

淡江大學八十八學年度日間部轉學生招生考試試題

系別：化學系三年級

科目：普通化學

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普通化學

轉學生入學考試 p. 1/3

一九九九年 七月

第一部份 -- 選擇題 【以下二十題選擇題，各題皆只有一個答案是正確的，請將之選出，依題目次序書寫於答案紙上。答對一題給四分，共 80 分。】

- 1 Which of the following species has the highest absolute entropy (S°) at 25°C ?
 a) CO(g) b) $\text{CH}_4\text{(g)}$ c) NaCl(s) d) $\text{H}_2\text{O(l)}$ e) Fe(s)
2. The equilibrium constant for the reaction: $\text{AgBr(s)} \rightleftharpoons \text{Ag}^+\text{(aq)} + \text{Br}^-\text{(aq)}$ is the solubility product constant, $K_{sp} = 7.7 \times 10^{-13}$ at 25°C . (A) Calculate ΔG for the reaction when $[\text{Ag}^+] = 1.0 \times 10^{-2} \text{ M}$ and $[\text{Br}^-] = 1.0 \times 10^{-3} \text{ M}$. (B) Is the reaction spontaneous or nonspontaneous at these concentrations?
 a) $\Delta G = 69.1 \text{ kJ}$, nonspontaneous b) $\Delta G = -69.1 \text{ kJ}$, spontaneous c) $\Delta G = 97.5 \text{ kJ}$, spontaneous
 d) $\Delta G = 40.6 \text{ kJ}$, nonspontaneous e) $\Delta G = -97.5 \text{ kJ}$, nonspontaneous
3. Which of the following reactions are accompanied by an increase in entropy?
 (1) $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_3\text{(g)}$ (2) $\text{H}_2\text{O(l)} \rightarrow \text{H}_2\text{O(s)}$ (3) $\text{Br}_2\text{(l)} \rightarrow \text{Br}_2\text{(g)}$
 (4) $\text{H}_2\text{O}_2\text{(l)} \rightarrow \text{H}_2\text{O(l)} + 1/2\text{O}_2\text{(g)}$
 a) 1, 2, 3, 4 b) 1, 2 c) 2, 3, 4 d) 3, 4 e) 1, 4
4. Sodium carbonate can be made by heating sodium bicarbonate:
 $2\text{NaHCO}_3\text{(s)} \rightarrow \text{Na}_2\text{CO}_3\text{(s)} + \text{CO}_2\text{(g)} + \text{H}_2\text{O(g)}$.
 Given that $\Delta H^\circ = 128.9 \text{ kJ}$ and $\Delta G^\circ = 33.1 \text{ kJ}$ at 25°C , above what minimum temperature will the reaction become spontaneous under standard conditions?
 a) 0.4 K b) 3.9 K c) 321 K d) 401 K e) 525 K
5. Calculate the lattice energy for LiF(s) given the following:
 Sublimation energy for $\text{Li(s)} = +166 \text{ kJ/mol}$, Dissociation energy for $\text{F}_2\text{(g)} = +154 \text{ kJ/mol}$
 First ionization energy of $\text{Li(g)} = +520 \text{ kJ/mol}$, Electron affinity of $\text{F(g)} = -328 \text{ kJ/mol}$
 Enthalpy (heat) of formation of $\text{LiF(s)} = -617 \text{ kJ/mol}$
 a) 285 kJ/mol b) -650 kJ/mol c) -941 kJ/mol d) -1047 kJ/mol e) -1425 kJ/mol
6. Using the following bond energies (in kJ/mol):
- | Bond | Bond energy | Bond | Bond energy | Bond | Bond energy |
|--------------------------|-------------|---------------------|-------------|---------------------|-------------|
| $\text{C}\equiv\text{C}$ | 839 | $\text{C}-\text{H}$ | 413 | $\text{O}=\text{O}$ | 495 |
| $\text{C}=\text{O}$ | 799 | $\text{O}-\text{H}$ | 467 | | |
- estimate ΔH , the heat of combustion, of one mole of acetylene
 $\text{C}_2\text{H}_2\text{(g)} + (5/2)\text{O}_2\text{(g)} \rightarrow 2\text{CO}_2\text{(g)} + \text{H}_2\text{O(g)}$
 a) 1228 kJ b) -1228 kJ c) -447 kJ d) +447 kJ e) +365 kJ
7. Which one of the following sets of quantum numbers is unacceptable?
- | n | m | m_l | m_s | n | m | m_l | m_s | n | m | m_l | m_s |
|------|---|-------|-------|------|---|-------|-------|------|---|-------|-------|
| a) 4 | 3 | -2 | +1/2 | b) 3 | 0 | 1 | -1/2 | c) 3 | 0 | 0 | +1/2 |
| d) 2 | 1 | 1 | -1/2 | e) 2 | 0 | 0 | +1/2 | | | | |
8. According to VSEPR theory, which of the following species has a square planar structure?
 a) TeBr_4 b) BF_4^- c) CCl_4 d) XeF_4 e) SF_4

