetrahedral.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

8.
Problem
Use VSEPR theory to predict the molecular shape for CH_2F_2(g).

What is Required?
You must draw the Lewis structure for CH_2F_2(g).

What is Given?
The chemical formula, CH_2F_2(g), tells you that there is one carbon atom, two hydrogen atoms, and two fluorine atoms in this molecule.

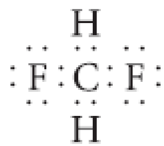
Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for CH_2F_2.
Step 1. The total number of valence electrons in the molecule is

$$(1\text{ C atom} \times \frac{4\text{ e}^-}{\text{C atom}}) + (2\text{ F atoms} \times \frac{7\text{ e}^-}{\text{F atom}}) + (2\text{ H atoms} \times \frac{1\text{e}^-}{\text{H atom}}) = 20\text{ e}^-$$

Step 2. Carbon is the central atom. Draw a pair of bonding electrons between each fluorine atom and the carbon atom. Draw a pair of electrons between each hydrogen atom and the central carbon atom.
Step 3. Place lone pairs around the fluorine atom to form octets. The skeleton structure has 20 electrons, which is the same as the total number of valence electrons in Step 1. The number of electrons is correct.

Determine the shape of the molecule.
Step 1. See the Lewis structure shown below.
Step 2. The Lewis structure shows four electron groupings around the central carbon atom.
Step 3. The Lewis structure shows four bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with four BPs around a central atom is tetrahedral.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

9.
Problem
Use VSEPR theory to predict the molecular shape for CS_2(l).

What is Required?
You must draw the Lewis structure for CS_2(l).

What is Given?
The chemical formula, CS_2(l), tells you that there is one carbon atom and two sulfur atoms in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for CS_2.
Step 1. The total number of valence electrons in the molecule is

$$(1\text{ C atom} \times \frac{4\text{ e}^-}{\text{C atom}}) + (2\text{ S atom} \times \frac{6\text{ e}^-}{\text{S atom}}) = 16\text{ e}^-$$

Step 2. Carbon is the central atom. Draw a skeleton structure with one pair of bonding electrons between each sulfur atom and the central carbon atom.
Step 3. Place lone pairs around the sulfur atoms to form octets. The skeleton structure has 16 electrons.
Step 4. All of the valence electrons from Step 1 have been accounted for, but the carbon atom has only four valence electrons. Move one lone pair of electrons from each sulfur atom to form a double bond between each of the sulfur atoms and the central carbon atom.

Determine the shape of the molecule.
Step 1. The double bond counts as one electron grouping.
Step 2. The Lewis structure shows two electron groupings around the central carbon atom.
Step 3. The Lewis structure shows two bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with two BPs around a central atom is linear.

Check Your Solution
This answer is in agreement with the shapes found in Table 1.

10.
Problem
Use VSEPR theory to predict the molecular shape for $CH_3COCH_3(\ell)$. (**Hint:** Treat the two CH_3 groups as single units)

What is Required?
You must draw the Lewis structure for $CH_3COCH_3(\ell)$.

What is Given?
The chemical formula, $CH_3COCH_3(\ell)$, tells you that two carbon atom are each bound to three hydrogen atoms, and a third carbon atom is bound to an oxygen atom.

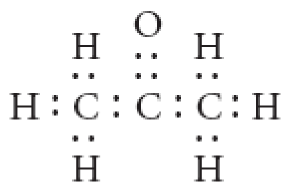
Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape.

Act on Your Strategy
Determine the Lewis structure for CH_3COCH_3.
Step 1. The total number of valence electrons in the molecule is

$$(3\text{ C atom} \times \frac{4\ e^-}{\text{C atom}}) + (1\text{ O atom} \times \frac{6\,e^-}{\text{O atom}}) + (6\text{ H atoms} \times \frac{1\,e^-}{\text{H atom}}) = 24\ e^-$$

Step 2. Carbon is the central atom. Draw one pair of bonding electrons between each of the three carbon atoms. Draw one pair of bonding electrons between the oxygen atom and the central carbon atom, and one pair of bonding electrons between each of the hydrogen atoms and the terminal carbon atoms.
Step 3. Place lone pairs around the oxygen atom to form octets. The skeleton structure has 24 electrons.
Step 4. All of the valence electrons from Step 1 have been accounted for, but the carbon atom has only six valence electrons. Move one lone pair of electrons from the oxygen atom to form a double bond between the oxygen atom and the central carbon atom.

