Ch. 13 Recommended Problems

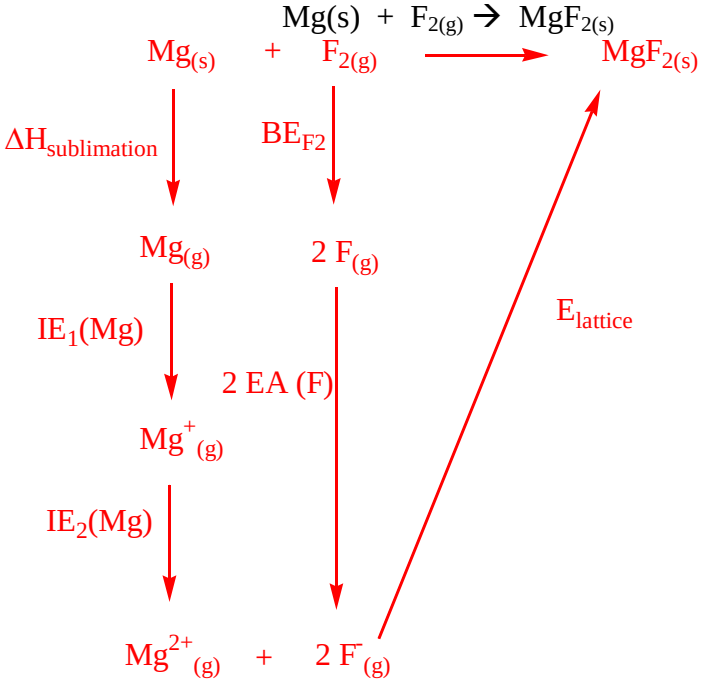
14. Without using figure 13.3, predict which bond in each of the following groups is the most polar.
    a. Ge-F is most polar here because all of the non-fluorine atoms are all in the same family. The lower the atom is in its family, the lower its electronegativity.
    b. P-Cl is the more polar bond here because as you go from right to left, the electronegativity goes down.
    c. S-F. Same reasoning as part a.
    d. Ti-Cl. Titanium is the atom closest to the lower left-hand corner so it has the lowest electronegativity.
    e. Sn-H. Same reasoning as part a.

18. Write electron configurations for each of the following.
    a. The cations:
        Mg^{2+}: [Ne]
        Sn^{2+}: [Kr] $5s^2$ $4d^{10}$
        K^{+}: [Ar]
        Al^{3+}: [Ne]
        Tl^{+}: [Xe] $6s^2$ $4f^{14}$ $5d^{10}$
        As^{3+}: [Ar] $4s^2$ $3d^{10}$
    b. The anions:
        N^{3-}: [Ne]
        O^{2-}: [Ne]
        F^{-}: [Ne]
        Te^{2-}: [Xe]
    c. The most stable ion formed by:
        Be: [He], Be^{2+}
        Rb: [Kr], Rb^{+}
        Ba: [Xe], Ba^{2+}
        Se: [Kr], Se^{2-}
        I: [Xe], I^{-}

22. Which compound in each of the following pairs of ionic substances has the most exothermic lattice energy? Justify your answers.
    a. NaCl. Na^{+} is smaller than K^{+}, so by Coulomb's law, it would have the most exothermic lattice energy.
    b. LiF. F^{-} is smaller than Cl^{-}.
    c. MgO. O^{2-} has a greater charge then OH^{-}.
    d. $Fe(OH)_3$. Fe^{3+} has the greater charge.
    e. Na_2O. O^{2-} has a greater charge than Cl^{-}.
    f. MgO. Both ions are smaller in MgO than in BaS.

26. Use the following data to estimate ΔH_f^o for magnesium fluoride:

$$Mg(s) + F_{2(g)} \rightarrow MgF_{2(s)}$$

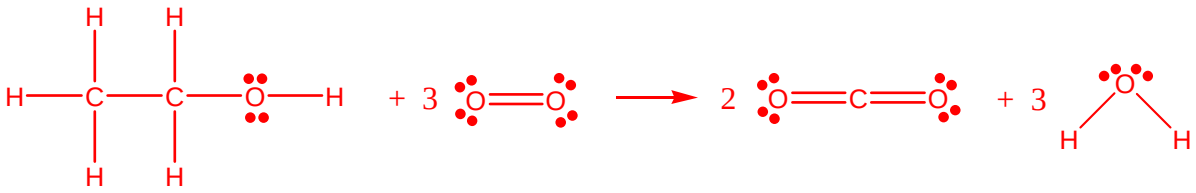


By Hess's Law: $\Delta H_{sublimation} + IE_1(Mg) + IE_2(Mg) + BE_{F2} + 2\ EA\ (F) + E_{lattice} = \Delta H_f$

$\Delta H_f = 150.\ kJ + 735\ kJ + 1445\ kJ + 154\ kJ + 2(-328\ kJ) + (-3916\ kJ) = -2088\ kJ$

