

Answer the questions below then check your answers.

- Which of the following bonds is the most polar?
 - C-H
 - H-H
 - H-Cl
 - C-C
- What is the key characteristic of an ionic bond?
 - Shared pair of electrons
 - Transfer of electrons
 - Attraction between dipoles
 - Equal sharing of electrons
- Which of the following molecules is non-polar?
 - H₂O
 - CO₂
 - NH₃
 - HCl
- In which type of bond are electrons shared equally between two atoms?
 - Ionic bond
 - Polar covalent bond
 - Non-polar covalent bond
 - Hydrogen bond
- Which of the following statements is true regarding polar molecules?
 - They have no net dipole moment.
 - They always contain polar bonds.
 - They always contain hydrogen bonds.
 - They have a symmetrical distribution of charge.

6. Fill in the gaps to complete the sentences below:

a. A dipole is created in a molecule when there is a difference in _____ between the bonded atoms.

b. In an ionic bond, electrons are _____ from one atom to another, resulting in the formation of positively and negatively charged ions.

c. A molecule with polar bonds may be non-polar overall if the _____ of the molecule is symmetrical.

d. Covalent bonds involve the _____ of electrons between atoms.

e. If a molecule has a net dipole moment, it is said to be _____.

7. Match the following bond types to their descriptions:

Bond type
Ionic bond
Polar covalent bond
Covalent bond

Description
Electrons are shared unequally between two atoms
Electrons are transferred from one atom to another
Electrons are shared equally between two atoms

8. Match the following molecules to their polarities:

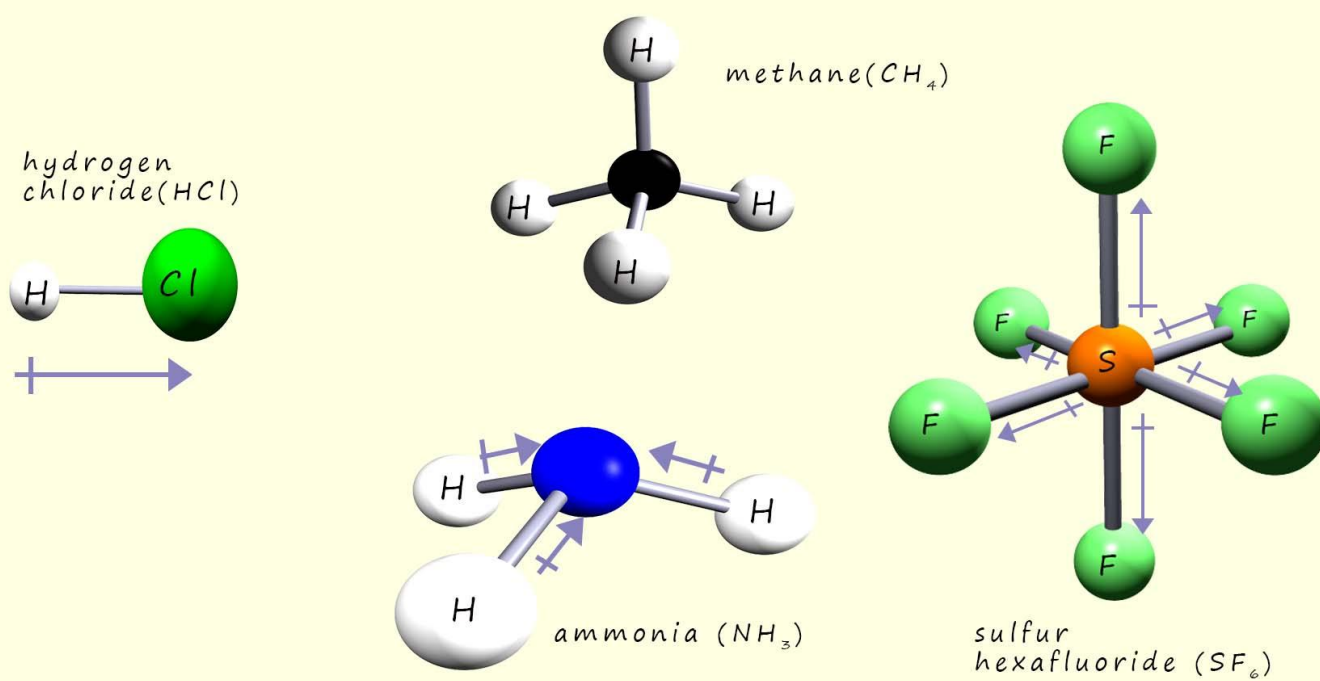
Molecule
H ₂ O
CH ₄
CO ₂

Polarity
Polar
Non-polar

9. Define a dipole and explain how a bond dipole is formed.

9b. The image below shows 4 common molecules. Identify which of these molecules is polar and which are non-polar.

c. What do the purple arrows shown on some of the molecules represent?



