HW. Set #2

(10) Higher IE,

A. Bi or Xe : Xe has the highest IE, because it has a closed-shell configuration.

B. Se or Te : Se has a higher IE, because its electrons are closer to its nucleus.

C. Rb or Y : Y will have a higher IE, because Rb must only lose 1 e^- to obtain a noble gas configuration.

D. K or Ne : Ne will have a higher IE, the electrons of K are much farther from its nucleus and K can easily lose one e^- to obtain a noble gas configuration.

(14) Higher EA   Table 3.2

A. Rb or Sr : Rb

B. I or Rn : I

C. Ba or Te : Te

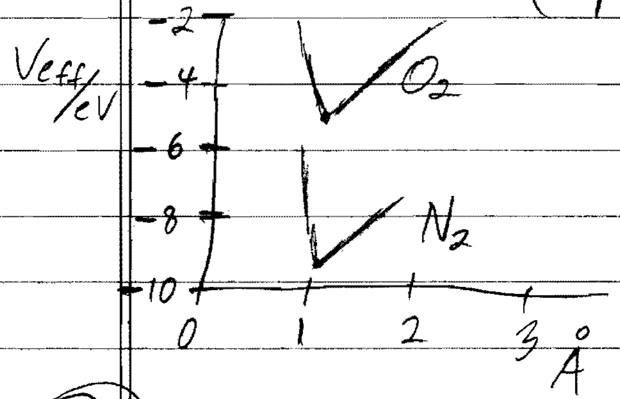
D. Bi or Cl : Cl

(18) N_2 Bond length 1.1 Å Energy: 942 KJ/mol

$$942\ KJ/mol \left(\frac{0.010364\ eV}{1\ KJ/mol}\right) = 9.76\ eV \text{ for } N_2$$

O_2 Bond length 1.211 Å Energy 495 KJ/mol

$$495\ KJ/mol \left(\frac{0.010364\ eV}{1\ KJ/mol}\right) = 5.13018\ eV \text{ for } O_2$$



(22) # of e^- = valence and core

A. Ra^{+2}: $86e^-$ $V=0e^-$ $C=86e^-$

B. Br : $35e^-$ $V=7e^-$ $C=28e^-$

C. Bi^{-2} : $85e^-$ $V=7e^-$ $C=78e^-$

D. Ga^+: $30e^-$ $V=2e^-$ $C=28e^-$

(26) RbF Bond length 2.274×10^{-10} M

$$RbF_{(g)} \rightarrow \cancel{Rb^+}_{(g)} + \cancel{F^-}_{(g)} \qquad \Delta E_1$$
$$\cancel{Rb^+}_{(g)} + \cancel{e^-} \rightarrow Rb_{(g)} \qquad \Delta E = -IE_i(Rb)$$
$$\cancel{F^-}_{(g)} \rightarrow F_{(g)} + \cancel{e^-} \qquad \Delta E = EA_{(F)}$$

Total $RbF_{(g)} \rightarrow Rb_{(g)} + F_{(g)} \qquad \Delta E_{total}$

$$\Delta E_1 = \frac{e^2}{4\pi\varepsilon_0 r} = \frac{(1.602\times10^{-19}C)^2(6.022\times10^{23}\,mol^{-1})}{4\pi(8.854\times10^{-12}C^2J^{-1}M^{-1})(2.274\times10^{-10}M)}$$

$$\Delta E_1 = 611\times10^3\ J/mol$$

$$\Delta E_{Total} = \Delta E_1 - IE_1(Rb) + EAF = 611 - 403 + 328 = 536\ kJ/$$

(32) Most ionic to least ionic ranking.

IF(1.32) > ClF(0.82) > ICl(0.50) > BrCl(0.2) > ClCl(

(36) $\left(\frac{0.2082\,\text{Å}}{debye}\right)\left(\frac{\text{Dipole Moment}}{\text{Bond length Å}}\right) = \%$ Char ionic

$$OH = \left(\frac{0.2082\,\text{Å}\ D^{-1}}{0.980\,\text{Å}}\right)(1.66\,D) = 0.353 \qquad 35.3\%\ \text{for OH}$$

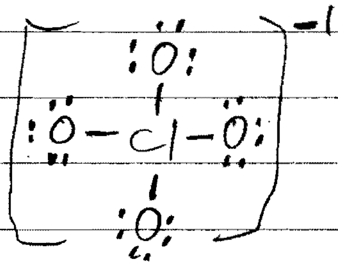
$$CH = \left(\frac{0.2082\,\text{Å}}{D}\right)\left(\frac{1.66\,D}{1.131\,\text{Å}}\right) = 0.269 \qquad 26.9\%\ \text{for CH}$$

