

選擇考題 (每題 3 分, 共 60 分) :

- 1) The color change of a chemical indicator requires an over-titration of 0.03 ml. What is the percent relative error if the total volume is 25.0 ml? (a) 0.1 %, (b) 0.5 %, (c) 0.6 %, (d) 0.3 %, (e) 0.2 %
- 2) What is the density of seawater at 25°C, salinity of 35 psu and 1 atm pressure? (a) 0.9821 kg/m<sup>3</sup>, (b) 0.9992 kg/m<sup>3</sup>, (c) 1.0000 kg/m<sup>3</sup>, (d) 0.9982 kg/m<sup>3</sup>, (e) 1.024 kg/m<sup>3</sup>
- 3) The mercury in a 0.7152 g sample was precipitated with an excess of paraperiodic acid, H<sub>5</sub>IO<sub>6</sub>: (reaction as, 5 Hg<sup>2+</sup> + 2 H<sub>5</sub>IO<sub>6</sub> → Hg<sub>5</sub>(IO<sub>6</sub>)<sub>2</sub> (s) + 10 H<sup>+</sup>). The precipitate was filtered, washed free of precipitating agent, dried, and found to weigh 0.3408 g. What is the percentage of Hg<sub>2</sub>Cl<sub>2</sub> in the sample? (a) 38.8%, (b) 54.3%, (c) 5.43%, (d) 3.88%, (e) 58.8%
- 4) The organic matter in a 3.776 g sample of an ointment is decomposes with nitric acid. After dilution, the Hg<sup>2+</sup> in the digested ointment is titrated with 21.3 ml of a 0.1144 M solution of NH<sub>4</sub>SCN. Calculate the percent Hg (fw = 200.59 g) in the ointment? Hg<sup>2+</sup> + 2 SCN<sup>-</sup> → Hg(SCN)<sub>2</sub> (a) 23.5 %, (b) 6.47 %, (c) 48.6 %, (d) 35.7 %, (e) 14.8 %
- 5) Prior to the 1900s, the study of seawater focused on the composition of the salts. The first published work in 1674 was by an English chemist, whom also discovered and described the behavior of ideal gases, which explains the inversely proportional relationship between the absolute pressure and volume of a gas, if the temperature is kept constant within a closed system. Name the scientist. (a) Robert Boyle, (b) William Dittmar, (c) Joseph Gay-Lussac, (d) Svante Arrhenius, (e) Alfred Redfield
- 6) Treatment of a 0.4 g sample of impure potassium chloride with an excess of AgNO<sub>3</sub> resulted in the formation of 0.7332 g of AgCl. What is the percentage of KCl in the sample? (a) 32.88% (b) 27.85%, (c) 28.86%, (d) 95.36%, (e) 33.86%
- 7) What is the hydronium ion concentration in 0.120 M nitrous acid (K<sub>a</sub> = 5.1 × 10<sup>-4</sup>)? (a) 0.0092, (b) 0.0839, (c) 0.0078, (d) 0.0532, (e) 0.0656
- 8) What is called for a compound can act either as an acid or a base, undergo self-ionization to form a pair of ion species? (a) Amphiprotic species, (b) Adiabatic species, (c) Aerobic species, (d) Agostic species, (e) Alicyclic species
- 9) The solubility-product constant for Ag<sub>2</sub>CrO<sub>4</sub> is 1.1 × 10<sup>-12</sup>, what is the concentration of chromate-ion is needed to lower the silver-ion concentration to 5.0 × 10<sup>-6</sup> M? (a) 6.5 × 10<sup>-8</sup>, (b) 5.8 × 10<sup>-8</sup>, (c) 6.9 × 10<sup>-8</sup>, (d) 5.5 × 10<sup>-8</sup> (e) 4.4 × 10<sup>-2</sup>
- 10) What is the pH of a 0.100 M solution of acetic acid (pK<sub>a</sub> = 4.76)? (a) 5.73, (b) 4.84, (c) 6.52, (d) 2.88, (e) 3.26
- 11) If tap water at 25°C is in contact with serpentine (Mg<sub>3</sub>Si<sub>2</sub>O<sub>5</sub>(OH)<sub>4</sub>) and reach equilibrium, has a Mg<sup>2+</sup> molarity of 10<sup>-3.38</sup> and a pH of 8.5, what is the H<sub>4</sub>SiO<sub>4</sub> concentration in mg/L? Assume *a* = *m*. The dissolution of serpentine can be written as ;  
Mg<sub>3</sub>Si<sub>2</sub>O<sub>5</sub>(OH)<sub>4</sub> + 6H<sup>+</sup> ↔ 3Mg<sup>2+</sup> + 2H<sub>4</sub>SiO<sub>4</sub> + H<sub>2</sub>O (a) 3.7 mg/L, (b) 9.7 mg/L, (c) 7.7 mg/L, (d) 6.7 mg/L, (e) 2.7 mg/L
- 12) Please calculate the ionic strength of a 0.1 M solution of NaBr? (a) 0.02, (b) 0.1, (c) 0.06, (d) 0.05, (e) 0.04
- 13) A 20-tablet sample of soluble saccharin was treated with 20 ml of 0.08181 M AgNO<sub>3</sub>. After removal of the solid, titration of the filtrate and washings required 2.81 ml of 0.04124 M KSCN, Calculate the average number of milligrams of saccharin (fw = 205.17) in each tablet. (a) 14.5, (b) 15.6, (c) 16.5, (d) 17.5, (e) 12.5
- 14) Calculate the equilibrium constant for the following reaction (2 Fe<sup>3+</sup> + 3 I<sup>-</sup> ↔ 2 Fe<sup>2+</sup> + I<sub>3</sub><sup>-</sup>; 2 Fe<sup>3+</sup> + 2 e<sup>-</sup> ↔ 2 Fe<sup>2+</sup>, E<sup>0</sup> = 0.771 V ; I<sub>3</sub><sup>-</sup> + 2 e<sup>-</sup> ↔ 3 I<sup>-</sup>, E<sup>0</sup> = 0.536 V) ? (a) 8.7 × 10<sup>7</sup>, (b) 2.8 × 10<sup>7</sup>, (c) 3.6 × 10<sup>3</sup>, (d) 8.7 × 10<sup>3</sup>, (e) 2.8 × 10<sup>3</sup>

