所別：水文與海洋科學研究所碩士班 不分組（一般生） 科目：普通化學 共 2 頁 第 1 頁

本科考試禁用計算器 ※請在試卷答案卷（卡）內作答

Please refer to data at the end of the examination paper to answer questions and solve problems in the following.

A. Multiple choices (2.5 points each)

1. The number of orbitals in a g subshell is a. 1, b. 3, c. 5, d. 7, e. 9.
2. Which of the following elements has the highest electron affinity? a. O, b. S, c. C, d. Cl, e. Br.
3. Which of the following diatomic molecules has the greatest bond strength? A. Cl_2, b. HCl, c. O_2, d. N_2, e. HF.
4. In the cobalt ammonia complex, $Co(NH_3)_6^{3+}$, the ligands are arranged about the central cobalt ion in term of a a. pyramid, b. tetrahedron, c. trigonal plane, d. octahedron, e. square plane.
5. Which of the following molecules has pi-bonds? a. CH_4, b. H_2O, c. C_2H_5OH, d. C_6H_6, e. NH_3
6. Which of the following compound is expected to exhibit hydrogen bonding? a. CH_2O, b. CH_3F, c. NH_3, d. NH_4^+, e. None of the above.
7. What is the molarity of a $CaCO_3$ solution, which contains 10.0 mg of calcium carbonate in 250 mL of solution? a. 0.00400 M, b. 0.0400 M, c. 0.100 mM, d. 0.040 mM, e. 0.400 mM.
8. The oxidation number of manganese in MnO_4^- is a. -5, b. +1, c. +3, d. +5, e. +7.
9. The gaseous reaction $2H_2 + 2NO = 2H_2O + N_2$ is first order in H_2 and second order in NO. Which is the rate law? a. $kP_{H2}\,P_{NO}$, b. $kP_{H2}^2\,P_{NO}^2$, c. $kP_{H2}^2\,P_{NO}$, d. $kP_{H2}\,P_{NO}^2$, e. $kP_{H2O}\,P_{N2}^2$
10. Which of the following is not a greenhouse gas? a. O_2, b. N_2O, c. CO_2, d. H_2O, e. CH_4
11. Carbon monoxide is toxic to animals because it a. reacts with oxygen, b. catalyzes smog formation, c. undergoes photochemical reaction, d. form a stable complex with hemoglobin, e. catalyzes the decomposition of ozone.
12. If the activation energy for a chemical reaction is 25 kJ, the reaction a. occurs rapidly, b. occurs spontaneously, c. reaction rate is low at room temperature, d. absorbs heat, e. favors the reactants when reaching chemical equilibrium.
13. Which radiation has the highest energy per photon? A. UV, b. X-ray, c. Gamma ray, d. Red light, e. Green light.
14. Which compound contains both ionic and covalent bonds? A. PF_3, b. KF, c. NaH, d. $NaHCO_3$, e. CH_2O, f. None of the above.
15. All of the following orbital representations are allowed except: a. 7s; b. 2p; c. 3f; d. 4d; e. 5g.
16. The best way to ensure quantitative removal of zinc ion in an aqueous solution by precipitation reaction with H_2S bubbles is to a. add H_2SO_4; b. add HCl; c. stir the solution; d. add ammonia; e. heat the solution.
17. Which of the following phase changes is endothermic (absorbing heat)? a. Condensation of alcohol vapor in a still, b. Freezing of water, c. Formation of water droplets in cloud, d. Dissolution

參考用

注意：背面有試題

of sugar, e. Dissolution of $CaCO_3$.

18. Which of the following nuclear decay results in no change in the nuclear charge? a. alpha decay, b. beta decay, c. electron capture decay, d. positron decay, e. gamma decay, f. none of the above.
19. What is the conjugate base of $B(OH)_3$? a. $H_2BO_3^-$, b. H_2BO_3, c. $B(OH)_2^+$, d. $B(OH)_4^-$, e. None of the above because $B(OH)_3$ is a base.
20. A 0.20 M solution of a weak monoprotic acid has a pH of 4.0, what is the dissociation constant for this acid? a. 1.0×10^{-8}, b. 2.0×10^{-8}, c. 5.0×10^{-8}, d. 2.0×10^{-7}, e. none of the above.

B. Short questions (10 points each)

1. What is the maximum equilibrium concentration of silver ion by adding silver nitrate to a solution of hydrochloric acid, which has a pH of 3.0?
2. Complete the following reactions and write equations of chemical equilibrium:
   $5\ C_6H_{12}O_6 + \_\ NO_3^- = \_CO_2 + \_\ H_2O + \_\ N_2$
   $2\ CsHCO_{3(s)} = Cs_2CO_{3\ (s)} + \_\_\_\_\_ + \_\_\_\_\_$
3. Classify the following compounds into strong acids, weak acids, strong bases, weak bases, and none of the above: $B(OH)_4^+$, $CaCl_2$, $KClO_4$, HCOOH, HCl, $NaHCO_3$, HF, H_2S, $Sr(OH)_2$, NH_4Cl.
4. Draw the structure of the following compounds: C_2H_5COOH; SF_6; S_8; N_2H_4; $Na_2S_2O_3$.
5. A solution 1.0 mM in hydrochloric acid and 0.6 mM in ammonia is prepared. Write equations of reactions that may occur in the solution. Calculate the concentrations of ammonia, and ammonium, hydronium, and hydroxide ions in the solution. Is the solution acidic or basic?

C. Data & information

Please use the following information to answer the questions or solve the problems.

Gas constant: $R = 0.082$ atm L mol^{-1} K^{-1}

Planck constant: $h = 6.63\times10^{-34}$ Js

Atomic weight: H = 1.008, C = 12.01, O = 16.00, Na = 23.00, S = 32.06, Ca = 40.08

Atomic number: C = 6, Si = 14, P = 15, Ar = 18, K = 19, Fe = 26, Br = 35, U = 92

Solubility product: AgCl, $K_{sp} = 1.8\times10^{-10}$

Dissociation constant: water $K = 1.0\times10^{-14}$, ammonium $K = 5.75\times10^{-10}$

1 mM = 10^{-3} M