Review Objectives for Quantitative Analysis

From your prior chemistry background, you should be able to.....

1. Calculate the weight percent of a solution or mixture when given the weights of the components.
2. Calculate the masses of the components in a given total amount of a solution or mixture when given the percentage composition. (Note: Volume and density are often supplied rather than total mass.)
3. Calculate the purity of a sample from the weight of the component of interest and the sample weight.
4. Give directions for preparing a specified amount of a specified percentage composition solution or mixture.
5. Calculate the amount of solute in a specified volume of a stated percentage (w/v) percentage composition.
6. Give directions for preparing a specified volume of solution having a stated (w/v) percentage composition.
7. Calculate the (v/v) percentage composition for a solution for which the solute volume and the total volume are specified.
8. Calculate the amount of a specified (v/v) percentage solution that must be used to a given volume of solute.
9. Calculate the amount of solute in parts per million, parts per billion, or parts per trillion when appropriate weight (or weight and volume) data is provided. (Note: parts per million is often equated to mg of solute per liter of solution in aqueous solutions.)
10. Calculate the concentration of mg% when weight and volume data are given.
11. Balance equations that involve:
    a. **simple** displacement or metathesis
    b. formation of coordination compounds
    c. oxidation and reduction
12. Select on the basis of the balanced equation:
    a. the mole ratio of any two components
    b. the number of equivalents of any reactant
    c. the mass of any component required to react with a specified amount of any other
13. Calculate the molecular or formula weight of any substance from the formula.
14. Calculate the gram equivalent weight of any substance from the balanced equation and the formula weight or formula.
15. Calculate the percentage of any element in a compound from the formula and a source of atomic weights.
16. Find the number of moles of OH^- or ions involved in an acid base reaction from the balanced equation.
17. Describe the relationship between moles of OH^- or H^+ to an acid-base equivalent.
18. Relate the number of moles, the number of equivalents, and the equivalent weight of a substance.
19. Apply the rules for the assignment of oxidation numbers to determine the oxidation number of an element in any combined or uncombined form.

20. Balance the gain or loss of electrons in a half-reaction.
21. Expand and -balance a half-reaction from the identities of the oxidized form and the reduced form of the substance of interest, and a statement of the conditions for the reaction. (Acidic, basic, or neutral solution)
22. Combine balanced half-reaction equations to form a balanced oxidation-reaction equation.
23. Find the number of moles of electrons transferred in an oxidation-reduction reaction by use of the balanced equation.
24. Relate the moles of transferred electrons (change in oxidation number) to the number of equivalents of a substance.
25. Calculate the molarity of a solution when given the number of moles (or sufficient information to find the number of moles) of solute and the final volume.
26. Give directions for preparing a solution of stated molarity from materials of stated purity.
27. Calculate the number of moles of solute contained in a specified volume of solution of stated molarity.
28. Describe the definitions of normality, molarity, and formality.
29. Calculate the formality of a solution from the weight of solute, the gram formula weight, and final volume of the solution.
30. Calculate the number of gram formula weights of solute in a sample from the formality and volume of a solution.
31. Calculate the final concentrations of the reactants and products when specified volumes of solutions of known normality are reacted.
32. Calculate the normality of a solution from the weight, gram equivalent weight, and final volume of a solution.
33. Calculate the number of equivalents of a solute from the normality and volume of a solution.
34. Convert between:
    a. moles and millimoles,
    b. equivalents and milliequivalents
35. Calculate the normality, formality; or molarity of a solution after it has been diluted.
36. Provide directions for the preparation of any diluted solution when given the percentage and density of starting material, and a source of atomic weights.
37. Write an equilibrium constant expression for a reaction from the information available in the balanced chemical equation for a reaction.
38. Describe the meaning of a "dynamic equilibrium".
39. Compare the terms "activity" and "concentration".
40. Relate "activity" to concentration by means of an equation.
41. Provide a brief description of the meaning of chemical equilibrium in terms of "chemical potentials"
42. Write an equilibrium constant expression in terms of activities when given the balanced chemical equation.
43. Calculate the value of K_{sp} for the dissociation of a slightly soluble substance from solubility data.
44. Calculate the solubility of a substance from the value for K_{sp}.
45. Calculate the resulting ionic concentrations when a specified amount of an ion common to the equilibrium is added to a system at equilibrium.

46. Calculate the ionic strength of a solution when given the solution composition.
47. Calculate the mean ionic activity coefficient for an ionic species in solution when the ionic strength is known or can be calculated.
48. Calculate the ionic concentrations for a slightly soluble substance in a specified concentration of extraneous ionic materials.
49. Define an acid or base in terms of Arhennius, the Bronsted-Lowry, and the Lewis concepts of acids and bases.
50. Apply the Bronsted-Lowry Concept of acids and bases to a reaction and identify the acid, base, and their conjugates.
51. Describe the meaning of acid or base strength.
52. List the assumptions that are made in writing a K_w for the dissociation of water.
53. Calculate the pH and/or pOH for any specified concentration of H_3O^+ or OH^- .
54. Calculate the $[H_3O^+]$ and/or $[OH^-]$ for any specified pH or pOH.
55. List the assumptions that are made in writing the K_a and K_b values for the acid and base dissociations.
56. Given a weak acid formula, write a reaction for its dissociation and the corresponding expression for K_a according to the Bronsted-Lowry concept.
57. Given a weak base formula, write an equation and the corresponding expression for K_b according to the Bronsted-Lowry concept.
58. Derive the Henderson-Hasselbalch equation for either a weak acid or weak base dissociation.
59. Decide using a rule, the values of K_a or and the concentrations of important species whether it is appropriate to drop "additive" or "subtractive" values of "X" in equilibrium calculations.
60. Calculate the H_3O^+ concentration for a specified concentration of a weak acid in water when given a value for K.
61. Calculate the H_3O^+ concentration for any specified concentration of a strong acid in water.
62. Calculate the OH^- concentration for any specified concentration of a strong base in water.
63. Calculate the $[H_3O^+]$ and/or $[OH^-]$ for any specified concentration of a weak monoprotic acid when the value of K is provided.
64. Calculate the $[H_3O^+]$ and/or $[OH^-]$ for any specified concentration of monofunctional base when the value of K_b is provided.
65. Calculate the pH and/or pOH for specified concentrations of a weak acid and its conjugate base when the K_a of the acid is known.
66. Calculate the pH and/or pOH for specified concentrations of a weak base and its conjugate acid when the K_b of the base is known.
67. Explain why the pH of a neutral aqueous solution is a function of temperature.
68. Derive an expression that allows the calculation of K_b for the conjugate base of a weak acid when the value of K_a for that acid is known.