
UNIVERSITI SAINS MALAYSIA

Kursus Semasa Cuti Panjang
2007/2008 Academic Session

KTT 212 – Inorganic Chemistry II
[Kimia Takorganik II]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of SEVENTEEN pages of printed material before you begin the examination.

Instructions:

Answer **FIVE** (5) questions. **Section A** is **COMPULSORY**. Answer **TWO** (2) questions from **Section B**. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.

Answers each question on a new page.

You may answer the questions either in Bahasa Malaysia or in English.

In the event of any discrepancies, the English version shall be used.

Appendix: Tanabe-Sugano Diagram

...2/-

SECTION A

1. (a) Write down the IUPAC name for each of the following complexes and indicate the oxidation state of the metal and its electronic configuration.
- (i) $\text{K}[\text{Cr}(\text{ox})_2(\text{H}_2\text{O})_2] \cdot 3\text{H}_2\text{O}$
- (ii) $\text{CrCl}_3(\text{py})_3$
- (iii) $\text{K}_4[\text{Mn}(\text{CN})_6]$ (6 marks)
- (b) The hexaaquamanganese(II) ion contains five unpaired electrons, while the hexacyanomanganese(II) ion contains only one unpaired electron. Explain this, using crystal field theory. (5 marks)
- (c) Outline how you would apply crystal field theory to explain why the five *d* orbitals in an octahedral complex are not degenerate. (5 marks)
- (d) The observed magnetic moment for $\text{K}_3[\text{TiF}_6]$ is $1.70 \mu_{\text{B}}$. Calculate μ (spin-only) for this complex. (4 marks)
2. (a) Explain briefly each of the following:
- (i) High spin complex.
- (ii) Binuclear complex.
- (iii) Five coordinate complex.
- (iv) Metal chelate. (8 marks)
- (b) Describe the formation of the following complexes by based on Werner Theory.
- (i) $\text{NH}_4[\text{Co}(\text{NCS})_4(\text{NH}_3)_2]$
- (ii) $[\text{Co}(\text{en})_3]_2(\text{SO}_4)_3$ (6 marks)

- (c) The stepwise formation constants (K) for the reaction between Ni^{2+} and ethylenediamine in aqueous solution are given as follows:

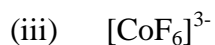
$$\log K_1 = 7.5 \quad \log K_2 = 6.4 \quad \log K_3 = 4.4$$

- (i) Write the equation for β_n in each step (where $n = 1, 2$ and 3).
- (ii) Calculate the value of $\log \beta$.

(6 marks)

SECTION B

4. (a) Which of the following complexes would you expect to experience a Jahn-Teller distortion:



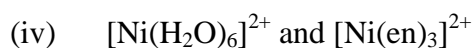
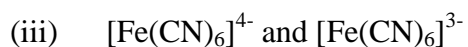
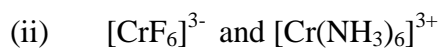
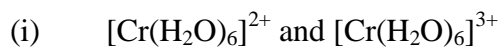
Give reasons for your answer.

(5 marks)

(b) Briefly explain the principles involve in molecular orbital theory (MO).

(7 marks)

(c) For which member of the following pairs of complexes, Δ_{oct} would be larger and state why:



(8 marks)

5. (a) The enthalpies of hydration, $-\Delta H$, at 25 °C for transition metal ions which form hexaaqua species are given as follows:

<u>Ion</u>	<u>$-\Delta H$ (kJ mol⁻¹)</u>
Ca ²⁺	2467
V ²⁺	2776
Cr ²⁺	2794
Mn ²⁺	2735
Fe ²⁺	2884
Co ²⁺	2915
Ni ²⁺	2994
Cu ²⁺	2998
Zn ²⁺	2932

- (i) Plot the enthalpies of hydration, $-\Delta H$ (y axis) versus the number of d electrons (x axis).
- (ii) Explain the pattern of graph as obtained from (i). (10 marks)
- (b) Draw the structure for each of the following compounds:
- (i) 1-chloro-3-bromoamminepyridineplatinum(II)
- (ii) anion bis(oxalato)cobalt(III)-di- μ -hydroxobis(oxalato)cobalt(III)
- (iii) bis(glicinato)cobalt(III)-di- μ -hydroxobis(glicinato)cobalt(III)
(glicinato = NH₂CH₂CO₂⁻) (6 marks)
- (c) How to differentiate the ionization isomer from the linkage isomer? (4 marks)

6. (a) Define the following terms:
- (i) Coordination complex
 - (ii) Coordination numbers
 - (iii) Pauling electroneutrality principle

(7 marks)

- (b) Transition metal complex does appear to have colour. Explain by using crystal field theory.

(7 marks)

