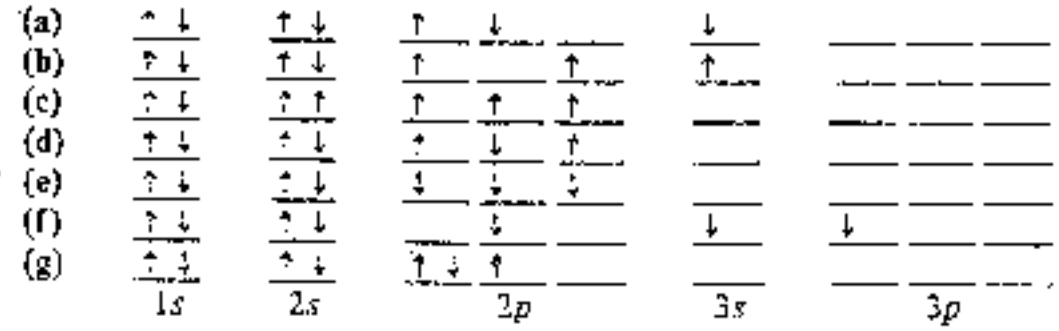
八十五學年度 輻射生物 系（所） 組碩士班研究生入學考試

科目 普通化學 科號 3907 共 2 頁第 1 頁 *請在試卷（答案卷）內作答

1. A buffer solution is made by mixing 0.100 mol of acetic acid and 0.400 mol of sodium acetate per liter of solution. Calculate the pH of this buffer. The equilibrium constant expression for HOAc is (8%)

$$K_a = \frac{[H_3O^+][OAc^-]}{[HOAc]} = 1.8\times10^{-5}\ M$$

2. Given below are several electronic configurations that may be correct for the nitrogen atom. Indicate whether each of these configurations represents the ground state, or an excited state, or is an impossible (forbidden) configuration for nitrogen. (7%)



3. Draw energy level diagrams showing the electronic configurations for the three species NO, NO^+, and NO^-. What is the bond order for each of these? Which of these three molecular species has the largest bond energy? (12%)

4. For the cell $Zn(s)|Zn^{2+}(1\ M)||Cu^{2+}(1\ M)|Cu(s)$ the measured EMF is 1.100 V. Write the equation for the anode reaction, the cathode reaction and the net cell reaction. (9%)

5. The C_p values at 25°C in joules per mole per kelvin are given for the following substances: Ar(g) 20.8, N_2(g) 29.3, $H_2O(l)$ 75.4, and Pb(s) 26.4. What is C_v for each of these substances? R is 8.314 $J\cdot mol^{-1}K^{-1}$. (8%)

6. What are the units of a second-order rate constant? (5%)

7. Predict the formulas of the carbonyl complexes of Cr and Ru. (8%)

8. The $Co(CN)_6^{3-}$ ion is not paramagnetic; its magnetic moment is zero. The CoF_6^{3-} ion, on the other hand, has a magnetic moment of 5.3 BM. Account for the difference between the magnetic properties of these two octahedral complexes using crystal field theory. (10%)

9. If molecules occupy the lattice points of a face-centered unit cell, how many molecules are there per unit cell? (8%)

10. A specimen of a sequoia tree is observed to emit β^- rays with a specific activity of 10.8 dpm/g of carbon. The radioactivity is due to ^{14}C, which has a half-life of 5730 yr. How long ago did the tree die?
At the time of death, which is zero time, the specific activity of the wood was 15.3 dpm/g of carbon, the value for living wood all over the earth. (10%)

11. Arrange the following three molecules in order of increasing boiling point: *n*-pen tanol (molecular weight 88.2); 2,2-dimethylbutane (molecular weight 86.2); ethyl *n*-propyl ether (molecular weight 88.2). (9%)

12. Balance the equation for the disproportionation of nitrous acid. (6%)