(36) Continued

$$CN = \left(\frac{0.2082\,Å}{D}\right)\left(\frac{1.45\,D}{1.175\,Å}\right) = 0.257 \qquad 25.7\%\text{ for } CN$$

$$C_2 = \left(\frac{0.2082\,Å}{D}\right)\left(\frac{0}{1.246\,Å}\right) = 0\%\text{ for } CN$$

(40) A. ClO_4^-

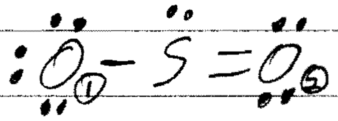


$Cl = +3 \qquad 7-0-\frac{1}{2}(8) = +3$

$O = -1 \qquad 6-6-\frac{1}{2}(2) = -1$

Formal = Valence − lone pair − ½ shared

B. SO_2

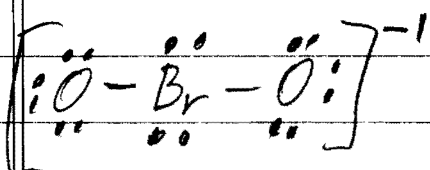


$S = 6-2-\frac{1}{2}6 = +1$

$O_1 = 6-6-\frac{1}{2}(2) = -1$

$O_2 = 6-4-\frac{1}{2}(4) = 0$

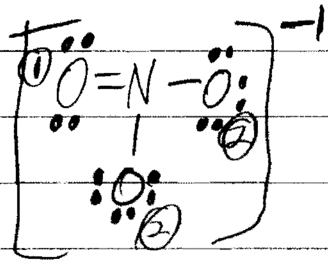
C. BrO_2^-



$Br = 7-4-\frac{1}{2}(4) = +1$

$O = 6-6-\frac{1}{2}(2) = -1$

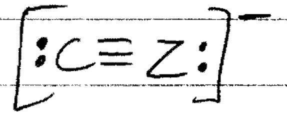
D. NO_3^-

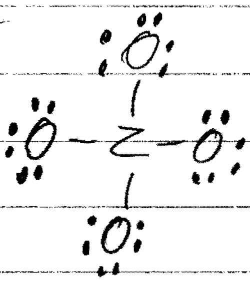


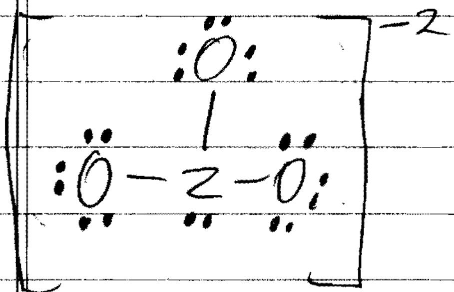
$N = 5-0-\frac{1}{2}(8) = +1$

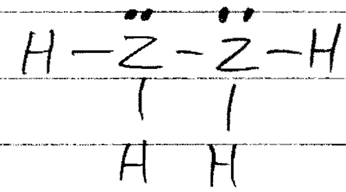
$O_1 = 6-4-\frac{1}{2}(4) = 0$

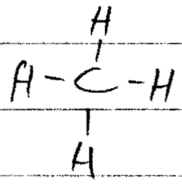
$O_2 = 6-6-\frac{1}{2}(2) = -1$

(44) A.  Group V

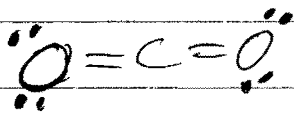
B.  Group VII

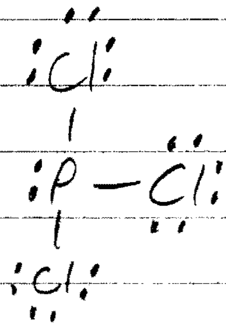
C.  Group VI

D.  Group V

(46) A. Methane 

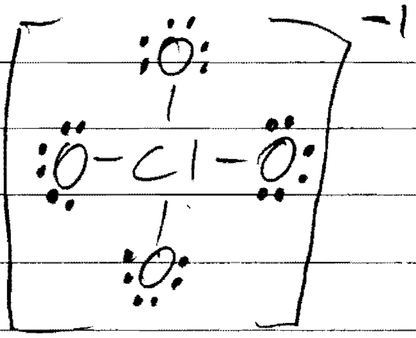
B. Carbon Dioxide



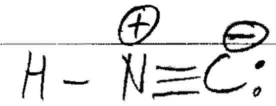
C. Phosphorous Trichloride 

(46) Continued

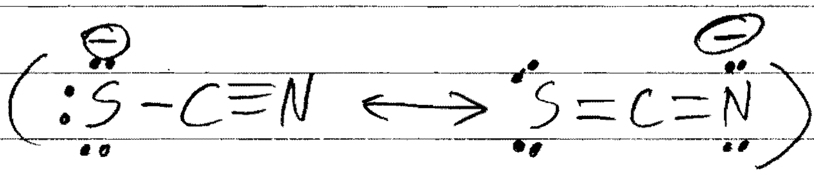
D. perchlorate



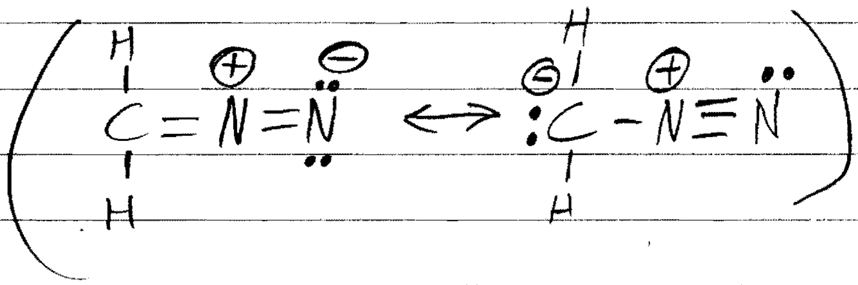
(52) A. HNC



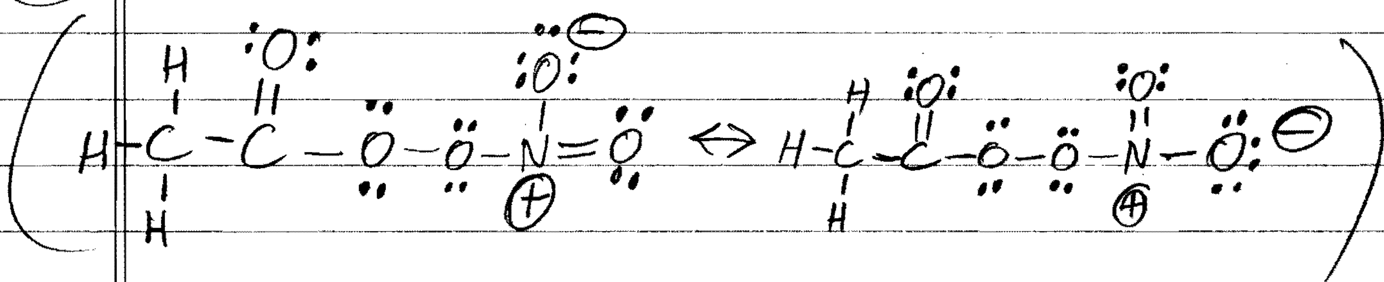