◀ 注意背面尚有試題 ▶

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9. The molecular orbital electron configuration of B_2 is:
- a) $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2px})^1 (\pi_{2py})^1$ b) $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2px})^2$
c) $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2$ d) $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2pz})^2$
e) $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2pz})^1 (\pi_{2px})^1$
10. Which of the following statements is false?
- a) Atoms or molecules with an even number of electrons must be diamagnetic.
b) Atoms or molecules with an odd number of electrons must be paramagnetic.
c) Paramagnetism cannot be deduced necessarily from the Lewis structure of a molecule.
d) Paramagnetic molecules are attracted into a magnetic field.
e) N_2 molecules are diamagnetic.
11. Specify the hybridization of the sulfur atom in each of the following species, respectively:
- SO_4^{2-} SF_6 SF_4
- a) sp^2, d^2sp^3, sp^2 b) sp^3, d^2sp^3, dsp^3 c) sp^3, dsp^2, sp^3
d) sp^3, d^2sp^3, sp^3 e) sp^2, d^2sp^3, sp^3
12. Which one of the following species would you expect to have the longest bonds?
- a) CN^+ b) CN c) CN^- d) NO^+
e) All four of the above species have approximately the same bond length.
13. The rate constant for a reaction at $40.0^\circ C$ is exactly three times that at $20.0^\circ C$. Calculate the Arrhenius energy of activation for the reaction.
- a) 3.00 kJ/mol b) 366 kJ/mol c) 41.9 kJ/mol d) 3.66 kJ/mol e) 36.6 kJ/mol
14. The molecules in a sample of solid SO_2 are attracted to each other by a combination of:
- a) London forces and H-bonding. b) H-bonding and ionic bond.
c) Covalent bonding and dipole-dipole interactions. d) London forces and dipole-dipole interactions.
e) Covalent bonding and London forces.
15. Which of the following liquids would have the highest viscosity at $25^\circ C$?
- a) CH_3OCH_3 b) CH_2Cl_2 c) $CH_2OHCHOHCH_2OH$ d) $CHBr_3$ e) $HOCH_2CH_2OH$
16. Doping Si with As would produce a(n) _____ semiconductor with _____ conductivity compared to pure Si.
- a) n-type, increased b) n-type, decreased c) p-type, increased
d) p-type, decreased e) intrinsic, identical
17. Solid $BaCl_2$ has the same crystal structure as fluorite CaF_2 . How many chloride ions surround each Ba^{+2} ion as nearest neighbors in $BaCl_2$?
- a) 4 b) 6 c) 8 d) 12 e) none of these

