

淡江大學八十九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

本試題共 三 頁

普通化學

轉學生招生考試 p. 1/3

二〇〇〇年七月

本試題雙面印製

第一部份 -- 選擇題 【以下二十五題選擇題，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。答對一題給三分，共 75 分。】

- 5.02 g of an unknown gas is sealed in a 1.0 L flask at 37°C and 3.75 atm. Which one of the following is most likely to be the unknown?
A. H₂O B. HBr C. HCN D. H₂S E. C₂H₂
- The combustion of butane produces heat according to the equation:
$$2\text{C}_4\text{H}_{10}(\text{g}) + 13\text{O}_2(\text{g}) \longrightarrow 8\text{CO}_2(\text{g}) + 10\text{H}_2\text{O}(\text{l}) \quad \Delta H_{\text{rxn}} = -5314 \text{ kJ}$$

How many grams of CO₂ are produced per 1.00 x 10⁴ kJ of heat?
A. 23.4 g B. 44.0 g C. 82.3 g D. 187 g E. 662 g
- The electron configuration of a vanadium atom (V) is:
A. [Ar]4s²4d³ B. [Ar]4s²4p³ C. [Ar]4s²3d³ D. [Ar]3d⁵ E. [Ar]4s¹3d⁴
- The total number of bonding electrons in a molecule of SO₂ is:
A. 3 B. 4 C. 6 D. 8 E. 18
- Which one of the following molecules has sp² hybridization at the central atom?
A. SO₂ B. N₂O C. BeCl₂ D. NF₃ E. PF₅
- The number of nearest neighbors (atoms that make contact) around each atom in a face-centered cubic lattice of a metal is:
A. 2 B. 4 C. 6 D. 8 E. 12
- What is the freezing point of an aqueous solution of a nonvolatile solute that has a boiling point of 102.5°C? For water K_f = 1.86°C/m and K_b = 0.52°C/m.
A. -8.94°C B. -366°C C. -0.99°C D. 0.99°C E. 8.94°C
- The activation energy for the reaction: $\text{O} + \text{O}_3 \longrightarrow 2\text{O}_2$ is 25 kJ/mol, and the enthalpy change is $\Delta H = -388 \text{ kJ}$. What is the activation energy for the decomposition of O₂ by the reverse reaction?
A. 413 kJ B. 388 kJ C. 363 kJ D. 50 kJ E. 25 kJ
- For the equilibrium reaction: $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{SO}_3(\text{g}) \quad \Delta H = -198 \text{ kJ}$ which one of the following factors would cause the equilibrium constant value to increase?
A. decrease the temperature B. add SO₂ gas C. remove O₂ gas D. add a catalyst
E. none of the above
- Calculate the hydrogen ion concentration in a solution of fruit juice whose pH is 4.25.
A. 1.0x10⁻¹⁴ M B. 5.6x10⁻⁵ M C. 4.0x10⁻²⁵ M D. 2.5x10⁻⁴ M E. 5.6x10⁻⁴ M
- Which of the following reactions are accompanied by an increase in entropy?
(1) $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow \text{SO}_3(\text{g})$ (2) $\text{H}_2\text{O}(\text{l}) \longrightarrow \text{H}_2\text{O}(\text{s})$ (3) $\text{Br}_2(\text{l}) \longrightarrow \text{Br}_2(\text{g})$
(4) $\text{H}_2\text{O}_2(\text{l}) \longrightarrow \text{H}_2\text{O}(\text{l}) + 1/2\text{O}_2(\text{g})$
A. 1, 2, 3, 4 B. 1, 2 C. 2, 3, 4 D. 3, 4 E. 1, 4
- CaCO₃ is least soluble in:
A. water B. 0.20 M CaCl₂ C. 0.10 M Na₂CO₃ D. 0.10 M HCl E. 0.20 M NaCl
- The value of K_{sp} at 25°C for AgI(s) in water is 8.3x10⁻¹⁷ M. Calculate ΔG_{rxn} at 25°C for the process:
$$\text{Ag}^+(\text{aq}, 1.0 \times 10^{-13} \text{ M}) + \text{I}^-(\text{aq}, 5 \times 10^{-3} \text{ M}) \longrightarrow \text{AgI}(\text{s})$$

A. +4.4 kJ B. +91.7 kJ C. 0.0 kJ D. -91.7 kJ E. -4.4 kJ
- The half-reaction that occurs at the cathode during electrolysis of aqueous sodium iodide solution is:
A. $\text{Na}^+ + \text{e}^- \longrightarrow \text{Na}$ B. $\text{Na} \longrightarrow \text{Na}^+ + \text{e}^-$ C. $2\text{H}_2\text{O} + 2\text{e}^- \longrightarrow \text{H}_2 + 2\text{OH}^-$
D. $\text{I}_2 + 2\text{e}^- \longrightarrow 2\text{I}^-$ E. $2\text{I}^- \longrightarrow \text{I}_2 + 2\text{e}^-$
- A complex with the composition [MA₂B₂]X₂ is found to have no geometrical isomers. Both A and B are monodentate ligands. The structure of the complex is:
A. linear B. square planar C. tetrahedral D. square pyramidal E. octahedral

◀ 注意背面尚有試題 ▶

淡江大學八十九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

本試題共 三 頁

普通化學

轉學生招生考試 p. 2/3

二 000 年 七月

16) When 0.56 g of Na(s) react with excess F₂(g) to form NaF(s), 13.8 kJ of heat are evolved at standard state conditions. What is the standard enthalpy of formation (ΔH_f^o) of NaF(s)?

