HW 4
CHEM 362

Due: October 15, 2019

1. Anions can be classified in four main ways, as well as categorized in four main ways.
   a. Name the four classifications of anions and give an example of each.

1. Simple anions
2. Oxo anions (discrete)
3. Oxp anions (polynuclear or polymeric)
Silicates Borates
4. Complex anions which are themselves metal complexes

   b. Name the four main categories of anions and give an example of each

1. Oxides, Hydroxides, Alkoxides (Discrete, molecular species)
2. Polymeric Oxides (also includes larger polynuclear ones)
3. Halogen – Containing Anions
4. Sulfide and Hydrosulfide Anions

2. Given the following elements Li, Si, Na, Cl, K, Rb, Ca, C, N, Tl, P, S, Se:
   a. Sort the above elements into which would form basic oxides or acidic oxides

Basic: Li, Na, K, Rb, Ca, Tl,
Acidic: Si, Cl, C, N, P, S, Se

   b. Pick one from each category and write the balanced chemical equation for a reaction of that oxide with water.

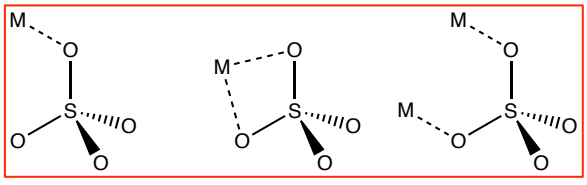
Basic should be of the form: $A_xO + X\ H_2O \rightarrow X\ AOH$
Acidic should be of the form: $A_xO + X\ H_2O \rightarrow X\ H_xA$

3. List the ways in which OH^- can act as a ligand

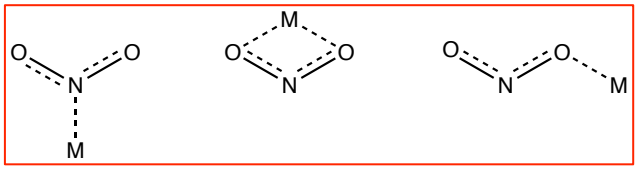
Terminal
Bridging
Triply Bridging

4. Many oxoanions can act as ligands in more than one way (ie. multiple potential binding modes). Draw the ways for:

   a. SO_4^{2-}

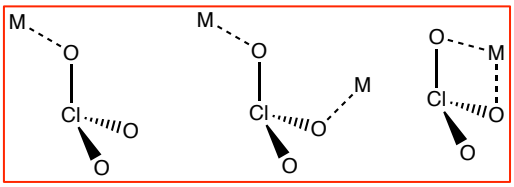


b. NO_2^-



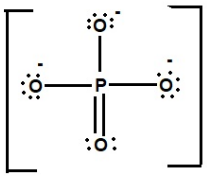
Can also see textbook for more examples

c. ClO_3^-

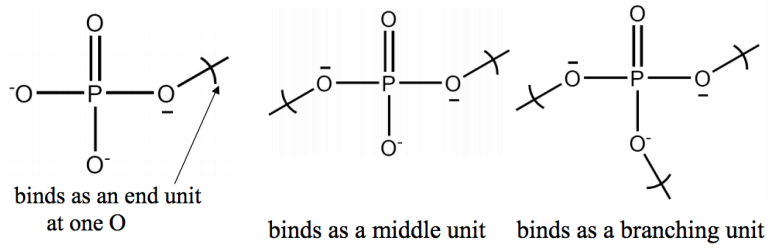


5. Phosphates are important in chemistry as discrete anions and in condensed phases as minerals.

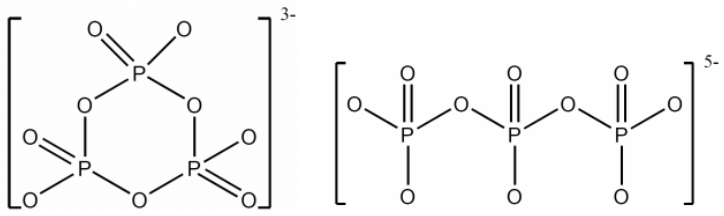
a. Draw the Lewis structure of PO_4^{3-}



b. Draw the way(s) phosphate can bind



c. Draw two examples of phosphate assembly structures.



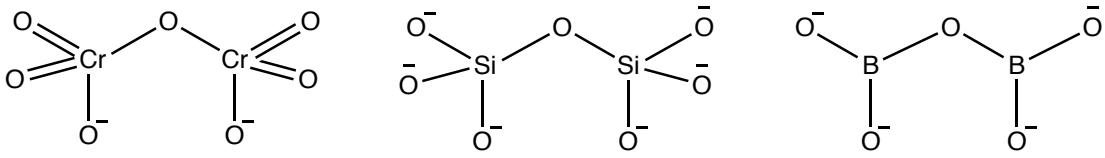
6. Explain in detail the basic composition of zeolites. Give two examples of what zeolites are used for.

Zeolites are hydrated aluminosilicate minerals made from interlinked tetrahedra of alumina (AlO4) and silica (SiO4). In simpler words, they're solids with a relatively open, three-dimensional crystal

Basic composition of Zeolites is: Mx/n[(AlO2)x(SiO2)y] · z H2O

Used for (including but not limited to:
Catalysis
Molecular Sieves
Ion Exhangers

7. Draw the structures of $Cr_2O_7^{2-}$, $Si_2O_7^{6-}$, and $B_2O_5^{4-}$



8. How does CN^- bond to metals? Explain this using MO theory. (*Hint: draw an MO diagram!)*

CN- coordinates to metals through the carbon atom first.

This is due to the HOMO having more C character.
- **Note the contributions from the carbon 2s towards the 3 sigma (HOMO). This is due to s-p mixing.**
- **Can also note the difference in relative atomic orbital energy between C and O, due to the difference in electronegativity.**