

※ 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. What is the first law of thermodynamics? What is the second law of thermodynamics? (10%)
2. How does an enzyme change the rate of a reaction? Does it change the rate of the reverse reaction? How does a catalyst affect the equilibrium? (10%)
3. Draw the chemical structures benzene, toluene, and xylene. How many atoms of carbon are there in 24 grams of benzene, toluene, and xylene respectively? (10%)
4. How many oxygen molecules are there in the 100-liter vacuum chamber of a mass spectrometer that was pumped down from ambient air and then operated in  $1 \times 10^{-5}$  torr? (10%)
5. 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? (10%)
6. 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%)
7. 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,  $pK_a(\text{salicylic acid}) = 2.97$ , in your calculation. (10%)
8. Explain the following terms: (30%)
  - (A)  $S_N1$  and  $S_N2$  reactions
  - (B) Beer's Law and Henry's Law
  - (C) Hydrolysis and hydrogenation
  - (D) Amino acid, peptide, and protein
  - (E) Zwitterionic compounds and amphoteric compound
  - (F) Stoichiometry and stereochemistry in a chemical reaction of organic molecules