1. A compound of oxygen and nitrogen contains 1.52 g of N and 3.47 g of O. The molar mass of this compound is known to be between 90 and 95 g/mol. (a) Determine its empirical formula. (b) Determine its molecular formula. [10%]

2. Name the following compounds in English [15%]:
   (a) $HClO_3$ (b) $NaMnO_4$ (c) $Ba(HCO_3)_2$ (d) $CuSO_4$ (e) $K_2Cr_2O_7$

3. Consider the following equilibrium process (3% each) [total 15%]:
   $N_2O_4(g) \rightleftarrows 2NO_2(g)$ $\Delta H° = 58.0 \, kJ$
   (a) Describe *Le Chatelier's Principle*
   Predict the changes in the equilibrium if —
   (b) the reaction mixture is heated at constant volume
   (c) more NO_2 is added to the mixture
   (d) the whole reaction mixture is compressed
   (e) What is (are) the unit(s) of the equilibrium constant for this reaction?

4. (a) Expalin the relationship between the strength of an acid and its equilibrium constant (4%); (b) List chemical formulas for two strong acids (3%); (c) List two weak bases (3%) [total 10%]

5. Calculate the pH of a 0.050 M HNO_2 ($K_a = 4.5 \times 10^{-4}$) solution [15%]

6. (a) Define *buffer solution* (4%); (b) List one application for a buffer solution; (c) Give an example (with compositions) of a buffer solution. [10%]

7. Write the Lewis structures for the following compounds [15%]
   (a) CS_2 (b) HNO_3 (c) H_2SO_4 (d) C_2H_3Cl (e) CH_2O

8. Urea, $(NH_2)_2CO$, is prepared by the following reaction —
   $2NH_3(g) + CO_2(g) \rightarrow (NH_2)_2CO(aq) + H_2O(l)$
   If 637.2 g of NH_3 are allowed to react with 1142 g of CO_2 (a) Which of the two reactants is the limiting reagent? (b) Calculate the mass of urea formed. [10%]