34. Use bond energies to predict DH for the combustion of ethanol:
$C_2H_5OH_{(l)} + 3\ O_{2(g)} \rightarrow 2\ CO_{2(g)} + 3\ H_2O_{(g)}$

Look at the Lewis structures to see which bonds are broken and which are formed:



Bonds Broken
5 C-H Bonds: 5(413) = 2065 kJ
1 C-C Bond: 347 kJ
1 C-O Bond: 358 kJ
1 O-H Bond: 467 kJ
3 O=O Bonds: 3(495) = 1485 kJ
Put in 4722 kJ

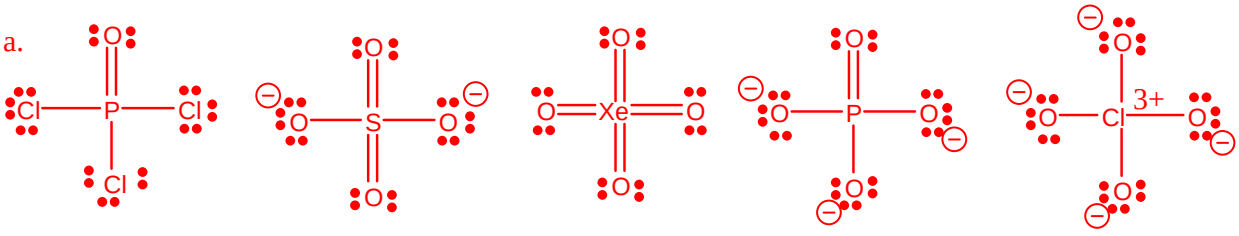
Bonds Formed
4 C=O Bonds: 4(-745) = -2980 kJ
6 O-H Bonds: 6 (-467) = -2802 kJ
Get Out -5782 kJ

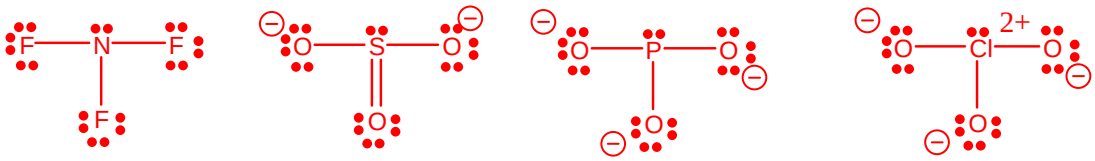
ΔH is the sum of the bonds broken and bonds formed: 4722 kJ + (-5782 kJ) = -1060 kJ/mol

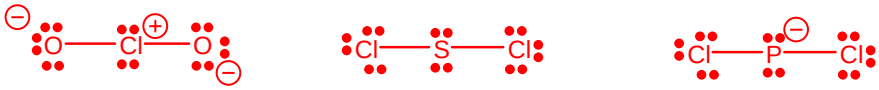
38. Acetic acid is responsible for the sour taste of vinegar. It can be manufactured using the following reaction. $CH_3OH_{(g)} + CO_{(g)} \rightarrow CH_3CO_2H_{(l)}$
Use values of tabulated bond energies to estimate ΔH for this reaction. Compare this result to the ΔH value calculated using standard enthalpies of formation in Appendix 4. Explain any discrepancies.

The calculations are pretty straightforward. Using bond energies you get ΔH = -20. kJ. Using standard enthalpies of formation you get ΔH = - 173 kJ. This is a pretty big difference until you look at the reaction again and see that the product is formed as a liquid, which isn't accounted for using the bond energies method.

46. Draw a Lewis structure that obeys the octet rule for each of the following molecules and ions.

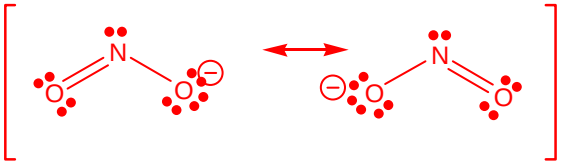
a. 

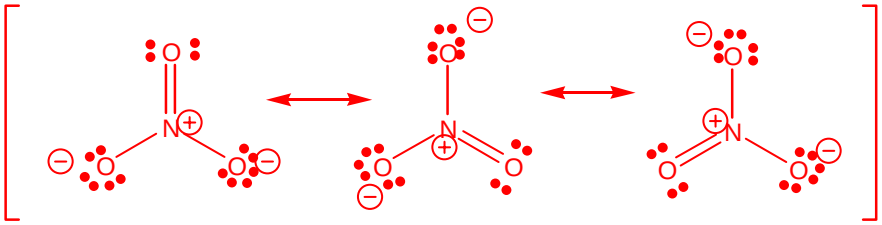
b. 

c. 

48. Draw Lewis structures for the following. Show all resonance structures, where applicable.

a.





