PART I. ORGANIC CHEMISTRY (50%)

1. (20%) Explain the following terms and give an example each (3% each, except "g")
   a. Zaitsev Rule (or Saytzeff Rule)
   b. Markovnikov's Rule
   c. Friedel-Crafts Acylation
   d. Aldol Condensation
   e. Lewis acids and Lewis Bases
   f. Chiral molecules and Chiral Center
   g. Polycyclic Aromatic Hydrocarbons (2%)

2. (30%) Write chemical equations, each with full molecular structures, for the following reactions (3% each): (Things in parentheses are either solvents or catalysts)
   a. Cyclopentanone + NaOH (ethanol)
   b. Benzene + $KMnO_4$
   c. 1-Methylcyclohexene + $KMnO_4$ (H_2O, NaOH)
   d. 1,3-Butadiene + HBr
   e. 1-Pentyne reacts + water (H_2SO_4 and $HgSO_4$)
   f. p-Methylbenzoic acid + Br_2 ($FeBr_3$)
   g. 1-Bromopropane + Mg, then reacted with water
   h. Cyclohexanone + NH_2OH
   i. Cyclohexanone + methanol (H^+)
   j. Ethyl acetate + $Na^{+-}OCH_2CH_3$ (ethanol), then reacted with H_3O^+

PART II. ANALYTICAL CHEMISTRY (50%)

1. (20%) Answer the the following questions (3% each, except question "g")
   a. What are *determinate errors*? List three sources of determinate errors.
   b. What are *primary chemical standards*? List two primary chemical standards used for standardizing bases.
   c. Explain the difference(s) between *accuracy* and *precision*.
   d. Explain the difference(s) between an *end point* and an *equivalence point* in titrimetric analyses.
   e. What is a *buffer solution*? What is *buffer capacity*?
   f. Explain the difference(s) between a *galvanic cell* and an *electrolytic cell*.
   g. What is a *back titration*? Explain with an example. (2%)

2. (10%) Describe how to prepare 400 ml of 6.0 F H_3PO_4 from the commercial reagent which is 85% (w/w) in H_3PO_4 and has a specific gravity of 1.84.

3. a. (5%) What is the pH of a solution that is 0.400 F in formic acid (HCOOH, $K_a = 1.77 \times 10^{-4}$)?
   b. (5%) What is the pH of a solution that is 0.400 F in formic acid and 1.00 F in sodium formate ($HCOO^-Na^+$)?

4. a. (3%) Write the Nernst equation for the following reaction and explain each symbol used.
   $aA + bB + n\,e^- = cC + dD$
   b. (7%) What is the potential for a half-cell consisting of a cadmium electrode immersed in a solution that is 0.0100 F in Cd^{2+}?
   (It is known that for $Cd^{2+} + 2e^- = Cd(s)$, $E^\circ = -0.403$ V)