Part 1: Analytical Chemistry

1. How many milliliters of 0.1000 M AgNO₃ are required to react with 0.4250 g of BaCl₂ · 2H₂O? Since one mole of BaCl₂ reacts with two moles of AgNO₃ in the balanced equation. (M.W. of BaCl₂ · 2H₂O = 244.28 g/mol) (10 points)

2. Calculate the pH of a 0.0096 M solution of ammonium chloride. (Kₐ of ammonium = 5.5 x 10⁻¹⁰) (10 points)

3. Calculate the pH of a solution that initially contains 0.01016 M ammonia and 0.00533 M ammonium nitrate. (Kₐ of ammonia = 1.8 x 10⁻⁵) (10 points)

4. Calcium oxalate, a component of kidney stones, becomes increasingly more soluble as pH decreases. What is its molar solubility at pH 9 (where species other than Ca²⁺ and C₂O₄²⁻ are negligible) (5 points) and at pH 3 (10 points)? (Ksp of CaC₂O₄ = 2 x 10⁻⁹; Kₐ of H₂C₂O₄ = 6 x 10⁻⁵)

5. Calculate the potential of a silver metal electrode in 0.15 M silver nitrate solution. (E°ₐg⁺/Ag = 0.7994) (8 points)
Part 2: Instrumental analysis

1. Name three major types of spectroscopic methods for identifying elements in a sample and determining their concentrations. (12 points)

2. What are main applications of Infrared spectroscopy in analytical chemistry? (8 points)

3. What are the five main components of various types of instruments for optical spectroscopy? (15 points)

4. Name three separation techniques and briefly describe their major applications in analytical chemistry. (15 points)