- A. 24.8 kJ/mol B. +570 kJ/mol C. -24.8 kJ/mol D. -7.8 kJ/mol E. -570 kJ/mol

17) 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 | | | | |

18) Calculate the energy change for the reaction: $K(g) + Br(g) \longrightarrow K^+(g) + Br^-(g)$

Given the following ionization energy (IE) and electron affinity(EA) values.

	IE	EA
K	419 kJ/mol	-48 kJ/mol
Br	1140 kJ/mol	-324 kJ/mol

- A. -1092 kJ/mol B. -95 kJ/mol C. 95 kJ/mol D. 1092 kJ/mol E. 1187 kJ/mol

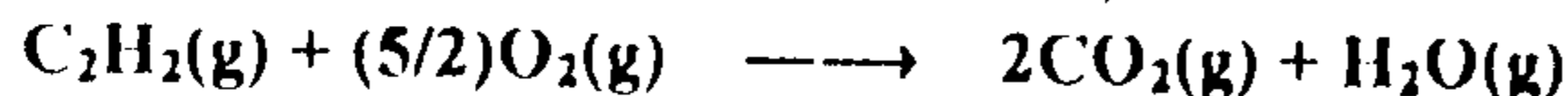
19) The bond angle in Cl₂O is expected to be approximately:

- A. 90 B. 109.5 C. 120 D. 145 E. 180

20) Using the following bond energies (in kJ/mol):

Bond	Bond energy	Bond	Bond energy	Bond	Bond energy
C≡C	839	C-H	413	O=O	495
C=O	799	O-H	467		

estimate ΔH, the heat of combustion, of one mole of acetylene



- A. 1228 kJ B. -1228 kJ C. -447 kJ D. +447 kJ E. +365 kJ

21) Phenoxide ion (C₆H₅O⁻) is a weak base, with K_b = 7.7x10⁻⁵. Calculate the pH of a 0.20 M solution of C₆H₅O⁻?

- A. 11.6 B. 3.9 x 10⁻³ C. 2.4 D. 9.2 E. 8.9

22) Gaseous N₂O₅ decomposes according to the equation $N_2O_5(g) \longrightarrow 2NO_2(g) + 1/2O_2(g)$.

The experimental rate law is:

$$-\frac{\Delta[N_2O_5]}{\Delta t} = k[N_2O_5]$$

At a certain temperature, the rate constant is k = 5.0x10⁻⁴ s⁻¹. How many seconds will it take for the concentration of N₂O₅ to decrease to one-tenth of its initial value?

- A. 2.0x10³ s B. 4.6x10³ s C. 2.1x10² s D. 1.4x10³ s E. 5.0x10⁻³ s

23) Equilibrium is established for the reaction: $2X(g) + Y(g) \rightleftharpoons 2Z(g)$ K_c = 100 at 500 K.

Determine the concentration of Z in equilibrium with 0.2 mol of X and 0.50 M Y at 500 K is:

- A. 3.2 M B. 3.5 M C. 4.5 M D. 7.1 M E. none of the above

24) Given that the normal freezing point of ammonia is -78°C. Predict the signs of ΔH, ΔS, and ΔG for ammonia when it freezes at -80°C and 1 atm.



- | ΔH | ΔS | ΔG | ΔH | ΔS | ΔG | ΔH | ΔS | ΔG |
|------|----|----|------|----|----|------|----|----|
| A. - | - | 0 | B. - | + | - | C. + | - | + |
| D. + | + | 0 | E. - | - | - | | | |

25) Which response gives the correct coordination number (C.N.) and oxidation number (O.N.) of the transition metal atom in [Co(NH₃)₂(H₂O)₂Cl₂]⁺?

- A. C.N. = 2; O.N. = +3 B. C.N. = 3; O.N. = +1 C. C.N. = 4; O.N. = +2
D. C.N. = 6; O.N. = +1 E. C.N. = 6; O.N. = +3

淡江大學八十九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

本試題共 三 頁

普通化學

轉學生招生考試 p. 3/3

二 000 年 七月

=====

第二部份 -- 問答與計算題 【 共 25 分。 】

- 1) How does the geometrical structure of PF_5 differ from that of IF_5 ? Is IF_5 a polar or nonpolar molecule? (5)
- 2) The activation energy for a certain reaction is 113 kJ/mol. How many times will the rate constant increase when the temperature is raised from 310 K to 325 K? (5)
- 3) What ratio of benzoate ion to benzoic acid would be required to prepare a buffer with a pH of 5.20? [$K_a(\text{C}_6\text{H}_5\text{COOH}) = 6.5 \times 10^{-5}$] (5)
- 4) For the reaction $3\text{H}_2 + \text{N}_2 \longrightarrow 2\text{NH}_3$ $K_c = 9.0$ at 350°C .
 - (a) Calculate K_p .
 - (b) Calculate ΔG° at 350°C .
 - (c) In what direction does this reaction proceed at 350°C under standard conditions?
 - (d) What is ΔG at this temperature when 1.0 mol NH_3 , 5 mol N_2 , and 5 mol H_2 are mixed in a 2.5 L reactor?
 - (e) In what direction does the reaction proceed under the conditions in (d)? (10)

=====

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

Atomic weight: H = 1.008, C = 12.011, N = 14.007, O = 15.999, F = 18.998,
Na = 22.99, Br = 79.904,