10. Explain how the shape of a molecule determines whether it will be polar or non-polar.

11. Compare and contrast ionic, covalent, and polar covalent bonds.

12. Discuss how the presence of polar bonds and the overall molecular geometry lead to the polarity of a molecule, using water (H_2O) and carbon dioxide (CO_2) as examples.

Answers

1. Which of the following bonds is the most polar?

- a) C-H b) H-H c) H-Cl d) C-C

Answer: c) H-Cl

2. What is the key characteristic of an ionic bond?

- a) Shared pair of electrons b) Transfer of electrons
c) Attraction between dipoles d) Equal sharing of electrons

Answer: b) Transfer of electrons

3. Which of the following molecules is non-polar?

- a) H₂O b) CO₂ c) NH₃ d) HCl

Answer: b) CO₂

4. In which type of bond are electrons shared equally between two atoms?

- a) Ionic bond b) Polar covalent bond
c) Non-polar covalent bond d) Hydrogen bond

Answer: c) Non-polar covalent bond

5. Which of the following statements is true regarding polar molecules?

- a) They have no net dipole moment.
b) They always contain polar bonds.

c) They always contain hydrogen bonds.

d) They have a symmetrical distribution of charge.

Answer: b) They always contain polar bonds.

6. Fill in the gaps to complete the sentences below:

a. A dipole is created in a molecule when there is a difference in _____ between the bonded atoms.

Answer: electronegativity

b. In an ionic bond, electrons are _____ from one atom to another, resulting in the formation of positively and negatively charged ions.

Answer: transferred

c. A molecule with polar bonds may be non-polar overall if the _____ of the molecule is symmetrical.

Answer: shape

d. Covalent bonds involve the _____ of electrons between atoms.

Answer: sharing

e. If a molecule has a net dipole moment, it is said to be _____.

Answer: polar

7. Match the following bond types to their descriptions:

Bond type	Description
Ionic bond	Electrons are shared unequally between two atoms
Polar covalent bond	Electrons are transferred from one atom to another
Covalent bond	Electrons are shared equally between two atoms

8. Match the following molecules to their polarities:

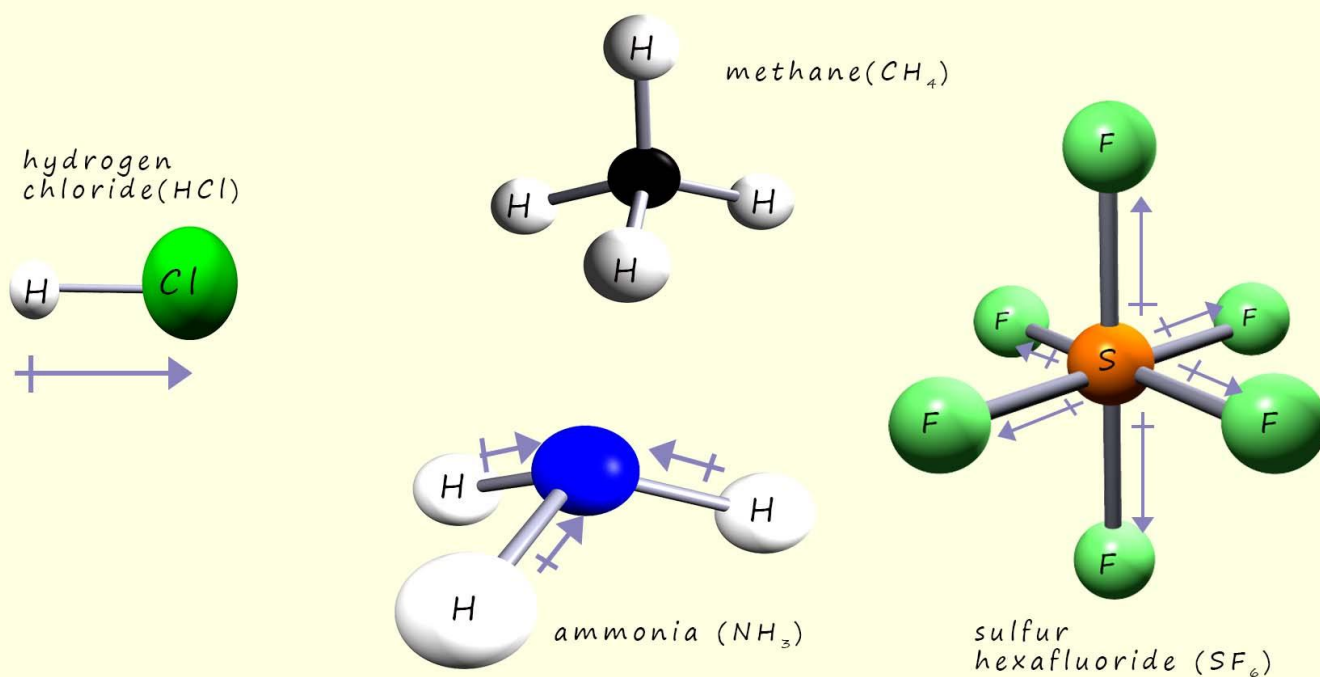
Molecule	Polarity
H ₂ O	Polar
CH ₄	Non-polar
CO ₂	

