

銘傳大學 99 學年度轉學生招生考試

生物科技學系

第四節

普通化學試題

(第 1 頁共 4 頁) (限用答案本作答)

可使用計算機 不可使用計算機

Gen. Chem. Exam For Students Transferring to Ming Chuan University







Summer 2010

Please feel free to use your calculator. (可以使用計算機)

The table of atomic masses is on page 4. (元素週期表在第四頁)

Multiple Choices

2 pts. each

1. What is the electronic configuration of chromium, Cr? A. $[Ar]4s^23d^4$. B. $[Ar]4s^13d^5$. C. $[Ar]3d^6$. D. None of the above.
2. Which of the following molecule is a resonance isomer of amide, ? A. . B. . C. . D. .
3. Elements and compounds that have unpaired electrons are attracted to a magnet. These species are referred to as A. Diamagnetism. B. Ferromagnetism. C. Paramagnetism. D. None of the above.
4. The magnetic quantum number, m_l ($m_l = 0, \pm 1, \pm 2, \dots, \pm l$) is related to the A. Energy. B. Size. C. Shape. D. Orientation. of an orbital in space
5. What is the name of this molecule, N_2H_4 ? A. Phosphine. B. Nitric oxide. C. Hydrazine. D. Ammonia.
6. What is the ion with the name, phosphate? A. SO_3^{2-} . B. NO_2^- . C. SO_4^{2-} . D. PO_4^{3-} .
7. In order for water molecules, H_2O , to solvate an ionic species, which of the following visual description is correct? A. $+ \cdots H-OH$. B. $- \cdots OH_2$. C. $+ \cdots OH_2$. D. All of the above.
8. What is the name of this ionic species, H^+ ? A. Hydronium ion. B. Hydrogenic ion. C. Hydride ion. D. Hypochlorite ion.
9. The property that does not depend on the path taken to go from the initial state to the final state is called A. Work function. B. Heat function. C. Formation function. D. State function.
10. The effective nuclear charge experienced by electrons in a multielectron atom is in the order, $ns > np > nd > nf$. This is because A. The penetrating ability of s subshell is higher. B. ns orbital has higher energy. C. nd orbitals are farther from nucleus. D. The principal quantum number, n , is not determined.
11. What is the bond order between two the oxygen atoms in ozone, O_3 or $O^{\ominus}O^{\ominus}O$? A. 1. B. 1.5. C. 2. D. 2.5.
12. Which of the following species is isoelectronic with C_2^{2-} ? A. O_2 . B. N_2 . C. F_2 . D. Ne_2 .
13. What is the formal charge on C in carbon monoxide, CO or $:C \equiv O:$? A. 1. B. 0. C. -1. D. -2.
14. Why do second-period elements (B, C, N, O, and F) are always restricted to a maximum of eight electrons in their compound? This is because A. Their atomic radii are smaller. B. They have lower atomic weights. C. Their ionization energies are lower. D. They do not have $3d$ orbitals.
15. The approach to derive molecular orbitals that are delocalized over the entire molecule is the basis of A. Valence bond theory. B. Molecular orbital theory. C. All of the above. D. None of the above.
16. The electron density is greatest along the axis of the bond. This is A. sigma (σ) bond. B. pi (π) bond. C. delta (δ) bond. D. None of the above.
17. In the molecular geometry, trigonal bipyramid, , why is equatorial (E) the preferred position taken by lone-pair electrons? A. Lone-pair electrons need less space. B. The E position is more hindered. C. In E, there are only two repulsive forces from electron pairs at 90° . D. Bond-pair electrons are more repulsive.
18. What is the hybridization of the central atom underlined in $\underline{Xe}O_6^{4-}$? A. sp^3 . B. sp^2d . C. sp^3d^2 . D. sp^2 .
19. Molecules that have non-superimposable mirror images are termed A. Enantiomers. B. Isomers. C. Epimers. D. Diastereomers.
20. What is the important constant derived from the study of blackbody radiation? A. Rydberg's constant (R). B. Boltzman's constant (k). C. Planck's constant (h). D. Avogadro's number (N).
21. HNO_3 is a stronger acid, compared to HNO_2 . This is because A. The O-H bond is stronger in HNO_3 . B. The resonance structures of NO_3^- are more stable than those of NO_2^- . C. HNO_3 has a higher molecular weight. D. HNO_2 has a higher polarity.
22. What is another resonance structure of $[O=N-O^-]$ of NO_2^- ? A. $[^-O-N-O^-]$. B. $[^-O-N=O]$. C. $[O=O-N^-]$. D. $[O=N=O]$.