B. SCN^-



C. H_2CNN



(56) $CH_3COOONO_2$



Other Problems

1. Mulliken scale Electronegativity

$$EN \propto \frac{1}{2}(IE_1 + EA)$$

$$\text{Oxygen} = \frac{1}{2}\left(\overset{IE_1}{1.31\times10^{6}\,J/mol} + \overset{EA}{141\times10^{3}\,J/mol}\right) = 725{,}500\ J/mol$$

$$\text{Sodium} = \frac{1}{2}\left(0.5\times10^{6}\,J/mol + 53\times10^{3}\,J/mol\right) = 276{,}500\ J/mol$$

$$\frac{O}{Na} = \frac{725{,}500}{276{,}500} = 2.62$$

The IE_1 is the major contributor to the EN. Oxygen is just over 2.5X more electronegative than Na.

IE_1 $\quad \frac{O}{Na} = \frac{1.31\times10^{6}}{0.5\times10^{6}} = 2.62$

EA. $\quad \frac{O}{Na} = \frac{141}{53} = 2.66$

2. IE_2 of Na = 4.65
IE_1 of Ne = 2.08

Both atoms have the same # of e^- so both atoms have equal shielding. The one extra proton in Na gives it a much larger effective charge than Ne. This causes Na to hold e^- more "tightly" than Ne.

(3.) HBr bond length = 1.424 Å Moment = 0.828 D

Partial charges of H and Br in units of electron charge.

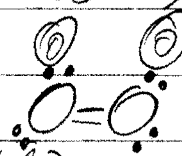
$\mu = 0.828\ D \qquad R = 1.424\ \text{Å}$

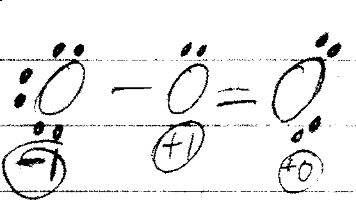
$\mu(D) = [R(\text{Å})/0.2082\text{Å}]$

$\frac{0.828\ D}{1.424\text{Å}/0.2082\text{Å}} = \delta$

$\delta = 0.121 = 12.1\%$

(4) Which has a stronger O-O bond? O_2 or O_3





$O = 6 - 4 - \frac{1}{2}(4) = 0$

O_2 = stronger

This acts as a double bond.

With resonance this acts as 1.5 bonds