

Polar and non-polar molecules

1) Describe the two factors that determine the polarity of a molecule.

2) Explain how a molecule can have polar bonds but overall have no net dipole moment (non-polar).

3) Classify the following molecules as polar or non-polar.

a) H_2O

b) CH_4

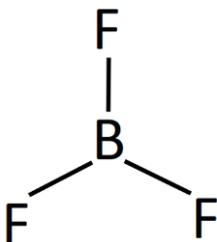
c) NH_3

d) CCl_4

e) CHCl_3

4) From the molecular structures below, classify the molecules as polar or non-polar.

a) Boron trifluoride (BF_3)



b) Hydrogen cyanide (HCN)



Answers:

1) The two factors that determine the polarity of a molecule are the presence of polar bonds within the molecule and the geometry (shape) of the molecule. Polar bonds are caused by unequal sharing of electrons in a bond due to a difference in electronegativity of 0.5 units or greater between the atoms in the bond.

2) A molecule can have polar bonds but be non-polar overall if the bond polarities cancel out. This is due to the shape of the molecule, for example, CO_2 has two polar bonds and a linear shape – the bond polarities cancel out leaving the molecule with no net dipole moment.

3)

a) H_2O polar

b) CH_4 non-polar

c) NH_3 polar

d) CCl_4 non-polar

e) CHCl_3 polar

4)

a) BF_3 is non-polar, it has no net dipole moment. The B-F bond is a polar bond (because of the difference in electronegativity), but due to the shape of the molecule (trigonal planar) the bond polarities cancel out making the molecule non-polar overall.

b) HCN is a polar molecule – it has a net dipole moment. The C-H is a non-polar bond and the C-N bond is a polar bond (because of the difference in electronegativity). The shape of the molecule is linear, therefore the bond polarities do not cancel, making the molecule polar overall.