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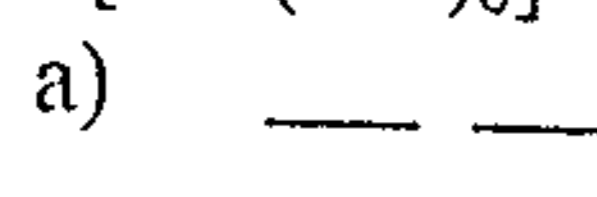
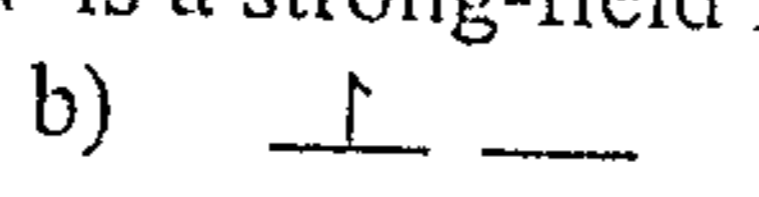



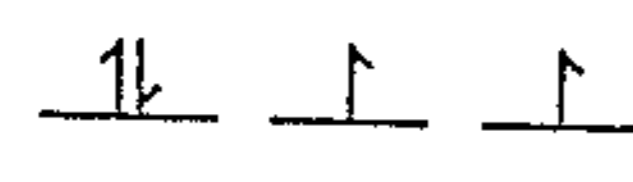

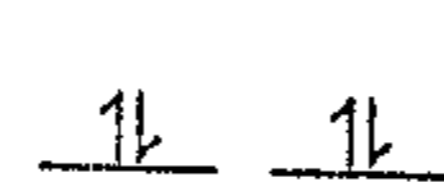
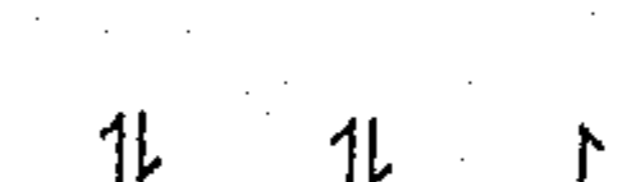

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18. A salt, MY, crystallizes in a simple cubic structure with a Y^- anion at each cube corner and an M^+ cation at the cube center. Assuming that Y^- anions touch each other and also touch the M^+ cation at the center, and the radius of Y^- is 150 pm, the radius of M^+ is:

- a) 62.0 pm b) 110 pm c) 124 pm d) 220 pm e) none of these

19. Which of the following energy level diagrams shows the correct electron distribution of the 3d electrons in $[Mn(CN)_6]^{3-}$? (CN^- is a strong-field ligand.)

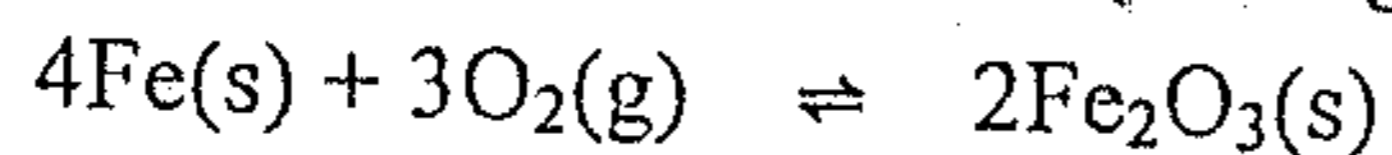
- a)  b)  c)  d)  e) 
-     

20. Give the number of geometrical isomers for the octahedral compound $[MA_2B_2C_2]$, where A, B, and C represent monodentate ligands.

- a) 1 b) 2 c) 3 d) 5 e) none of these

第二部份 -- 問答與計算題 【共 20 分。】

1. The overall reaction for the corrosion (rusting) of iron by oxygen is



Using the following data, calculate the equilibrium constant for the reaction at 25°C.

Substance	ΔH_f° (kJ/mol)	S° (J K ⁻¹ mol ⁻¹)
Fe ₂ O ₃ (s)	-826	90
Fe(s)	0	27
O ₂ (g)	0	205

(10)

2. Give eight possible Lewis structures for XeO₃, an explosive compound of xenon. Indicate which is the most important and which is the least important Lewis structure(s).

(10)

Gas constant $R = 8.314510 \text{ J K}^{-1} \text{ mol}^{-1} = 0.082056 \text{ L atm K}^{-1} \text{ mol}^{-1}$

1 Cal = 4.184 J