What is Molecular Polarity?

Worksheet

A molecule is polar if it has a net dipole moment (asymmetric charge distribution). Polarity requires both polar bonds AND an asymmetric 3D geometry. Symmetry cancels dipoles; asymmetry adds them into a net dipole.

Questions

1. What determines if a molecule is polar?

A) Only electronegativity difference
B) Only molecular geometry
C) Both polarity of bonds AND asymmetric geometry
D) Only number of atoms

2. Why is HO polar but CO is nonpolar?

A) HO has no C
B) CO has no polar bonds
C) HO is bent (asymmetric); CO is linear (symmetric)
D) Water is covalent

3. In NH, which direction does the dipole point?

A) Toward N (N end negative)
B) Toward H atoms (H end negative)
C) Random
D) No net dipole

4. A nonpolar molecule has

A) No electronegativity differences
B) Perfect symmetry so dipoles cancel
C) No atoms
D) No electrons

5. Is HCl (hydrogen chloride) polar or nonpolar?

6. Is CCl (carbon tetrachloride) polar or nonpolar?

7. Is NH (ammonia) polar or nonpolar?

8. Define: What is electronegativity?

9. Define: What is a dipole moment?

10. Define: Can a molecule with polar bonds be nonpolar?

Answer Key

1. C) Both polarity of bonds AND asymmetric geometry - A polar molecule needs both polar bonds (electronegativity difference) AND an asymmetric 3D shape so dipoles don't cancel.

2. C) HO is bent (asymmetric); CO is linear (symmetric) - Both have polar bonds. HO's bent shape means dipoles ADD into a net dipole. CO's linear shape means dipoles CANCEL.

3. A) Toward N (N end negative) - Nitrogen is more electronegative; dipoles on N-H bonds point toward N. The lone pair also contributes, making N the negative end.

4. B) Perfect symmetry so dipoles cancel - A nonpolar molecule can have polar bonds, but symmetric 3D geometry causes all dipoles to cancel (vector sum = 0).

5. H and Cl have different electronegativities (H = 2.1, Cl = 3.0). The H-Cl bond is polar. Linear geometry with only 2 atoms no way to cancel the dipole. Net dipole moment 0. HCl is POLAR.

6. C-Cl bonds are polar (Cl is more electronegative). Tetrahedral geometry: 4 identical Cl atoms symmetrically arranged. Dipoles on all 4 C-Cl bonds cancel each other (vector sum = 0). Net dipole moment = 0. CCl is NONPOLAR.

7. N is more electronegative than H; N-H bonds are polar. Trigonal pyramidal geometry (3 H atoms + 1 lone pair on N). Asymmetric shape: dipoles on N-H bonds add up. The lone pair also points in a direction, adding to the dipole. Net dipole moment 0. NH is POLAR.

8. The ability of an atom to attract electron density in a covalent bond. Higher electronegativity = stronger pull on electrons.

9. A measure of polarity: charge separation distance. Polar bonds create dipoles; net dipole = vector sum of all bond dipoles.

10. Yes! If dipoles cancel due to symmetry. Example: CO has polar C=O bonds but is nonpolar (linear, dipoles cancel).