

所別： 水文科學研究所碩士班 科目： 普通化學

Note: If you need any information to answer the questions, please refer to Table 1.

A. Choose the correct answer. (20%)

1. The number of significant figures in the concentration determined as 0.01340 M is a. 3, b. 4, c. 5, d. 6, e. 7
2. What is the best answer to report for $(2.521 \times 13.51 / 2.78) + 0.31$? a. 12.5613, b. 12.561, c. 12.56, d. 12.5, e. 12.6
3. Liquid propane boils at -42°C . What is its boiling Point on the Kelvin scale? a. 231 K, b. 256 K, c. 273 K, d. 315 K, e. 345 K
4. What is the concentration of H_2SO_4 in a solution that has a density of 1.55 g/cm^3 and consisting of 65.0% of H_2SO_4 by weight? a. 10.3 N, b. 1.03 M, c. 20.6 N, d. 20.6 M, e. 2.06 N
5. The name of the ion SO_3^{2-} is a. sulfide, b. sulfate, c. thiosulfate, d. thiosulfite, e. sulfite
6. All of the following are strong acids except a. HClO_4 , b. H_3PO_4 , c. H_2SO_4 , d. HNO_3 , e. HCl .
7. Which of the following is a weak electrolyte in aqueous solution? a. Ammonium acetate, b. carbon dioxide, c. hydrogen chloride gas, d. sulfuric acid, e. potassium hydroxide
8. Which of the following characteristics does not apply to ammonia? a. H-N-H angle less than 120° ; b. Nitrogen atom has sp^2 -hybridization; c. polar molecule; d. one unshared pair of electrons on N; e. Nitrogen is the negative end of a dipole.
9. Which of the following statements is false? a. The rate-determining step is the fastest one in a series of stepwise reactions. b. The rate constant changes with temperature. c. The specific rate constant does not depend on reactant concentrations. d. Reaction rates change with time. e. The rate of catalyzed reaction is dependent on the catalyst concentration.
10. Which one of the following mixture will be a buffer when dissolved in a liter of water? a. 0.1 mol $\text{Ba}(\text{OH})_2$ and 0.2 mol HCl , b. 0.3 mol KCl and 0.3 mol HCl , c. 0.4 mol ammonia and 0.4 mol HCl , d. 0.2 mol CH_3COOH and 0.1 mol NaOH , e. 0.2 mol HBr and 0.1 mol NaOH

B. Balance the following equations (30%):

1. $\text{I}_2 + \text{HNO}_3 = \text{HIO}_3 + \text{NO}_2 + \text{H}_2\text{O}$
2. $\text{CO}_2 + \text{H}_2\text{O} = \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$
3. $\text{MnO}_4^- + \text{H}^+ + \text{e}^- = \text{MnO}_2 + \text{H}_2\text{O}$
4. $\text{NO}_3^- + \text{H}^+ + \text{e}^- = \text{N}_2 + \text{H}_2\text{O}$
5. $\text{Al} + \text{NH}_4\text{NO}_3 = \text{N}_2 + \text{H}_2\text{O} + \text{Al}_2\text{O}_3$

C. Answer the following questions or solve the problems (50%):

1. Oxygen gas may be produced by heating KClO_3 with MnO_2 as catalyst.
 - 1.1. Write the reaction equation.
 - 1.2. How many moles of oxygen gas will be produced from 1.3 g of KClO_3 ?
 - 1.3. If the oxygen gas is collected over water at 23°C at a total pressure of 745 mmHg, what is the partial pressure of oxygen?
 - 1.4. How big is the volume (ml) of the oxygen gas?

參考用

注意：背面有試題

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2. A sample of pyrite (FeS_2) was burned in oxygen in a calorimeter to Fe_2O_3 and SO_2 , from which it was determined that combustion of one mole of pyrite evolves 828 KJ of heat at a constant pressure of 1 atm.
 - 2.1. Write the reaction equation.
 - 2.2. Write the standard reaction equations for the formation of each of the compounds in the previous equation.
 - 2.3. Calculate the standard heat of formation of pyrite.

3. Write electron configurations (such as 1S^2 for Li^+) of the following species.
 - 3.1. Fe, O and H in $\text{Fe}(\text{OH})_3$
 - 3.2. Cu and S in CuS
 - 3.3. Mg and Cl in MgCl_2

4. Write Lewis formula for the bonding and unshared electrons of the following compounds.
 - 4.1. HNO_2
 - 4.2. BF_3
 - 4.3. CH_3COOH
 - 4.4. C_6H_6
 - 4.5. O_3

5. The solubility product of BaF_2 is 1×10^{-6} at 25°C .
 - 5.1. Write the reaction equation of dissolution of BaF_2 in pure water.
 - 5.2. Calculate the maximum amount (in grams) of BaF_2 that may dissolve in 1 liter of distilled water.
 - 5.3. What is the molar solubility of BaF_2 in 0.15 M of NaF solution?

Table 1.

Elements	Atomic number	Atomic masses	Constants
H	1	1.008	$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$
B	5	10.81	$P_{\text{H}_2\text{O}} @ 23^\circ\text{C} = 21.1 \text{ mmHg}$
C	6	12.011	$\Delta H_f^\circ(\text{Fe}_2\text{O}_3) = -825.5 \text{ kJ mol}^{-1}$
N	7	14.007	$\Delta H_f^\circ(\text{SO}_2) = -296.8 \text{ kJ mol}^{-1}$
O	8	15.999	
F	9	18.998	
Mg	12	24.305	
S	16	32.06	
Cl	17	35.453	
K	19	39.098	
Cu	29	63.546	
Ba	56	137.33	

參考用