所別：水文科學研究所碩士班　　科目：普通化學

Please use data listed in Table 1 to answer the questions.

A. Multiple choices (30%)

1. How many protons are there in the molecule $^{37}Cl_2$? a. 17, b. 20, c. 34 K, d. 37, e. 40
2. A gas condenses to liquid at a temperature measured to be -43 °C. What is the boiling point of the liquid in the Kelvin scale? a. 100 K, b. 230 K, c. 230.15 K, d. 231 K, e. 231.15 K
3. Five successive determinations of the specific weight of a liquid gave the following results: 1.018, 0.996, 1.021, 1.014, and 0.993. What is the best answer to report for the specific weight of the liquid? a. 0.9, b. 1.0, c. 1.01, d. 1.008, e. 1.0084
4. A student dissolves 58.44 g of NaCl in 1.000 kg of distilled water. What is the concentration of the NaCl solution? a. 1 N, b. 1.0 N , c. 1.00 M, d. 1.000 M, e. 1.000 m
5. All of the following are strong bases except a. $Al(OH)_3$, b. $Ca(OH)_2$, c. KOH, d. NaOH,e. LiOH
6. The name of the ion $S_2O_3^{2-}$ is a. sulfide, b. sulfate, c. thiosulfate, d. thiosulfite, e. sulfite
7. The correct formula for magnesium phosphate is: a. $MgPO_4$, b. $Mg_3(PO_4)_2$, c. $Mn_3(PO_4)_2$, d. $Mg_2(PO_4)_3$, e. $Mn_2(PO_4)_3$
8. Which of the following characteristics does not apply to methane? a. H-C-H angle is less than 120°. b. Carbon atom has sp^3-hybridization. c. polar molecule, d. no unshared pair of electrons on C, e. Carbon is the negative end of a dipole.
9. A 0.10 M solution of a weak monoprotic acid has a pH of 2.30. What is the equilibrium constant for the dissociation of this acid? a. 5.0×10^{-2}, b. 5.0×10^{-3}, c. 2.5×10^{-4}, d. 2.5×10^{-5}, e. 2.5×10^{-6}.
10. What is the molar solubility of MgF_2 in a 0.20 M NaF solution? a. 0.2 M, b. 2.0×10^{-6} M, c. 5.0×10^{-7} M, d. 2.0×10^{-7} M, e. 8.0×10^{-8} M.

B. Balance the following equations (30%):

1. $CO + \_H_2 = \_\_\_ + \_H_2O$
2. $CH_3NH_2 + \_CH_3COOH = \_\_\_ + CH_3NHCOCH_3$
3. $\_MnO_4^- + \_SO_3^{2-} + H_2O = 2 \_\_\_\_ + \_OH^- + \_SO_4^{2-}$
4. $2NO_2^- + \_ H^+ + \_e^- = \_N_2O + \_H_2O$
5. $Ag(NH_3)_2^+ + \_H^+ + \_Cl^- = \_\_\_\_ + \_NH_4^+$

C. Answer the following questions or solve the problems (40%):

1. Hydrogen gas may be produced by reacting zinc with HCl.

1.1. Write the reaction equation.

1.2. How many moles of hydrogen gas will be produced from 1.31 g of zinc? (0.0200 mole)

1.3. If the gas is collected over water at 26 °C at a total pressure of 0.98 atm, what is the partial pressure of hydrogen?

1.4. How big is the volume (ml) of the hydrogen gas?

1.5. Why is the hydrogen gas quite dangerous?

2. Acetic acid is dissolved in water to yield a solution of 0.010 M.

2.1. Write the reaction equation for the dissociation of acetic acid.

2.2. Calculate the equilibrium concentrations of the species in the solution.
2.3. What is the pH of the solution?

3. Write electron configurations of the following species.
3.1. Al in $Al(OH)_3$
3.2. C and Cl in CCl_4
3.3. Si and O_2 in SiO_2

4. Write Lewis formula of the following compounds.
4.1. N_2O
4.2. CO
4.3. H_2NCH_2COOH
4.4. C_6H_5OH
4.5. H_2SO_3

5. A battery consists of two electrodes, one is made of copper and the other of cadmium, which are partially submerged in electrolytic solutions of $CuCl_2$ and $CdCl_2$ respectively.
5.1. Write the half redox reactions of the two half cells.
5.2. Which is the cathode (+) and which is the anode(-)?
5.3. Write the redox reaction of the battery.
5.4. What is the standard potential of the battery?

Elements	Atomic number	Atomic masses	Constants
H	1	1.008	$R = 0.08206$ L atm mol^{-1} K^{-1}
B	5	10.81	P_{H_2O} @ 26°C = 25.2 mmHg
C	6	12.011	K_{sp} for $MgF_2 = 8.0x10^{-8}$
N	7	14.007	K_a for acetic acid = 1.6×10^{-5}
O	8	15.999	Cu^{2+}/Cu $E^o = 0.34$ V
F	9	18.998	Cd^{2+}/Cd $E^o = -0.40$ V
Na	11	22.99	
Mg	12	24.305	
S	16	32.06	
Cl	17	35.453	
K	19	39.098	
Cu	29	63.546	
Zn	30	65.39	