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 二 頁 第 1 頁
　　　水文與海洋科學研究所碩士班 不分組(在職生)

本科考試禁用計算器　　　　　　　　　　　　　　＊請在試卷答案卷（卡）內作答

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

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

Atomic weight: H = 1, C = 12, O = 16, Na = 23

Atomic number: C = 6, Si = 14, P = 15, Ar = 18, K = 19, Fe = 26, Cu = 29, Br = 35, Po = 84

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

Dissociation constant: acetic acid K = 1.7×10^{-5}, water K = 1.0×10^{-14}

1 mM = 10^{-3} M

A. Multiple choices (2 points each)

1. The volume of a microsyringe is 5.0 μl. This is the same as a. 5.0 μg, b. 5.0×10^{-6} m^3, c. 5.0×10^{-6} L, d. 0.0050 g, e. 5.0 mg.

2. The formula for potassium bicarbonate is a. P_2CO_3, b. Po_2CO_3, c. P_2C, d. $KHCO_3$, e. K_2C

3. If $\Delta H = -32$ kJ for a chemical reaction, the reaction a. occurs rapidly, b. releases heat, c. absorbs heat, d. cannot occur, e. occurs spontaneously.

4. Which radiation has the shortest wavelength? a. UV, b. X-ray, c. Gamma ray, d. Red light, e. Microwave.

5. Which of the following diatomic molecules has triple bond? a. Cl_2, b. HCl, c. N_2, d. H_2, e. O_2.

6. Which compound contains both ionic and covalent bonds? a. PF_3, b. KF, c. NaH, d. $CaCO_3$, e. C_3H_8.

7. Which of the following is not a greenhouse gas? a. H_2O, b. N_2, c. N_2O, d. CH_4, e. CCl_4, f. None of the above

8. For a reaction that has an equilibrium constant of 10^{-10}, which of the following statements must be true? a. ΔG is negative. b. ΔG is positive. c. ΔH is negative. d. ΔH is positive. e. ΔS is negative. f. ΔS is positive.

9. Which of the following nuclear decay results in an increase 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.

10. Which functional group does not contain an oxygen atom? a. Alcohol, b. Carboxylic acid, c. Ketone, d. Amide, e. Methyl

11. Ammonium can be oxidized to nitrogen gas. How many moles of electrons are lost from one mole of nitrogen in the reaction? a. 1 mole; b. 2 moles; c. 3 moles; d. 4 moles; e. 5 moles, f. None of the above.

12. Which of the following is a weak acid in water? a. Na_2SO_3; b. HCl; c. HI; d. HBr; e. $HClO_3$, f. $B(OH)_3$.

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13. Liquid nitrogen boils at -183 °C. What is its boiling point on the Kelvin scale? a. -90 K. b. -80 K. c. -70K. d. 70 K. e. 80 K, f. 90 K.

14. The number of orbitals in an f subshell is a. 1, b. 2, c. 3, d. 5, e. 7.

15. In the hydronium ion, H_3O^+, the valence electrons are arranged about the central oxygen atom in term of a a. pyramid, b. tetrahedron, c. trigonal plane, d. bent structure, e. square plane.

16. Which of the following compound is expected to exhibit hydrogen bonding? a. CH_2O, b. CH_3F, c. HF, d. CH_2ClF, e. None of the above.

17. What is the molarity of a Na_2CO_3 solution, which contains 10.6 mg of sodium carbonate in 5.0 L of solution? a. 0.10 M, b. 0.050 M, c. 0.10 mM, d. 0.050 mM, e. 0.020 mM.

18. What is the conjugate base of HSO_4^-? a. H_2SO_4, b. H_2SO_3, c. HSO_3^-, d. SO_4^{2-}, e. SO_3^{2-}.

19. Carbon monoxide is toxic 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.

20. The best way to ensure complete precipitation of ZnS from a saturated H_2S solution is to a. add H_2SO_4; b. add HCl; c. stir the solution; d. add ammonia; e. heat the solution.

B. Short questions (6 points each)

1. What is the electronic configuration of a stable ferrous ion?

2. Balance the following reactions:

   $3 CH_3CH_2COOH + \_ O_3 = \_ CO_2 + \_ H_2O$

   $NO_3^- + \_ I^- = \_ IO_3^- + \_ NO_2$

3. What is the density (g/L) of the propane, C_3H_8, at 300K and 1.1 atm pressure?

4. What are the electron-dot structures of ClO_3^- ion and HNO_2?

5. Draw the structure of benzene molecule. Is it a polar or non-polar molecule? Explain.

6. What is hydrogen bonding between water molecules? Use a diagram to explain.

7. For the reaction $CoS(s) + H_2(g) = Co(s) + H_2O(g)$ at 550°C, K = 67. Write the expression of the equilibrium constant.

8. The gaseous reaction $2H_2 + 2NO = 2H_2O + N_2$ is first order in H_2 and second order in NO. Please write equations of (a) the equilibrium constant, and (b) the rate law.

9. The molar solubility of $PbBr_2$ is 0.010 M. Calculate its solubility product.

10. The second dissociation constant of sulfuric acid is 10^{-2}. Calculate the concentration of sulfate in a 1.0 M sulfuric acid solution.

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