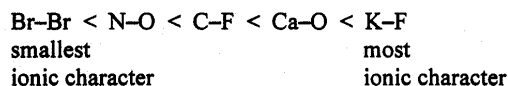


20. a. $\text{Rb} < \text{K} < \text{Na}$ b. $\text{Ga} < \text{B} < \text{O}$ c. $\text{Br} < \text{Cl} < \text{F}$ d. $\text{S} < \text{O} < \text{F}$

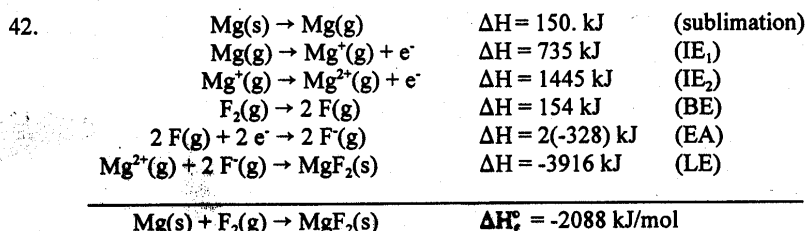
26. Ionic character is proportional to **the difference** in electronegativity values between the two elements forming the bond. Using the trend in electronegativity, the order will be:



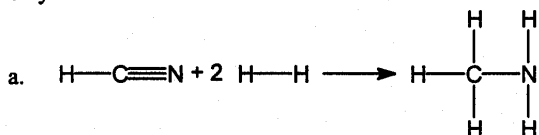
Note that Br-Br, N-O and C-F bonds are all covalent bonds since the elements are all nonmetals. The Ca-O and K-F bonds are ionic as is generally the case when a metal forms a bond with a nonmetal.

36. a. $\text{V} > \text{V}^{2+} > \text{V}^{3+} > \text{V}^{5+}$ b. $\text{Cs}^+ > \text{Rb}^+ > \text{K}^+ > \text{Na}^+$ c. $\text{Te}^{2-} > \text{I}^- > \text{Cs}^+ > \text{Ba}^{2+}$
 d. $\text{P}^{3-} > \text{P}^{2-} > \text{P}^- > \text{P}$ e. $\text{Te}^{2-} > \text{Se}^{2-} > \text{S}^{2-} > \text{O}^{2-}$

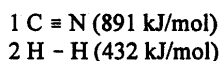
32. a. V^{3+} b. none c. Sr^{2+} d. P^{3-}



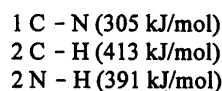
48. Sometimes some of the bonds remain **the same between** reactants and products. To save time, only break and form bonds that are involved in the reaction.



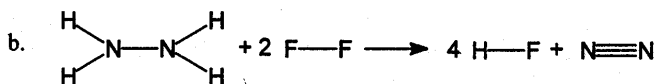
Bonds broken:



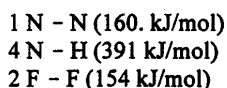
Bonds formed:



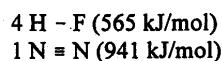
$$\Delta H = 891 \text{ kJ} + 2(432 \text{ kJ}) - [305 \text{ kJ} + 2(413 \text{ kJ}) + 2(391 \text{ kJ})] = -158 \text{ kJ}$$



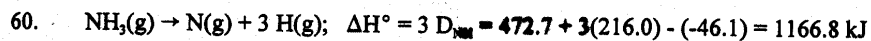
Bonds broken:



Bonds formed:



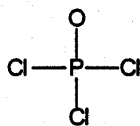
$$\Delta H = 160. \text{ kJ} + 4(391 \text{ kJ}) + 2(154 \text{ kJ}) - [4(565 \text{ kJ}) + 941 \text{ kJ}] = -1169 \text{ kJ}$$



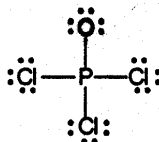
$$D_{\text{NH}} = \frac{1166.8 \text{ kJ}}{3 \text{ mol NH bonds}} = 388.93 \text{ kJ/mol} \approx 389 \text{ kJ/mol}$$

$D_{\text{calc}} = 389 \text{ kJ/mol}$ as compared to 391 kJ/mol in the table. There is good agreement.

