國立臺灣師範大學103學年度碩士班招生考試試題

科目：無機化學　　適用系所：化學系

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

(1) Draw the crystal field splitting energy diagram of the d-block complexes that have a trigonal Bipyramidal geometry. (10 points)

(2) A tetracoordinated complex Mabcd is known to have stereoisomers. Please draw the 3-D structures for all the possible stereoisomers. (M stands for the central metal ion and a, b, c, and d each stand for a monodentate ligand) (10 points)

(3) Draw and mark the symbols (Δ and Λ) for the enantiomers of $Cr(acac)_3$. (10 points)

(4) The magnetic moment of $[Mn(en)_2Br(NO)]^+$ is 6.06 μ_B (B.M.) and en is the abbreviation for ethylenediamine. Please answer the following questions. (20 points)

(a) Draw the structure for en.

(b) How many lone pair electrons does the central Mn ion have?

(c) Draw the d-orbital energy splitting diagram for the Mn ion.

(d) Draw all stereoisomers for $[Mn(en)_2Br(NO)]^+$.

(5) Calculate the lattice energy for $NaCl_{(s)}$ ($Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$) by Born-Haber cycle. Ionization energy of $Na_{(g)}$ is 496 kJ/mol, sublimation of $Na_{(s)}$ is 108 kJ/mol, dissociation of $Cl_{2(g)}$ is 244 kJ/mol, electron affinity of $Cl_{(g)}$ is 349 kJ/mol, and formation of $NaCl_{(s)}$ is –411 kJ/mol. (10 points)

(6) Which of the following species are nonpolar? (a) PH_3 (b) H_2Se (c) CH_2Cl_2 (d) IF_5 (e) NO_3^- (f) O_3 (g) SO_4^{2-} (h) NH_4^+ (i) I_3^- (j) PCl_5 (10 points)

(7) Construct the MO diagram of N_2 and use the diagram to explain why N_2 is a very stable molecule. (10 points)

(8) What is the ratio of the edge length of the unit cell for a body-centered cubic crystal to the radius of the atoms in the crystal? (10 points)

(9) The point group of $Mn(CO)_5Cl$ is C_{4v}. Please find the IR active modes for the CO stretching vibrations of $Mn(CO)_5Cl$? (10 points)

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$		
A_1	1	1	1	1	1	z	x^2-y^2, z^2
A_2	1	1	1	−1	−1	R_z	
B_1	1	−1	1	1	−1		x^2-y^2
B_2	1	−1	1	−1	1		xy
E	2	0	−2	0	0	$(x, y)(R_x, R_y)$	(xz, yz)