※ 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: (40%)

   (A) ppm and ppb, (B) acid and base, (C) pH and pKa, (D) anion, cation, and free radical

   (E) monomer, oligomer, and polymer, (F) Stoichiometry and stereochemistry

   (G) Hydrolysis and hydrogenation, (H) Avogadro's number and ideal gas constant

   (I) Beer's Law and Henry's Law, (J) Ractopamine and beta-agonist

2. Draw the following chemical structures (10%)

   (A) Acetone, acetic acid, ethanol, formaldehyde, (B) Glycine, alanine, tyrosine

   (C) PCBs, dioxins, phthalates, (D) Epoxide, 1,3-butadiene, acrylamide

   (E) Benzene, toluene, ethylbenzene, xylene

3. Calculate (10%)

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

   (B) The mass percentage of Na2SO4 in a solution containing 10.6 g Na2SO4 in 482 g of water.

4. A compound containing carbon, nitrogen, and hydrogen is combusted completely with excess oxygen to produce 138 g of NO2, 28.0 g of CO2, and 90.0 g of H2O. What is the empirical formula of the compound? (5%)

5. The total pressure is 5.11 atmospheres for a gas mixture that consists of 0.307 moles of carbon dioxide and an unknown quantity of methane (CH4) in a 2.59 liter container at 27.0 °C. How many grams of methane are in this mixture? (5%)

6. 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? (5%)

7. Like all carbonates, barium carbonate can be decomposed to the metal oxide and CO2.

   　　BaCO3 (s) → BaO (s) + CO2 (g)

   If the ΔHrxn of barium carbonate decomposition is 269.3 kJ/mol, how many kJ are required to decompose 10.0 g of BaCO3? The molecular weight of Ba is 137.3 g/mol. (5%)

8. "Tris" is short for tris(hydroxymethyl)aminomethane. This weak base is widely used in biochemical research for the preparation of buffers. It offers low toxicity and a pKb of 5.92 making it convenient for the control of pH in clinical applications. A buffer is made by mixing 0.050 mol of Tris and 0.025 mol of HCl in a volume of 2.00 L. Calculate the pH of the solution. (10%)

9. 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 10⁻⁴s⁻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%)