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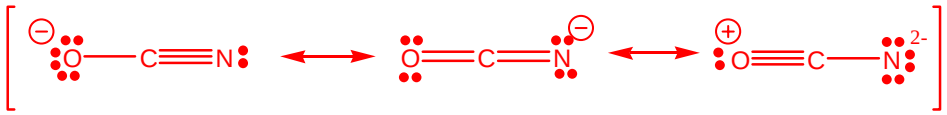
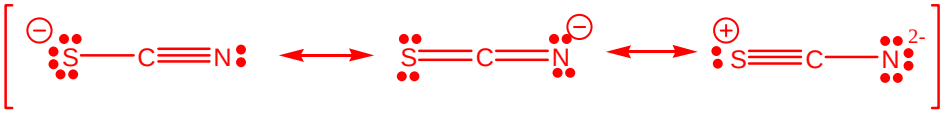
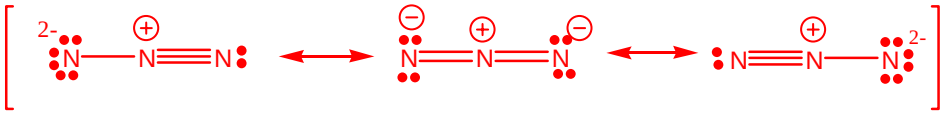
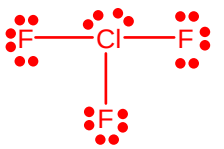
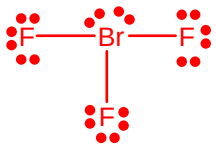






58. ClF_3 and BrF_3 are both used to fluorinate uranium to produce UF_6 in the processing and reprocessing of nuclear fuel. Draw Lewis structures for ClF_3 and BrF_3.

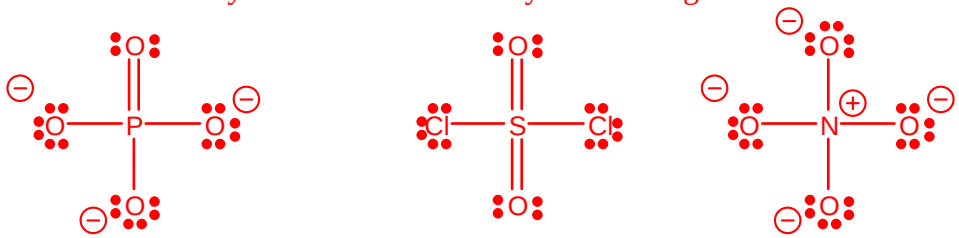




62. Order the following species with respect to the carbon-oxygen bond length (longest to shortest): CO, CO_2, CO_3^{2-}, CH_3OH (this is the correct order). What is the order from weakest to the strongest carbon-oxygen bond? The exact reverse order is the order of bond strength from weakest to strongest.

68. Draw Lewis structures that involve minimum formal charges for the species in exercise

The structures that you haven't seen already in this assignment are shown below....



70. Predict the molecular structure and the bond angles for each of the following

a. SeO_3: Trigonal Planar. Bond angle will be 120^o.
b. SeO_2: Bent (like ozone). Bond angle will be ~120^o.
c. PCl_3: Trigonal pyramidal (like ammonia). Bond angle will be ~109.5^o.
d. SCl_2: Bent (like water). Bond angle will be ~109.5^o.
e. SiF_4: Tetrahedral (like methane). Bond angle will be 109.5^o.

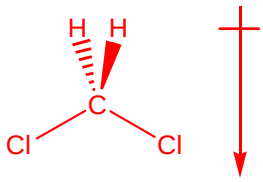
76. Which of the molecules in exercises 73 and 74 have dipole moments (are polar)?

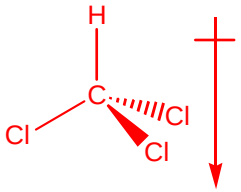
From exercise 73: ICl_3, TeF_4
From exercise 74: ICl_5
You would have to draw the compounds using Lewis dot structures and VSEPR theory in order to evaluate each compound.

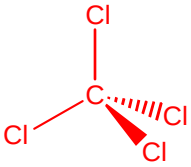
80. Which of the following molecules have dipole moments? For the molecules that are polar, indicate the polarity of each bond and the direction of the net dipole moment of the molecule.

On this problem, I left of lone pairs of electrons for clarity.

a.



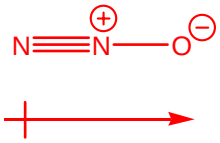




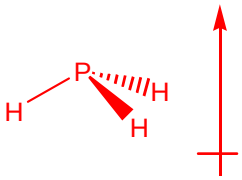
no dipole

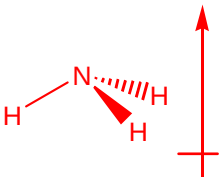
b.

no dipole



c.





For this one, P-H bonds are not polar, but there is a lone pair of electrons that are directly above the P which have to be taken into account.