科目：普通化學　　　　　系所：化學工程及材料工程學系

是否使用計算機：是

考試時間：100 分鐘　　　本科原始成績：100 分

1. Write the formula for each compound: (4%)

   (a) calcium chloride (b) lithium nitride (c) potassium sulfate (d) sodium hypochlorite

2. A compound contains only C, H, and N. Combustion of 35.0 mg of the compound produces 33.5 mg CO_2 and 41.1 mg H_2O. What is the empirical formula of the compound? (atomic mass: C, 12.01; N, 14.01; H, 1.008) (8%)

3. If a sample containing 18.1 g of NH_3 is reacted with 90.4 g of CuO, which is the limiting reactant? The products of this reaction are nitrogen gas, solid copper, and water vaper. How many grams of N_2 will be formed? (atomic mass: O, 16.00; Cu, 63.55) (8%)

4. The 3p orbital has its maximum probability closer to the nucleus than for the 3s orbital. Explain why 3s orbital is lower in energy than the 3p orbitals in a polyelectronic atom? (4%)

5. Determine (1) the electron configuration, (2) bond order, and (3) magnetism for Cl_2^{2+} and NO^+. (8%)

6. Predict and explain which substance in each of the following pairs would have the greater intermolecular forces. (6%)

   a. CO_2 or OCS　　　b. SeO_2 or SO_2　　　c. CH_3OH or H_2CO

7. Why do the coldest temperatures in winter always occur on clear nights? Explain why. (3%)

8. Draw all resonance structures for N_3^-. Which resonance structure is the most stable one? Explain why. (5%)

9. Predict the hybridization of each atom for I_3^- and XeF_2, and describe their molecular structures. (8%)

10. Write Lewis structures that obey the octet rule for the following species. Assign the formal charge for each central atom.　(a) $POCl_3$　(b) NO_4^{3-} (6%)

11. Draw a figure (vapor pressure vs. composition) to show the solution behavior of acetone-water and compare it with that of ideal solution. Explain why. (6%)

12. Calculate the equilibrium concentrations of $H_2C_2O_4$, $HC_2O_4^-$, and $C_2O_4^{2-}$ of a 1.40 M $H_2C_2O_4$ solution. (K_{a1} = 6.5 x 10^{-2}, K_{a2} = 6.1 x 10^{-5})　(10%)

13. Analysis of a rock showed the ratio of $^{206}_{82}Pb$ atoms to $^{238}_{92}U$ atoms to be 0.115.　Assuming that no lead was originally present, calculate the age of the rock. ($t_{1/2}$ of $^{238}_{92}U$ =4.5 x 10^9 year, ln 2= 0.693) (9%)

14. Explain the difference between dipole-dipole forces and London dispersion forces. (4%)

15. Determine which one is likely to be water soluble. Explain why. (6%)

    (a) $CH_3(CH_2)_5NH_2$　　　　　　　(b) $CH_3CH(OH)NH_2$
    (c) $CH[N(C_6H_5)][NH(C_6H_5)]$

16. Give an example for Lewis acid (other than H^+) and Lewis base each, and write the Lewis adduct formed from the given Lewis acid and base. (5%)