Determine the shape of the molecule.
Step 1. The double bond counts as one electron grouping.
Step 2. The Lewis structure shows three electron groupings around the central carbon atom.
Step 3. The Lewis structure shows three bonding pairs (BP) around the central carbon atom.
Step 4. The predicted shape for a molecule with three BPs around a central atom is trigonal planar.



Check Your Solution
This answer is in agreement with the shapes found in Table 1.

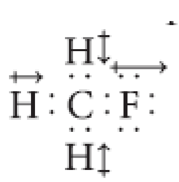
11.
Problem
Use VSEPR theory to predict the molecular shape for $CH_3F(g)$. From the molecular shape and the polarity of the bonds, determine whether or not the molecule is polar. Justify your conclusion.

What is Required?
You must draw a Lewis structure for $CH_3F(g)$, determine its molecular shape, and decide if the molecule is polar.

What is Given?
The chemical formula, $CH_3F(g)$, tells you that there is one carbon atom, three hydrogen atoms, and one fluorine atom in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity of the molecule.

Act on Your Strategy
Following the steps for drawing a Lewis structure results in a central carbon atom surrounded by four electron groupings, all four of which are bonding pairs. The predicted shape of this molecule is tetrahedral (refer to Practice Problem 7). If all four bonds are the same, the polarity of the bonds will give a zero resultant when added together as vectors. In the case of CH_3F, the polarity of the C-H bond is different from the polarity of the C-F bond. Therefore, when these polarities are added as vectors, there will be a resultant polarity. CH_3F is a polar molecule.



Check Your Solution
This result is consistent with the information from Table 1 and Table 2.

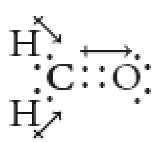
12.
Problem
Use VSEPR theory to predict the molecular shape for $CH_2O(\ell)$. From the molecular shape and the polarity of the bonds, determine whether or not the molecule is polar. Justify your conclusion.

What is Required?
You must draw a Lewis structure for $CH_2O(\ell)$, determine its molecular shape, and decide if the molecule is polar.

What is Given?
The chemical formula, $CH_2O(\ell)$, tells you that there is one carbon atom, two hydrogen atoms, and one oxygen atom in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity of the molecule.

Act on Your Strategy
Following the steps for drawing a Lewis structure results in a central carbon atom surrounded by 3 electron groupings, all three of which are bonding pairs. The predicted shape of this molecule is trigonal planar (refer to Table 1). If all three bonds are the same, the polarity of the bonds will give a zero resultant when added together as vectors. In the case of CH_2O, the polarity of the C-H bond is different from the polarity of the C=O bond. Therefore, when these polarities are added as vectors, there will be a resultant polarity. CH_2O is a polar molecule.



Check Your Solution
This result is consistent with the information from Table 1 and Table 2.

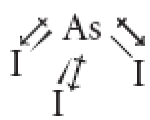
13.
Problem
Use VSEPR theory to predict the molecular shape for $AsI_3(s)$. From the molecular shape and the polarity of the bonds, determine whether or not the molecule is polar. Justify your conclusion.

What is Required?
You must draw a Lewis structure for $AsI_3(s)$, determine its molecular shape, and decide if the molecule is polar.

What is Given?
The chemical formula, AsI_3, tells you that there is one arsenic atom and three iodine atoms in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity of the molecule.

Act on Your Strategy
Following the steps for drawing a Lewis structure results in a central arsenic atom surrounded by four electron groupings, three bonding pairs, and one lone pair. The predicted shape of this molecule is pyramidal (refer to practice problem 24 for $AsCl_3$). For any pyramidal shape, regardless of the polarities of the bonds, when the polarities are added as vectors, there will be a resultant polarity. AsI_3 is a polar molecule.