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(第 2 頁共 4 頁) (限用答案本作答)

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23. The pK_a of HClO_4 , HClO_3 , HClO_2 , and HClO , are -8 , -3 , 2 and 7.46 , respectively. This is because **A.** HClO_4 has a higher molecular weight. **B.** HClO has fewer resonance structures. **C.** HClO cannot be easily ionized in water. **D.** The formal charge of Cl is $+7$, $+5$, $+3$, and $+1$, respectively.
24. In acetic acid, $\text{CH}_3\text{CO}_2\text{H}$, why is the H on $-\text{CO}_2\text{H}$ group dissociated, instead of the H on CH_3 ? Which one of the following statement is **WRONG**? **A.** The product anion, C^- , is not well stabilized. **B.** $-\text{CO}_2\text{H}$ group is relatively larger, compared to the $-\text{CH}_3$ group. **C.** O in $-\text{CO}_2\text{H}$ group can accommodate and stabilize negative charge. **D.** Negative charge on $-\text{CO}_2^-$ can be delocalized via resonance structures.
25. What is the **ONLY** force that exists between non-polar molecules, such as $\text{Br}_2 \cdots \text{Br}_2$, $\text{CH}_4 \cdots \text{CH}_4$, and so forth? **A.** Induced dipole/induced dipole force. **B.** London dispersion force. **C.** Temporarily induced force. **D.** All of the above.
26. Which of the following species is a PROTIC acid? **A.** BH_3 . **B.** HCl . **C.** Al^{3+} . **D.** NH_3 .
27. Which one of the following interactions (\cdots) is an ion-dipole force? **A.** $\text{Br}-\text{Br} \cdots \text{Br}-\text{Br}$. **B.** $\text{Na}^+ \cdots ^-\text{Cl}$. **C.** $\text{H}_2\text{O}^{\delta^-} \cdots \delta^+\text{H}-\text{OH}$. **D.** $\text{Na}^+ \cdots \delta^-\text{OH}_2$.
28. Above this temperature, the vapor pressure cannot be liquefied at any pressure. This temperature is called **A.** Critical temperature. **B.** Absolute temperature. **C.** Relative temperature. **D.** Room temperature.
29. For a metal ion, such as Fe^{2+} , what is the most likely structure of the metal ion in an aqueous solution? **A.** Fe^{2+} . **B.** $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$. **C.** $[\text{Fe}(\text{NH}_3)_6]^{2+}$. **D.** Fe^{3+} .
30. Does the equilibrium concentration of NOCl increase or decrease as the temperature of the system is increased? $2\text{NOCl}(\text{g}) \leftrightarrow 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \quad \Delta_r H^\circ = +77.1 \text{ kJ/mol}$ **A.** Increase. **B.** Decrease. **C.** All of the above. **D.** It depends on the temperature.
31. For $\text{CH}_3\text{CO}_2\text{H}$, $\text{ClCH}_2\text{CO}_2\text{H}$, $\text{Cl}_2\text{CHCO}_2\text{H}$, and $\text{Cl}_3\text{CCO}_2\text{H}$, which one of these acids has the highest acidity (*i.e.*, the lowest pK_a)? **A.** $\text{CH}_3\text{CO}_2\text{H}$. **B.** $\text{ClCH}_2\text{CO}_2\text{H}$. **C.** $\text{Cl}_2\text{CHCO}_2\text{H}$. **D.** $\text{Cl}_3\text{CCO}_2\text{H}$.
32. For CO_2 and Ar, which has larger entropy, ΔS , *i.e.*, which molecule has a more complex structure? **A.** CO_2 . **B.** Ar. **C.** It depends on the temperature in the environment. **D.** All of the above.
33. The second law of thermodynamics states that a spontaneous process is the one that results in an increase of entropy in the **A.** Universe. **B.** System. **C.** Surroundings. **D.** All of the above.
34. Which of the following interactions (\cdots) is an ion-ion interaction? **A.** $\text{Cl}^- \cdots \delta^+\text{H}-\text{OH}$. **B.** $\text{Na}^+ \cdots ^-\text{Cl}$. **C.** $\text{Br}_2 \cdots \text{Br}_2$. **D.** $\text{Cl}_2 \cdots \text{Cl}_2$.
35. What is the name of this interaction, $\text{H}_2\text{O}^{\delta^-} \cdots \delta^+\text{H}-\text{OH}$ **A.** London force. **B.** Dipole-dipole interaction. **C.** Ion-dipole interaction. **D.** All of the above.
36. Which one of the following description is correct, concerning ligand field splitting between tetrahedral and octahedral complexes? **A.** The d orbitals of both complexes are splitted by ligands. **B.** d_{xy} , d_{yz} , and d_{zx} orbitals are higher in energy in tetrahedral complexes. **C.** The splitting of d orbitals is larger in octahedral complexes. **D.** All of the above.
37. In the case of Cr^{2+} , an octahedral complex has the maximum number of unpaired electrons, four in the d orbitals. This arrangement of electrons is called **A.** High spin. **B.** Low spin. **C.** It depends on the temperature of the environment. **D.** Magnetism needs to be ascertained.
38. Coordination ligands can be listed in order of their ability to split the d orbitals. This list is called **A.** Redox potentials. **B.** Electronegativity. **C.** Spectrochemical series. **D.** All of the above.
39. Carbon monoxide, $:\text{C}\equiv\text{O}$, is a poor electron pair donor to low-valent metals, *i.e.*, $\text{M}\leftarrow:\text{C}\equiv\text{O}$. What is the other major interaction that may strengthen the interaction between the central metal and $:\text{C}\equiv\text{O}$? **A.** Hydrogen bonding. **B.** Metal d electrons donated to $:\text{C}\equiv\text{O}$ empty π^* bonding. **C.** Oxygen atom in $:\text{C}\equiv\text{O}$ is reversed to become bonded to the central metal. **D.** Carbon atom cannot be isotopically labeled.
40. The boiling points of CH_4 , C_2H_6 , C_3H_8 , and $n\text{-C}_4\text{H}_{10}$ are -161.5 , -88.6 , -42.1 , and -0.5°C , respectively. This is a reflection of increased intermolecular **A.** Electrostatic interactions. **B.** Hydrogen bondings. **C.** Dispersion forces. **D.** Ion-dipole interactions.

