※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Describe or explain the following terms: (30%)

   (A) Zwitterionic and amphoteric compounds, (B) Activation energy and solvation energy,

   (C) Stoichiometry and stereochemistry, (D) Avogadro's number and ideal gas constant,

   (E) Beer's Law and Henry's Law, (F) Enantiomers and diastereomers

2. Calculate (20%)

   (A) The molality of a solution formed by dissolving 1.14 mol of KCl in 16.0 mol of water.

   (B) A compound containing carbon, nitrogen, and hydrogen is combusted completely with excess oxygen to produce 138 g of NO_2, 28.0 g of CO_2, and 90.0 g of H_2O. What is the empirical formula of the compound?

   (C) If 0.500 L of a 0.50 M NaCl solution is concentrated to 25 mL by an evaporator, what is the molarity of the resulting solution? What is the total weight of the resulting solution?

   (D) You generate hydrogen gas by reacting zinc with HCl to produce hydrogen gas and zinc dichloride. You collect the hydrogen gas in an evacuated container with a volume of 3.0 L. If you start with 6.0 grams of zinc and sufficient HCl to complete the reaction, what is the final pressure of the gas collected in the container if the temperature is 25 °C?

3. Provide, and giving examples, the following definitions of acids and bases: (A) Arrhenius, (B) Brønsted-Lowery, (C) Lewis (10%)

4. Describe the three laws of thermodynamics. (10%)

5. What is alpha radiation? Beta radiation? Gamma radiation? Which type is electromagnetic in nature? Which types have particles with mass? Which types have particles with significant mass? Which types have charged particles? (10%)

6. Give the definitions of pH and pKa. What are the differences between these two terms? Calculate the pH of salicylic acid solution when the solution is titrated to contain only 1.0% of salicylates. Use the fact, pKa (salicylic acid) = 2.97, in your calculation. (10%)

7. A physiologically important first order reaction has an activation energy that is equal to 45.0 kJ/mole at normal body temperature, 37°C. Without a catalyst, the rate constant for the reaction is 5.0 x $10^{-4} s^{-1}$. To be effective in the human body, where the reaction is catalyzed by an enzyme, the rate constant must be at least 2.0 x $10^{-2} s^{-1}$. If the activation energy is the only factor affected by the presence of the enzyme, by how much must the enzyme lower the activation energy of the reaction to achieve the desired rate? (10%)