Ch 17: Coordination Compounds and Ch 12: Acid and Base Structures

Coordination Compounds

1. Give the shape of the following coordination compounds:

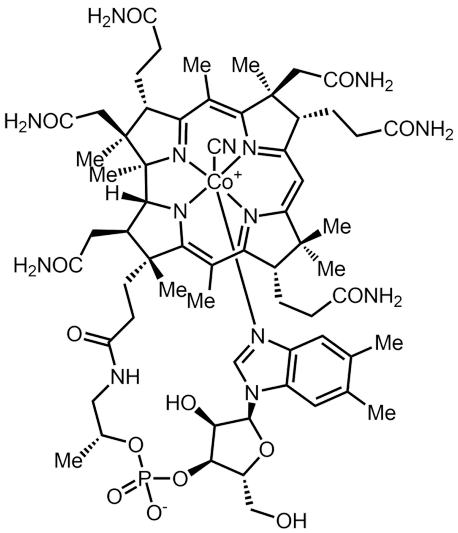
a) $[Cr(NH_3)_3(H_2O)_3]Cl_3$

octahedral

b) $[Pt(NH_3)_5Cl]Br_3$

octahedral

2. Vitamin B12 is an essential nutrient containing Cobalt (Co). Cyanocobalamin, shown at right, is one form of B12 in which the cobalt center has a cyanide ligand. In addition, the cobalt is coordinated by a ring structure, whose long tail (at bottom) loops underneath and makes a final stabilizing coordination.



a) What is the coordination number of cobalt and the expected geometry?

6, octahedral

b) There are only 2 ligands: cyanide, and the entire ring with its tail (corrin-DMB). State each ligand's total charge. Hint: determine the formal charge of each coordinated nitrogen. One will be different from the others.

CN: -1
Corrin-DMB: -1

c) The cobalt has an oxidation state of +3. What is the total charge of the entire complex?

+1

Note: This worksheet contains problems adapted from Dr. Lavelle's past exams.

Acids and Bases

1. Sodium hydroxide is a strong base. This means that _____.
   a. aqueous solutions of NaOH contain equal concentrations of H+ (aq) and OH- (aq)
   b. NaOH does not dissociate at all when it is dissolved in water
   c. NaOH dissociates completely to Na+(aq) and OH-(aq) when it dissolves in water
   d. NaOH cannot be neutralized by a weak acid
   e. NaOH cannot be neutralized by ordinary means

2. Which one of the following cannot act as a Lewis base?
   a. NH_3
   b. BF_3
   c. Cl^-
   d. CN^-
   e. H_2O

3. B is a weak base. Which equilibrium corresponds to the equilibrium constant K_a for HB^+?
   a. $HB^+_{(aq)} + H_3O^+_{(aq)} \leftrightarrow H_2B^{2+}_{(aq)} + H_2O_{(l)}$
   b. $B_{(aq)} + H_2O_{(l)} \leftrightarrow HB^+_{(aq)} + OH^-_{(aq)}$
   c. $HB^+_{(aq)} + OH^-_{(aq)} \leftrightarrow B_{(aq)} + H_2O_{(l)}$
   d. $B_{(aq)} + H_3O^+_{(aq)} \leftrightarrow HB^+_{(aq)} + H_2O_{(l)}$
   e. $HB^+_{(aq)} + H_2O_{(l)} \leftrightarrow B_{(aq)} + H_3O^+_{(aq)}$

4. Metal oxides are typically _____ while nonmetal oxides are typically _____.
   a. acidic, basic
   b. basic, amphoteric
   c. basic, acidic
   d. amphoteric, basic
   e. amphoteric, acidic

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5. Our bodies maintain a blood pH of 7.4. The body does this by having many buffer systems to counterbalance additions of acidic and basic substances. An excess amount of acid is termed acidosis whereas an excess amount of base is termed alkalosis. One of these systems is the bicarbonate buffer system which is created by the transfer of CO_2 from tissue back to our lungs. This system includes carbonic acid (H_2CO_3) and bicarbonate (HCO_3^-):

   Step 1: $CO_2 + 2H_2O \leftrightarrow H_2CO_3$

   Step 2: $H_2CO_3 + H_2O \leftrightarrow H_3O^+ + HCO_3^-$

   a. Which species above can neutralize an added base?

H2CO3, although HCO3- can also potentially neutralize base due to being able to donate its H+. However, the step for that is not shown.

   b. Which species above can neutralize an added acid?

      HCO3-

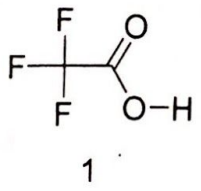
   c. Which species is potentially amphoteric (in any environment)?

      HCO3-

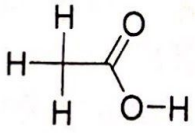
   d. A patient died due to blood pH of 6.5. Is this a result of acidosis or alkalosis?

      acidosis

6. List the following acids in order of increasing strength. Explain your choice.



1



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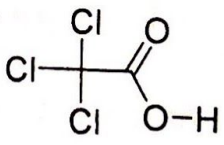

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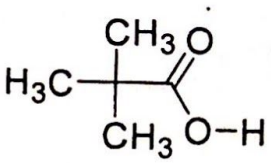

4

4 < 2 < 3 < 1

Note: This worksheet contains problems adapted from Dr. Lavelle's past exams.

7. Why is CH_3COOH a stronger acid than CH_3OH?

Acids donate their H+ proton. When both of these compounds donate its H+, the negative charge formed on the oxygen in CH3COO- has more electron delocalization available to stabilize the ion, while CH3O- does not have any resonance stabilization at all. Remember: a stronger base will form a more stable ion upon losing its proton.