國立中央大學97學年度碩士班考試入學試題卷

所別：水文與海洋科學研究所碩士班　　科目：普通化學　共 2 頁 第 1 頁

＊請在試卷答案卷（卡）內作答

Please refer to data at the end of the examination paper to answer the following questions or problems.

A. Multiple choices (2.5 points each)

1. The formula for potassium bicarbonate is a. P_2CO_3, b. Po_2CO_3, c. $K(CO_3)_2$, d. $KHCO_3$, e. K_2CO_3
2. If ΔG = +25 kJ for a chemical reaction, the reaction a. occurs rapidly, b. releases heat, c. absorbs heat, d. occurs spontaneously, e. Chemical equilibrium favors the reactants.
3. Which of the following is NOT a greenhouse gas? a. H_2O, b. N2O, c. CO_2, d. CH_4, e. O_2, f. None of the above
4. Which radiation has the lowest energy per photon? a. UV, b. X-ray, c. Gamma ray, d. Red light, e. Green light.
5. Which of the following elements has the lowest first ionization energy? a. Li, b. Be, c. B, d. C, e. N.
6. Which compound contains both ionic and covalent bonds? a. PF_3, b. KF, c. NaH, d. $NaClO_4$, e. CH_2O, f. None of the above.
7. Which of the following diatomic molecules has the greatest bond strength? a. Cl_2, b. HCl, c. N_2, d. H_2, e. HF.
8. In the water molecule 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.
9. Which of the following molecules has pi-bonds? a. CH_4, b. H_2O, c. C_2H_5OH, d. C_2H_2, e. NH_3, f. None of the above
10. Which of the following compound is expected to exhibit hydrogen bonding? a. CH_2O, b. HF, c. HBr, d. CH_2ClF, e. None of the above.
11. Liquid nitrogen boils at -196 °C. What is its boiling point on the Kelvin scale? a. -96 K. b. -6 K. c. 7K K. d. 77 K. e. 96 K, f. None of the above.
12. All of the following orbital representations are allowed except: a. 7s; b. 2p; c. 3f; d. 4d; e. 5g.
13. Which is the electronic configuration of a stable ferric ion? a. $1s^2 2s^2 2p^6$; b. $1s^2 2s^2 2p^6 3s^2 3p^5$; c. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$; d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$; e. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$, f. None of the above.
14. Which of the following atoms has the highest electron affinity? a. F; b. Cl; c. Br; d. S; e. I.
15. Elemental sulfur can be oxidized to sulfuric acid. How many moles of electrons are lost from one mole of sulfur in the reaction? a. 1 mole; b. 2 moles; c. 4 moles; d. 6 moles; e. 8 moles, f. None of the above.
16. Which of the following is a weak acid in water? a. H_2SO_4; b. HCl; c. HF; d. HBr; e. $HClO_3$, f. None of the above.
17. 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.
18. What is the molarity of a Na_2SO_3 solution, which contains 12.6 mg of sodium sulfite in 2.0 L of solution? a. 0.10 M, b. 0.050 M, c. 0.10 mM, d. 0.050 mM, e. 0.020 mM, f. None of the above.
19. Which of the following phase changes is or are endothermic (absorbing heat)? a. Condensation of vapor, b. Melting of salt, c. Evaporation of water, d. Both a and b, e. Both b and c, f. None of the above.
20. 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.

參考用

注意：背面有試題

B. Short questions (10 points each)

1. 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.
2. A solution is 0.1 M in acetic acid and 0.2 M sodium acetate. Is it acidic or basic? Please explain.
3. The molar solubility of $PbBr_2$ is 0.010 M. Calculate its solubility product.
4. Balance the equations and write the expression of the equilibrium constants of the reactions:
   $NH_4^+ + \_\_ O_2 = \_\_ NO_3^- + \_\_ H_2O + \_\_ H^+$
   $2\ CsHCO_{3(s)} = Cs_2CO_{3\ (s)} + \_\_\_\_\_{}_{(g)} + \_\_\_\_\_{}_{(g)}$
5. Draw the structure of the following compounds: O_3; C_6H_6; C_2H_6; HNO_3; N_2O.

C. Data

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

Planck constant: $h = 6.63 \times 10^{-34}$ 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

Dissociation constant:

acetic acid $K_a = 1.7 \times 10^{-5}$,

water $K = 1.0 \times 10^{-14}$,

ammonia $K_b = 1.8 \times 10^{-5}$

1 mM = 10^{-3} M

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