

系所組別： 化學系

考試科目： 無機化學

考試日期： 0219 · 節次： 3

※ 考生請注意：本試題  可  不可 使用計算機

請勿在本試題紙上作答，否則不予計分

一 選擇題 (每題 4 分)

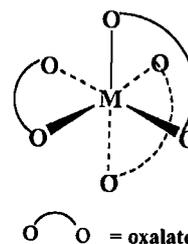
1. For a six-coordinate complex with an octahedral geometry such as  $M(L)_6$  complex, what is likely interaction between  $d_{xz}$  orbital of metal and  $p_x$  orbital of ligand? (a) no interaction, (b)  $\sigma$  interaction, (c)  $\pi$  interaction, (d)  $\delta$  interaction)

2. What is the order of acidity in gas phase? (a)  $SiH_4 < PH_3 < H_2S < HCl$  (b)  $SiH_4 > PH_3 > H_2S > HCl$  (c)  $PH_3 < H_2S < HCl < SiH_4$  (d)  $H_2S < HCl < SiH_4 < PH_3$

3. Please order the bond dissociation energy for the following species  $C_2^+$ ,  $C_2$ ,  $C_2^-$   
 (a)  $C_2^- > C_2 > C_2^+$  (b)  $C_2^+ > C_2 > C_2^-$  (c)  $C_2^+ = C_2 = C_2^-$  (d)  $C_2 > C_2^- > C_2^+$

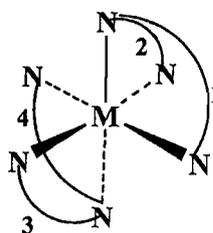
4. Determine the chirality label for the complex on the right.

(a)  $\lambda$  (b)  $\delta$  (c)  $\Delta$  (d)  $\Lambda$

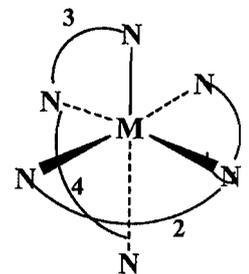


5. Which of the following statement for compound I and compound II shown on the right figure is incorrect?

- a) compound I is a facial form
- b) compound II is a meridional form
- c) compounds I and II are geometric isomers
- d) compound I and II are optical isomers



Compound I



Compound II

6. Which of the following compound is most likely to stabilize dihydrogen species rather than dihydride species?

(a)  $Mo(PMe_3)_5H_2$  (b)  $Mo(PF_3)_5H_2$  (c)  $Mo(PMe_3)_4(CO)H_2$  (d)  $Mo(PF_3)_4(CO)H_2$

7. Which of the following metalloproteins does not play the role for electron transfer?

(a) iron sulfur protein (b) coenzyme  $B_{12}$  (c) cytochrome a (d) blue copper protein

8. Which metal shown below has the most affinity for binding to the amino acid, methionine?

(a)  $Cu^{2+}$ , (b)  $Co^{3+}$ , (c)  $Hg^{2+}$  (d)  $Fe^{2+}$

(背面仍有題目, 請繼續作答)

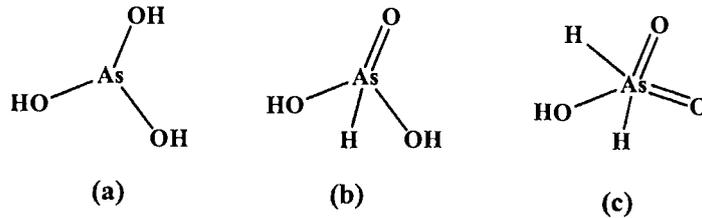
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9. The pK value for arsenious acid,  $H_3AsO_3$ , is 9.2. What is the likely structure for  $H_3AsO_3$  that is consistent with the value?



10. Considering a  $ML_6$  complex, how many of the following complexes have strong Jahn-Teller effects? high-spin  $d^3$  complex, low-spin  $d^3$  complex, high-spin  $d^4$  complex, high spin  $d^5$  complex,, low-spin  $d^7$  complex, high-spin  $d^7$  complex,  $d^9$ -complex

- (a) 6 (b) 5 (c) 4 (d) 3 (e) 2

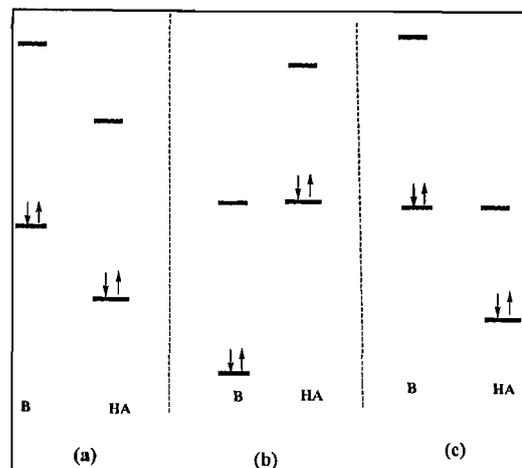
11. What is the number of atoms in each unit cell of a faced centered cubic structure?

- a) 1      b) 2      c) 3      d) 4

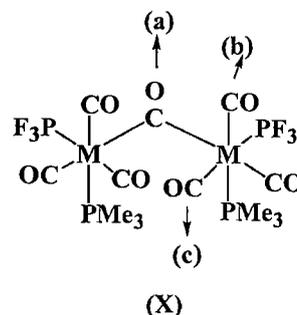
12. Which of the following is not the Lattice point of a faced centered cubic structure

- a) (0,0,0)      b) (1/2, 1/2, 0)      c) (1/2, 1/2, 1/2)      d) (1/2, 0, 1/2)      e) (0, 1/2, 1/2)

13. HA and B has a very strong hydrogen bonding. Which one is the possible MO diagram for the frontier orbitals of HA and B? (a), (b), or (c)?



14. Please predict the order of the bond distance for different CO (a, b, and c) in compound X on the right. (a)  $a > c > b$  (b)  $b > c > a$  (c)  $a > b > c$  (d)  $c > a > b$



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15. determine the valence electron count for the transition metal in  $[(\eta^5\text{-C}_5\text{H}_5)(\text{cis-}\eta^4\text{-C}_4\text{H}_6)\text{Fe}(\text{PMe}_3)(\text{H})]$   
 (a) 20 (b) 19 (c) 18 (d) 17 (e) 16

## 二 簡答題 (每題 4 分)

Considering the character table of  $C_{3v}$ , and answer the following three questions.

$C_{3v}$	$E$	$3\sigma_v$	$2C_3$	
$A_1$	1	1	1	
$A_2$	1	-1	1	Rz
$E$				(x,y), (Rx,Ry)

1. What are characters for  $E$  representation?
2. What is the irreducible representation for  $z$  coordinate in this point group?
3. How many bands do you expect in IR spectrum for  $\text{NH}_3$  molecule?
4. Please indicate the point group of cyclohexane (chair conformation)
5. How many microstates for an  $s^1p^1$  configuration?
6. Determine the ground terms for low-spin  $d^7$  configurations in  $O_h$  symmetry.

The electronic spectrum of  $[M(\text{H}_2\text{O})_6]^{n+}$  and the simplified Tanabe-Sugano Diagrams in octahedral ligand field are shown in the appendix. Please answer the following two questions.

7. Please indicate the term of the ground state for  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$
8. Please indicate the term of the ground state for  $[\text{Fe}(\text{CN})_6]^{4-}$
9. Please draw the ligand acetylacetonato (acac).
10. Please draw the d-orbitals splitting diagram for a five-coordinate complex with trigonal bipyramidal geometry.

(背面仍有題目,請繼續作答)

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# Appendix