Check Your Solution
This result is consistent with the information from Table 1 and Table 2.

14.
Problem
Use VSEPR theory to predict the molecular shape for $H_2O_2(\ell)$. From the molecular shape and the polarity of the bonds, determine whether or not the molecule is polar. Justify your conclusion.

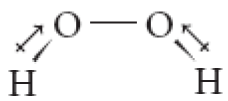
What is Required?
You must draw a Lewis structure for $H_2O_2(\ell)$, determine its molecular shape, and decide if the molecule is polar.

What is Given?
The chemical formula, $H_2O_2(\ell)$, tells you that there are two oxygen atoms and two hydrogen atoms in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity of the molecule.

Act on Your Strategy
Following the steps for drawing a Lewis structure results in the Lewis structure shown below. Each oxygen atom has two bonding pairs (BP) and two lone pairs (LP), and shares another BP. The BP–LP repulsions from one central oxygen atom exactly balance the equivalent repulsions from the other central oxygen atom. Each H–O–O bond will be bent. Each O–H bond will be

polar. Depending on the orientation of the bends with each other, the vectors may or may not cancel. (Experimental observation indicates that the shape causes the molecule to be polar.)



Check Your Solution
This result is consistent with the information from Table 1 and Table 2.

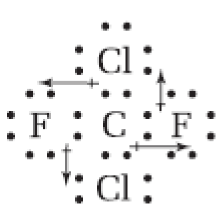
15.
Problem
Freon-12, CCl_2F_2(g), was used as a coolant in refrigerators until it was suspected to be a cause of ozone depletion. Determine the molecular shape for CCl_2F_2 and discuss whether the molecule is polar or non-polar.

What is Required?
You must draw a Lewis structure for CCl_2F_2(g), determine its molecular shape and decide if the molecule is polar.

What is Given?
The chemical formula, CCl_2F_2(g), tells you that there is one carbon atom, two chlorine atoms, and two fluorine atoms in this molecule.

Plan Your Strategy
Apply the steps for drawing a Lewis structure. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity of the molecule.

Act on Your Strategy
Following the steps for drawing a Lewis structure results in a central carbon atom surrounded by four electron groupings, all four of which are bonding pairs. The predicted shape of this molecule is tetrahedral (similar to Practice Problem 26). If all four bonds are the same, the polarity of the bonds will give a zero resultant when added together as vectors. In the case of CCl_2F_2(g), the polarity of the C–Cl bond is different from the polarity of the C–F bond. Therefore, when these polarities are added as vectors, there will be a resultant polarity. CCl_2F_2 is a polar molecule.



Check Your Solution

This result is consistent with the information from Table 1 and Table 2.

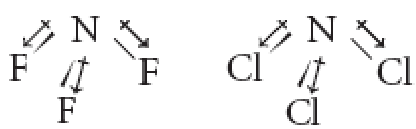
16.
Problem
Which is more polar, NF_3(g) or NCl_3(ℓ)? Justify your answer.

What is Required?
You must determine the molecular shape of the two molecules and decide which is more polar.

What is Given?
The chemical formulas, NF_3 and NCl_3 allow you to draw a Lewis structure for the molecules. Determine their shape, and decide which is more polar.

Plan Your Strategy
Apply the steps for drawing a Lewis structure for each molecule. Using this possible Lewis structure, follow the four-step procedure to predict molecular shape. Based upon this shape, decide if the vector addition of the polarities of the bonds leads to a resultant polarity for each molecule. Compare the magnitude of the polarity in the N–F bond with that in the N–Cl bond.

Act on Your Strategy
Following the steps for drawing a Lewis structure of these two molecules results in a central nitrogen atom surrounded by four electron groupings, three bonding pairs and one lone pair. The predicted shape of both molecules is pyramidal. For any pyramidal shape, regardless of the polarities of the bonds, when the polarities are added as vectors, there will be a resultant polarity. Since the N–F bond has a greater polarity than the N–Cl bond, the resultant polarity of the NF_3 molecule will be greater than for the resultant polarity of the NCl_3 molecule.



Check Your Solution
This result is consistent with the information from Table 1 and Table 2.