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(第 3 頁共 4 頁) (限用答案本作答)

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請依下列格式作答於答案本上，並請標清楚題號。

1. ____ 2. ____ 3. ____ 4. ____ 5. ____ 6. ____ 7. ____ 8. ____ 9. ____ 10. ____

11. ____ 12. ____ 13. ____ 14. ____ 15. ____ 16. ____ 17. ____ 18. ____ 19. ____ 20. ____

21. ____ 22. ____ 23. ____ 24. ____ 25. ____ 26. ____ 27. ____ 28. ____ 29. ____ 30. ____

31. ____ 32. ____ 33. ____ 34. ____ 35. ____ 36. ____ 37. ____ 38. ____ 39. ____ 40. ____

4 pts each

1. Draw Lewis structures for NH_4^+ , CO , NO^+ , and SO_4^{2-} .
2. Use a Lewis structure and the VSEPR model to determine the electron-pair and molecular geometries for the sulfite ion, SO_3^{2-} .
3. Do you expect H_2^+ to exist? Please show your explanation and calculation of its bond order if it does.
4. Calculate the enthalpy of vaporization, $\Delta_{\text{vap}}H^\circ$, of diethyl ether, $(\text{C}_2\text{H}_5)_2\text{O}$. This compound has vapor pressure of 57.0 mm Hg and 534 mm Hg at -22.8°C and 25.0°C , respectively. [Hint: $\ln(P_2/P_1) = (-\Delta_{\text{vap}}H^\circ/R) \times (1/T_2 - 1/T_1)$, where $R = 8.314 \text{ J/K}\cdot\text{mol}$]
5. Use the Henderson-Hasselbalch equation to calculate the pH of 1.00 L of a buffer solution containing 15.0 g of NaHCO_3 and 18.0 g of Na_2CO_3 . [Hint: K_a of $\text{HCO}_3^- = 4.8 \times 10^{-11}$; $\text{pH} = \text{p}K_a + \log([\text{Salt}]/[\text{Acid}])$]

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普通化學試題

(第 4 頁共 10 頁) (限用答案本作答)

