1. Classify the nature of the chemical bonds (ionic, nonpolar covalent, polar covalent) in the following compounds:
   HCl, NaF, C–C in $H_3C–CH_3$, CsCl, C–O in CO_2, and N_2

2. Indicate the polarity of each of the following bonds using an arrow (→):
   O–H, C–O, C–N, C–Cl, N–H, F–Cl

3. Multiple choice questions:
   a. Considering the ground state, indicate the quantum number(s) that have the same value for all the unpaired electrons in Fe^{3+}:
      a) the principal quantum number n
      b) the azimuthal (angular momentum) quantum number l
      c) the magnetic quantum number m_l
      d) the spin quantum number m_s

   b. From the following list, indicate the group(s) in which the two chemical species have the same number of unpaired electrons in the ground state:
      a) Ti and Ti^{2+}
      b) Ti and Ti^{4+}
      c) Zn^{2+} and Ni
      d) Mn^{2+} and Fe^{3+}

   c. Considering the ground state of the mentioned atoms, indicate the correct statement(s) from the list:
      a) In the nitrogen atom (N), three electrons with n=2, l=1necessarily have the same m_s value
      b) The unpaired electrons of an atom necessarily have the same n and l values
      c) In the arsenic atom (As), there are 8 electrons with $m_l=0$
      d) In the mercury atom (Hg), there are 8 electrons with $m_l=-2$

   d. Indicate the correct statement(s):
      a) It takes more energy to remove an electron from the Na^+ ion than from the Ne atom
      b) The atomic radius of sodium (Na) is larger than that of chlorine (Cl)
      c) The first ionization energy of potassium (K) is greater than that of bromine (Br)
      d) The electronegativity of cesium (Cs) is higher than that of sodium (Na)

4. Draw the Lewis structure of $AsCl_3$, then deduce its geometry and polarity.

5. Indicate whether the following molecules are polar or nonpolar:
   BCl_3, PF_3, $SiCl_4$, SCl_2

6. Which compounds are polar in the following list?
   NH_3, CCl_4, H_2S, CO_2, $CHCl_3$

7. Describe the type of bonding and the hybridization of carbon in the ions CH_3^+ and CH_3^-

8. Write the Lewis structures of the following molecules, determine their molecular geometry, and indicate the hybridization state of the central atom:
   PCl_3, H_2S, BF_3, BF_4^-, SO_2, SO_3

9. Determine three Lewis structures of the ion NO_3^-.What is the geometry of this ion? Why are the N–O bonds identical?

10. Determine the type of hybridization for each underlined atom in the following molecules:
    H–C≡N, CH_3NH_2, CH_3CH_2OH, $H_2C{=}O$, SiH_4

11. Multiple choice questions:

Indicate the correct statement(s) for the ion NO_2^-:

a) The hybridization of the nitrogen atom is sp^2.
b) The two N–O bonds have the same length.
c) The bond angle between two N–O bonds is greater than in NO_3^-.
d) The bond angle between two N–O bonds is smaller than in NO_2^+.

Indicate, from the following list, the molecule(s) whose central atom is hybridized sp^2:

a) O_3
b) CO_3^{2-}
c) SO_3^{2-}
d) SO_2

Indicate, from the following list, the molecule(s) in which all atoms lie in the same plane:

a) SeH_4
b) ICl_3
c) XeF_4
d) XeO_3

Although Xe is a noble gas, it is part of some molecules. Indicate the correct statement(s) from the following list concerning xenon trioxide, XeO_3:

a) The hybridization of Xe is sp^3.
b) All atoms are in the same plane.
c) The bond angles are 120°.
d) Its dipole moment is zero.