國立彰化師範大學105學年度碩士班招生考試試題

系所：化學系　　科目：無機化學與分析化學

☆☆請在答案紙上作答☆☆　　

I、無機化學 (50%)

一、選擇題 (30%)

1. Which of the following is an ionic compound?

   (A) H_2S　(B) NH_3　(C) I_2　(D) KI　(E) CCl_4

2. The lattice energy of $MgCl_2$ is the energy change for which one of the following processes?

   (A) $Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$

   (B) $Mg(g) + 2Cl(g) \rightarrow MgCl_2(s)$

   (C) $Mg^{2+}(s) + 2Cl^-(g) \rightarrow MgCl_2(g)$

   (D) $Mg^{2+}(g) + 2Cl^-(g) \rightarrow MgCl_2(s)$

   (E) $MgCl_2\ (aq) \rightarrow MgCl_2(s)$

3. According to VSEPR theory, a molecule with the general formula AX4E2 will have a _____ molecular shape.

   (A) tetrahedral　(B) square pyramidal　(C) square planar

   (D) octahedral　(E) seesaw

4. Which one of the following molecules does not have a dipole moment?

   (A) CS_2　(B) H_2S　(C) CH_2Cl_2　(D) PH_3　(E) CH_2O

5. The ground state electron configuration of Cr^{2+} is

   (A) $[Ar]4s^13d^5$　(B) $[Ar]4s^23d^4$　(C) $[Ar]3d^4$　(D) $[Ar]4s^13d^3$　(E) $4s^23d^2$

6. Which of the following will be diamagnetic?

   (A) Ni^{2+}　(B) Cr^{2+}　(C) Mn^{2+}　(D) Co^{3+}　(E) Ti^{4+}

7. Which of the following species could exist as isomers?

   (A) $[Co(H_2O)_4Cl_2]^+$　(B) $[Pt(NH_3)Br_3]^-$　(C) $[Pt(en)Cl_2]$

   (D) $[Pt(NH_3)_3Cl]^+$　(E) none of these choices is correct

8. Which of the following will have the highest boiling point?

   (A) O_2　(B) Cl_2　(C) Br_2　(D) I_2　(E) Xe

9. What elements are alloyed to make stainless steel?

   (A) Fe and C　(B) Fe and Mn　(C) Fe and Ni

   (D) Fe and Cr　(E) Fe, Cr and Ni

10. Select the element with the lowest first ionization energy.

    (A) Se　(B) S　(C) Sn　(D) Sr　(E) H

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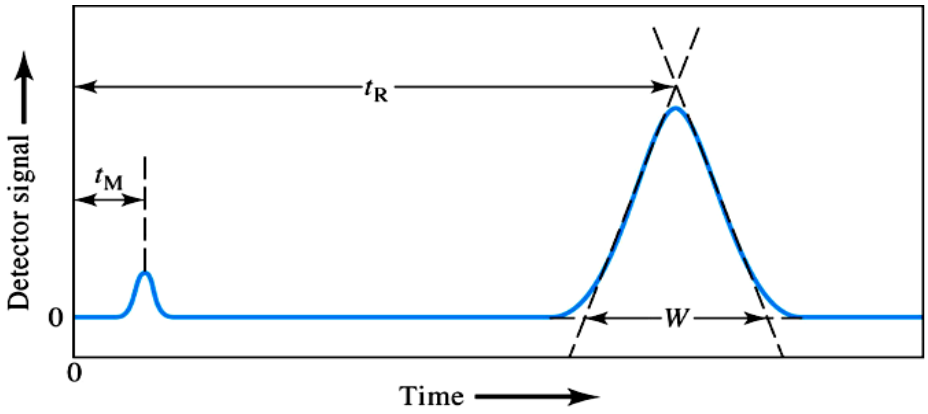
二、簡答題 (20%)

1. Explain what is meant by the term "bond order" and describe how it can be calculated using the information in a molecular orbital energy level diagram. (5%)
2. Draw all important resonance structures of the nitrate ion, NO_3^- (5%)
3. What is Heisenberg's uncertainty principle? Using formula to describe it. (5%)
4. Give Lewis dot structure and sketch the shapes of ICl_2^- (5%)

II、分析化學 (50%)

一、簡答與計算題 (50%)

1. A 0.50 M solution of a base is 8.0% hydrolyzed, find its K_b. (10%)
2. Calculate the pH of a solution that contains：
   (a) 0.70 M H_3PO_4 and 0.65 M NaH_2PO_4. (5%)
   (for H_3PO_4：$K_{a1} = 7.11\text{x}10^{-3}$, $K_{a2} = 6.32\text{x}10^{-8}$, $K_{a3} = 4.50\text{x}10^{-13}$)
   (b) 0.40 M Na_2CO_3 and 0.50 M $NaHCO_3$. (5%)
   (for H_2CO_3：$K_{a1} = 4.45\text{x}10^{-7}$, $K_{a2} = 4.69\text{x}10^{-11}$)
3. The following chromatogram is obtained from an HPLC separation,
   (a) How can you determine the number of plates (N) for the major peak? (5%)
   (b) If the column has a length of L, how can you determine the plate height (H)? (5%)



4. How would you prepare 1.0 L of the following solution：
   0.08 M H_2SO_4 from a reagent that has a density of 1.164 g/mL and is 20.9% H_2SO_4 (w/w)? (5%)
5. The Mg in a 0.80 g sample of stomach medicine was titrated with 27.50 mL of 0.02 M EDTA. Calculate the percent (w/w) Mg in this sample. (Mg = 24.305) (5%)
6. Derive the Nernst equations for the following half-cell reactions：
   (a) $MnO_4^- + 5e^- + 8H^+ \leftrightarrows Mn^{2+} + 4H_2O$ (5%)
   (b) $2H^+ + 2e^- \leftrightarrows H_{2\,(g)}$ (5%)