可使用計算機 不可使用計算機

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
| 1 H 1.008 | | | | | | | | | | | | | | | | | 2 He 4.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Li 6.94 | 4 Be 9.01 | | | | | | | | | | | 5 B 10.81 | 6 C 12.01 | 7 N 14.01 | 8 O 16.00 | 9 F 19.00 | 10 Ne 20.18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 Na 22.99 | 12 Mg 24.31 | | | | | | | | | | | 13 Al 26.98 | 14 Si 28.09 | 15 P 30.97 | 16 S 32.07 | 17 Cl 35.45 | 18 Ar 39.95 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 K 39.20 | 20 Ca 40.08 | 21 Sc 44.96 | 22 Ti 47.88 | 23 V 50.94 | 24 Cr 52.00 | 25 Mn 54.94 | 26 Fe 55.85 | 27 Co 58.93 | 28 Ni 58.69 | 29 Cu 63.55 | 30 Zn 65.39 | 31 Ga 69.72 | 32 Ge 72.61 | 33 As 74.92 | 34 Se 78.96 | 35 Br 79.90 | 36 Kr 83.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 37 Rb 85.47 | 38 Sr 87.62 | 39 Y 88.91 | 40 Zr 91.22 | 41 Nb 92.91 | 42 Mo 95.94 | 43 Tc (98) | 44 Ru 101.0 | 45 Rh 102.9 | 46 Pd 106.4 | 47 Ag 107.8 | 48 Cd 112.4 | 49 In 114.8 | 50 Sn 118.7 | 51 Sb 121.7 | 52 Te 127.6 | 53 I 126.9 | 54 Xe 131.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 55 Cs 132.9 | 56 Ba 137.3 | 57 La 138.9 | 72 Hf 178.5 | 73 Ta 180.1 | 74 W 183.9 | 75 Re 186.2 | 76 Os 190.2 | 77 Ir 192.2 | 78 Pt 195.1 | 79 Au 197.0 | 80 Hg 200.6 | 81 Tl 204.4 | 82 Pb 207.2 | 83 Bi 209.0 | 84 Po (209) | 85 At (210) | 86 Rn (222) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 87 Fr 223.0 | 88 Ra 226.0 | 89 Ac 227.0 | 104 Rf (261) | 105 Db (262) | 106 Sg (263) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 Ds (281) | 111 Rg (272) | 112 Uub (285) | 113 Uut (284) | 114 Uuq (289) | 115 Uup (288) | 116 Uuh (292) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>58 Ce 140.1</td> <td>59 Pr 141.0</td> <td>60 Nd 144.2</td> <td>61 Pm (145)</td> <td>62 Sm 150.4</td> <td>63 Eu 153.0</td> <td>64 Gd 157.3</td> <td>65 Tb 158.9</td> <td>66 Dy 162.5</td> <td>67 Ho 164.9</td> <td>68 Er 167.3</td> <td>69 Tm 168.9</td> <td>70 Yb 173.0</td> <td>71 Lu 175.0</td> </tr> <tr> <td>90 Th 232.4</td> <td>91 Pa 231.4</td> <td>92 U 238.0</td> <td>93 Np (237)</td> <td>94 Pu (240)</td> <td>95 Am (243)</td> <td>96 Cm (247)</td> <td>97 Bk (248)</td> <td>98 Cf (251)</td> <td>99 Es (252)</td> <td>100 Fm (257)</td> <td>101 Md (257)</td> <td>102 No (259)</td> <td>103 Lr (262)</td> </tr> </tbody> </table> | | | | | | | | | | | | | | | | | | 58 Ce 140.1 | 59 Pr 141.0 | 60 Nd 144.2 | 61 Pm (145) | 62 Sm 150.4 | 63 Eu 153.0 | 64 Gd 157.3 | 65 Tb 158.9 | 66 Dy 162.5 | 67 Ho 164.9 | 68 Er 167.3 | 69 Tm 168.9 | 70 Yb 173.0 | 71 Lu 175.0 | 90 Th 232.4 | 91 Pa 231.4 | 92 U 238.0 | 93 Np (237) | 94 Pu (240) | 95 Am (243) | 96 Cm (247) | 97 Bk (248) | 98 Cf (251) | 99 Es (252) | 100 Fm (257) | 101 Md (257) | 102 No (259) | 103 Lr (262) |
| 58 Ce 140.1 | 59 Pr 141.0 | 60 Nd 144.2 | 61 Pm (145) | 62 Sm 150.4 | 63 Eu 153.0 | 64 Gd 157.3 | 65 Tb 158.9 | 66 Dy 162.5 | 67 Ho 164.9 | 68 Er 167.3 | 69 Tm 168.9 | 70 Yb 173.0 | 71 Lu 175.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 90 Th 232.4 | 91 Pa 231.4 | 92 U 238.0 | 93 Np (237) | 94 Pu (240) | 95 Am (243) | 96 Cm (247) | 97 Bk (248) | 98 Cf (251) | 99 Es (252) | 100 Fm (257) | 101 Md (257) | 102 No (259) | 103 Lr (262) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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