CHEM 1413
Chapters 10 & 11
Homework Solutions

TEXTBOOK HOMEWORK

Chapter 10

10.54 (a) SO_2: SO_3 is trigonal planar, and has no dipole moment, SO_2 is bent. Therefore, Therefore, it does have a dipole moment.

(b) IF: Both are polar. For ICl, $\lambda\chi$ = 3.0 - 2.5 = 0.5. For IF, $\lambda\chi$ = 4.0 - 2.5 = 1.5

Because of the larger $\lambda\chi$, IF has the greater dipole moment.

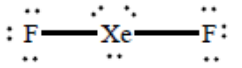
(c) SF_4: SiF_4 is tetrahedral and has no dipole moment. SF_4 has a See-Saw molecular shape. Therefore, SF_4 does have dipole moment.

(d) H_2O: Both are bent, and therefore, polar, For H_2S , $\lambda\chi$ = 2.5 - 2.1 = 0.4.

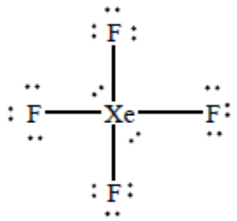
For H_2O, $\lambda\chi$ = 3.5 - 2.1 = 1.4

Because of the larger $\lambda\chi$, H_2O has the greater dipole moment.

10.61 XeF_2 **Linear** (AX_2E_3)



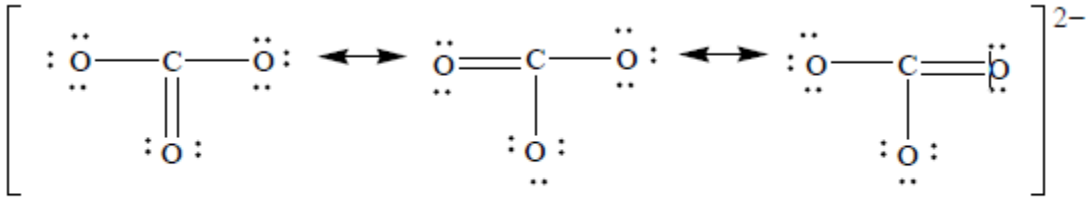
XeF_4 **Square planar** (AX_4E_2)



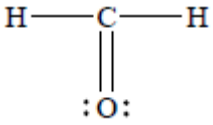
Note: I have skipped XeF_6, because the SN = 7 (i.e. there are 6 F atoms and 1 lone pair about the central atom. We are not covering Steric Numbers greater than SN = 6.

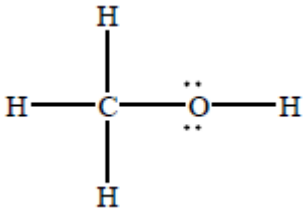
10.66 (a) CO: BO = 3 

(b) CO_3^{2-}: BO = 1.33

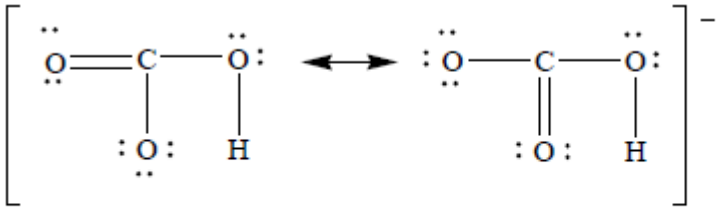


Each C–O bond is a single bond two-thirds of the time and a double bond the rest of the time.
The average is [(1 + 1 + 2)/3] = 4/3 = 1.33

(c) H_2CO: BO = 2 

(d) $CH_4O = CH_3OH$: BO = 1 

(e) HCO_3^-: BO = 1.5



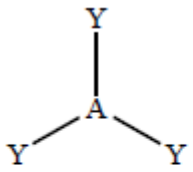
The resonating double bond means the average bond length is [(1 + 2)/2] = 1.5
The C–O bond for the O attached to the H does not resonate and remains 1.0

Ignore the C-O Bond involving the COH

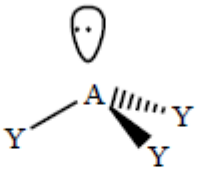
Bond Lengths: a < c < e < b < d [i.e. lower BO's have greater Bond Lengths]

Bond Strength: d < b < e < c < a [i.e. higher BO's have greater Bond Enthalpies] (aka Bond Enthalpy)

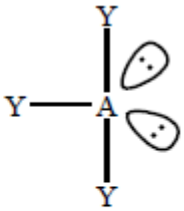
10.79



a)
three groups
(AX_3)
trigonal planar



b)
four groups
(AX_3E)
trigonal pyramidal



c)
five groups
(AX_3E_2)
T shaped

Trigonal planar molecules are non-polar. Therefore, it cannot be (a). However, it can be either (b) or (c), which are both polar.

10.81 (a) XeF_3^+ has 28 val. e^-s, SN = 5, and is T-shaped (i.e. the first shape)
$SbBr_3$ has 26 val e^-s, SN = 4 and is Trigonal Pyramidal (i.e. the 3rd. shape)
$GaCl_3$ has 24 val. e^-s, SN = 3 and is Trigonal Planar (i.e. the 2nd. shape)

(b) XeF_3^+ and $SbBr_3$ are polar. $GaCl_3$ is non-polar

(c) XeF_3^+, with SN = 5, wins the prize for the most valence electrons around the central atom (10 electrons = 5 pairs = 3 bonding pairs and 2 nonbonding pairs)

Chapter 11

11.2 (a) SN = 1+2 = 3 ‖ HY = sp^2

(b) SN = 1+3 = 4 ‖ HY = sp^3

(c) SN = 1+4 = 5 ‖ HY = sp^3d

(b) SN = 1+5 = 6 ‖ HY = sp^3d^2

11.10 (a) BrF_3: With 28 val e^-s, the SN = 5 [3 bonded atoms and 2 lone pairs]
Therefore, HY = sp^3d

(b) BrO_2^-: With 20 val e^-s, the SN = 4 [2 bonded atoms and 2 lone pairs]
Therefore, HY = sp^3

(c) BrF_5: With 42 val e^-s, the SN = 6 [5 bonded atoms and 1 lone pair]
Therefore, HY = sp^3d^2

11.35 (a) Be_2^+ has 3 val e^-s [2x2 - 1]. The val. shell e^- config. is: $(\sigma_{2s})^2(\sigma_{2s}^*)^1$.
Therefore, the BO is ½(2-1) = 1/2.
Therefore, Be_2^+ **is stable**

(b) Because Be_2^+ has an unpaired electron, it is **paramagnetic**, not diamagnetic.

(c) The outer-shell (valence shell) configuration is given in part (a)

11.37 C_2^-: 9 val e^-s ‖ val. shell e^- config is: $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4(\sigma_{2p})^1$: BO = ½(7-2) = 2.5

C_2: 8 val e^-s ‖ val. shell e^- config is: $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^4$: BO = ½(6-2) = 2.0

C_2^+: 7 val e^-s ‖ val. shell e^- config is: $(\sigma_{2s})^2(\sigma_{2s}^*)^2(\pi_{2p})^3$: BO = ½(5-2) = 1.5

(a) Bond Enthalpy (aka Bond Energy): $C_2^+ < C_2 < C_2^-$
i.e. BE correlates directly with Bond Order

(b) Bond Length: $C_2^- < C_2 < C_2^+$
i.e. BL correlates inversely with Bond Order