9. Define a dipole and explain how a bond dipole is formed.

Answer: A dipole refers to the separation of electrical charges within a molecule, resulting in one end having a partial positive charge and the other a partial negative charge. A bond dipole is formed when two atoms in a covalent bond have different electronegativities, causing the shared electrons to be pulled closer to the more electronegative atom, creating a partial charge distribution.

9b. The image below shows 4 common molecules. Identify which of these molecules is polar and which are non-polar.

c. What do the purple arrows shown on some of the molecules represent?



Answer: hydrogen chloride and ammonia are polar molecules, the centres of negative and positive charge on these molecules do not overlap and so the molecule is polar.

Sulfur hexafluoride is non-polar due to its symmetrical shape, the centres of positive and negative charge are on top of the central sulfur atom.

Methane is non-polar since the C-H bonds are covalent bonds.

c. The arrows represent the bond dipoles.

10. Explain how the shape of a molecule determines whether it will be polar or non-polar.

Answer: The shape of a molecule plays a crucial role in determining its polarity. Even if a molecule has polar bonds, it can be non-polar overall if the molecular shape is symmetrical, as the bond dipoles may cancel each other out. For example, carbon dioxide (CO_2) has polar bonds but is a linear molecule, so the dipoles cancel, making it non-polar. In contrast, water (H_2O) has a bent shape, so the dipoles do not cancel, making it a polar molecule.

11. Compare and contrast ionic, covalent, and polar covalent bonds.

Answer: Ionic bonds involve the transfer of electrons from one atom to another, leading to the formation of positively and negatively charged ions.

Covalent bonds involve the sharing of electrons between atoms. If the electrons are shared equally, the bond is a non-polar covalent bond.

However, if the electrons are shared unequally due to differences in electronegativity, the bond becomes a polar covalent bond. Ionic bonds generally occur between metals and non-metals, while covalent bonds typically occur between non-metals.

12. Discuss how the presence of polar bonds and the overall molecular geometry lead to the polarity of a molecule, using water (H_2O) and carbon dioxide (CO_2) as examples.

Answer: The polarity of a molecule depends on both the presence of polar bonds and the overall molecular geometry. In water (H_2O), the oxygen atom is more electronegative than the hydrogen atoms, leading to polar covalent bonds. Due to the bent shape of the water molecule, the bond dipoles do not cancel out, resulting in a net dipole moment and making the molecule polar.

In contrast, carbon dioxide (CO_2) also has polar covalent bonds between carbon and oxygen. However, CO_2 has a linear geometry, meaning that the bond dipoles are directly opposite each other and cancel out. As a result, despite having polar bonds, CO_2 is a non-polar molecule. This illustrates how both bond polarity and molecular shape are crucial in determining the overall polarity of a molecule.