64. a. POCl_3 has $5 + 6 + 3(7) = 32$ valence electrons.



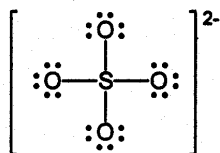
Skeletal
structure



Lewis
structure

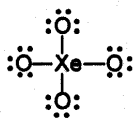
This structure uses all $32 e^-$ while satisfying the octet rule for all atoms. This is a valid Lewis structure.

SO_4^{2-} has $6 + 4(6) + 2 = 32$ valence electrons.

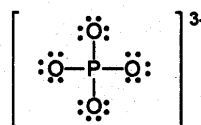


Note: A negatively charged ion will have additional electrons to those that come from the valence shells of the atoms.

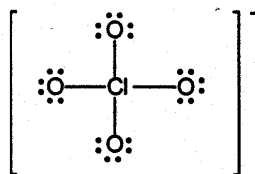
XeO_4 , $8 + 4(6) = 32 e^-$



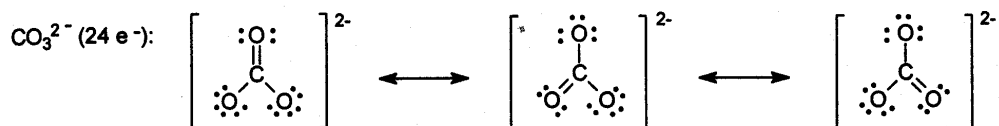
PO_4^{3-} , $5 + 4(6) + 3 = 32 e^-$



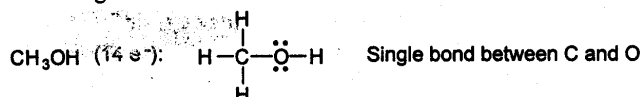
ClO_4^- has $7 + 4(6) + 1 = 32$ valence electrons.



74. The Lewis structures for the various species are below:



Average of 1 1/3 bond between C and O



As the number of bonds increase between two atoms, bond length decreases and bond strength increases. With this in mind, then:

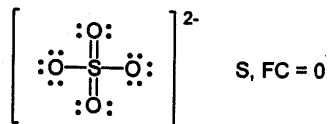
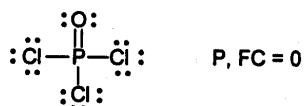
longest → shortest C – O bond: CH₃OH > CO₃²⁻ > CO₂ > CO

weakest → strongest C – O bond: CH₃OH < CO₃²⁻ < CO₂ < CO

For SO₄²⁻, ClO₄⁻, PO₄³⁻ and ClO₃⁻, only one of the possible resonance structures is drawn.

a. Must have five bonds to P to minimize formal charge of P. The best choice is to form a double bond to O since this will give O a formal charge of zero and single bonds to Cl for the same reason.

b. Must form six bonds to S to minimize formal charge of S.



80. See Exercises 8.64 and 8.68 for the Lewis structures.

8.64 a. All are tetrahedral; 109.5°

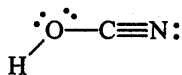
b. All are trigonal pyramid; < 109.5°

c. All are V-shaped; < 109.5°

8.68 O₃ and SO₂ are V-shaped (or bent) with a bond angle ≈ 120°. SO₃ is trigonal planar with 120° bond angles.

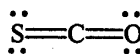
88. All have polar bonds; in SiF_4 the individual **bond dipoles** cancel when summed together, and in PCl_3 and SCl_2 the individual bond dipoles do **not cancel**. Therefore, SiF_4 has no dipole moment (is nonpolar) and PCl_3 and SCl_2 have dipole moments (are polar). For PCl_3 , the negative end of the dipole moment is between the more electronegative chlorine atoms and the positive end is around P. For SCl_2 , the negative end is between the more electronegative Cl atoms and the positive end of the dipole moment is around S.
-

92. a.



Polar; The bond dipoles do not cancel.

b.



Polar; The C - O bond is a more polar bond than the C - S bond. So the two bond dipoles do not cancel each other.
