I. 60% 單選題，每題答對得四分，答錯扣一分。

1. What is the number of microstates for an f^3 configuration?
   (A) 140　　　　(B) 182　　　　(C) 210　　　　(D) 364

2. Which is the ground-state term for the d^4 configuration?
   (A) ^5I　　　　(B) ^3H　　　　(C) ^5D　　　　(D) ^3I

3. Which atom has the higher electron affinity (EA)?　$X_{(g)} + e^- \rightarrow X^-_{(g)}$　$\Delta H = -EA$
   (A) V　　　　(B) Mn　　　　(C) Re　　　　(D) Au

4. What is the shape of TeF_4?
   (A) pyramidal　　　(B) seesaw　　　(C) square planar　　(D) tetrahedral

5. What is the point group for F_2SeO? (Se is the center atom.)
   (A) C_s　　　　(B) C_2　　　　(C) C_{2v}　　　　(D) C_{2h}

6. What is the point group for the $[Mo_6Cl_8]^{4+}$ ion?　Each Cl ligand is located in the corner of a cube and each Mo atom is located in the face-center.
   (A) D_{4h}　　　　(B) T_d　　　　(C) T_h　　　　(D) O_h

7. What is the point group for the $nido$-$[B_6H_6]^{4-}$ ion?
   (A) C_{2v}　　　　(B) C_{3v}　　　　(C) C_{5v}　　　　(D) D_{3h}

8. Which is diamagnetic?
   (A) B_2　　　　(B) C_2^{2-}　　　　(C) O_2　　　　(D) NO^-

9. Which is the ground-state term for O_2?
   (A) $^3\Sigma$　　　　(B) $^3\Pi$　　　　(C) $^1\Delta$　　　　(D) $^3\Delta$

10. Which of the following species does not obey the 18-electron rule?
    (A) $(\eta^5$-$C_5Me_5)Re(=O)_3$　　　　(B) $Cr(CPh)(CO)_4$
    (C) $[Fe(CO)_3(NO)]^-$ (Fe-N-O: linear)　　(D) $CH_3Mn(CO)_5$

11. Which one of the following complexes has the lowest water exchange rate?
    (A) $[Mg(H_2O)_6]^{2+}$　　(B) $[V(H_2O)_6]^{2+}$　　(C) $[Cr(H_2O)_6]^{3+}$　　(D) $[Al(H_2O)_6]^{3+}$

12. cis-ML_4AX　+　Y　$\rightarrow$　ML_4AY　+　X　(M: metal center; L, A, X, and Y: ligands)
    The substitution reaction is believed to proceed by "dissociation mechanism" with trigonal bipyramid structure as the intermediate.　What is the ratio of cis and $trans$ products?
    (A) 3:1　　　　(B) 4:1　　　　(C) 5:1　　　　(D) 6:1

13. Which is an intercalation compound?　[C222: $N\{(C_2H_4O)_2C_2H_4\}_3N$]
    (A) $[Na^+(C222)]Na^-$　(B) $YBa_2Cu_3O_7$　(C) $Y_2@C_{60}$　(D) Li_xMoS_2

14. Which has a stronger acidity?
    (A) $B_{16}H_{20}$　　　　(B) $B_{10}H_{14}$　　　　(C) B_6H_{10}　　　　(D) B_5H_9

（背面仍有題目，請繼續作答）

15. Which is the active metal in water oxidation center of photosynthesis system II?
    (A) Mg　　　　　　(B) Mn　　　　　　(C) Fe　　　　　　(D) Co

II. 1. Use **molecular orbital** theory to explain the following observations.
8%　(A) The first ionization energy of N_2 (1501 kJ/mol) is greater than the first ionization energy
    of atomic nitrogen (1402 kJ/mol).
    (B) The first band in photoelectron spectrum of molecule oxygen shows a progression with
    an interval of 1774 cm^{-1}. The vibration frequency of molecular oxygen is 1568 cm^{-1}

2. Using the character table provided below.
10% (A) To find the irreducible representations of π bonds of BF_3.

    (B) To find the number and symmetry species of the Raman and infrared active vibrations of
    BF_3. (It is important to show your derivation.)

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A_1'	1	1	1	1	1	1		x^2+y^2, z^2
A_2'	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x,y)	(x^2-y^2, xy)
A_1''	1	1	1	-1	-1	-1		
A_2''	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(xz, yz)

3. Arrange the following complexes in increasing order of radius for the iron ion. Explain.
8%　(A) $[Fe(CN)_6]^{3-}$　　　　(B) $[Fe(H_2O)_6]^{2+}$　　　　(C) $[Fe(CN)_6]^{4-}$

4. What is the color of the following? Account for the color of the following.
6%　(A) K_2CrO_4　　　　(B) $[Cu(NH_3)_4]^{2+}$　　　　(C) $KFeFe(CN)_6$

5. Predict the **structures** of the reaction products.
8%

(A) + $P(CH_3)Ph_2 \longrightarrow$

(B) + $H_2 \longrightarrow$

(C) $\xrightarrow{\beta - \text{elimination}}$

(D) + $F_2C=CF_2 \longrightarrow D$