見背面

- 15) Calculate the hydronium ion concentration for a buffer solution that is 2.00 M in phosphoric acid and 1.50 M in potassium dihydrogen phosphate. ( $K_1 = 7.11 \times 10^{-3}$ ;  $K_2 = 6.34 \times 10^{-8}$ ;  $K_3 = 4.2 \times 10^{-13}$ ) (a)  $5.48 \times 10^{-3}$ , (b)  $4.58 \times 10^{-3}$ , (c)  $9.48 \times 10^{-3}$ , (d)  $2.88 \times 10^{-3}$ , (e)  $1.48 \times 10^{-3}$
- 16) Limestone,  $\text{CaCO}_3 (s)$ , is in equilibrium with water in which carbonate,  $\text{CO}_3^{2-}$  concentration is  $10^{-5} \text{ M}$ . What is the concentration of the calcium ions,  $\text{Ca}^{2+}$  in the water? (a)  $5 \times 10^{-7} \text{ mol/L}$ , (b)  $5 \times 10^{-4} \text{ mol/L}$ , (c)  $3 \times 10^{-7} \text{ mol/L}$ , (d)  $6 \times 10^{-7} \text{ mol/L}$ , (e)  $5 \times 10^{-10} \text{ mol/L}$
- 17) Which of the following acid-base indicators can be used to identify a ground water sample with a pH of 8.5? (a) Bromphenol Blue, (b) Phenol Red, (c) Methyl Yellow, (d) Phenolphthalein, (e) Nile Blue
- 18) What is the standard oxidation/reduction potential for the  $\text{O}_2/\text{H}_2\text{O}$  couple? (a) 1.35 V, (b) 0.229 V, (c) 0.239 V, (d) 0.259 V, (e) 1.23 V
- 19) Who received the 1920 Nobel Prize in Chemistry, was the chemist known especially in electrochemistry for establish of an equation that relates the reduction potential of an electrochemical reaction (half-cell or full cell reaction) to the standard electrode potential, temperature, and activities of the chemical species undergoing reduction and oxidation? (a) Alfred Werner, (b) Ernest Rutherford, (c) Luigi Galvani, (d) Alessandro Volta, (e) Walther Nernst
- 20) Calculate the pH of the 0.30M  $\text{NH}_3/0.36\text{M NH}_4\text{Cl}$  buffer system,  $\text{p}K_a = 9.25$ ? (a) 9.17, (b) 3.6, (c) 7.8, (d) 8.9, (e) 9.8

問答考題 (共 40 分):

- 1). What is Peptization ? (10 分)
- 2). In 1923, P. Debye and E Hückel used model to derive a theoretical expression that permits the calculation of activity coefficients of ions from their charge and average size. Please write out this Debye-Huckel equation and explain each terms. (10 分)
- 3). What are the structural characteristics of a chelates? Please also give one example. (10 分)
- 4). Please briefly describe the basic laws and operation principles of atomic absorption spectrometry. (10 分)

1 hydrogen 1 H 1.0079	2 helium 2 He 4.0026																												
3 lithium 3 Li 6.941	4 beryllium 4 Be 9.0122																												
5 boron 5 B 10.811	6 carbon 6 C 12.011	7 nitrogen 7 N 14.007	8 oxygen 8 O 15.999	9 fluorine 9 F 18.998	10 neon 10 Ne 20.180																								
11 sodium 11 Na 22.990	12 magnesium 12 Mg 24.305																												
13 aluminum 13 Al 26.982	14 silicon 14 Si 28.086	15 phosphorus 15 P 30.974	16 sulfur 16 S 32.065	17 chlorine 17 Cl 35.453	18 argon 18 Ar 39.948																								
19 potassium 19 K 39.098	20 calcium 20 Ca 40.078	21 scandium 21 Sc 44.956	22 titanium 22 Ti 47.867	23 vanadium 23 V 50.942	24 chromium 24 Cr 51.996	25 manganese 25 Mn 54.938	26 iron 26 Fe 55.845	27 cobalt 27 Co 58.933	28 nickel 28 Ni 58.693	29 copper 29 Cu 63.546	30 zinc 30 Zn 65.38	31 gallium 31 Ga 69.723	32 germanium 32 Ge 72.61	33 arsenic 33 As 74.922	34 selenium 34 Se 78.96	35 bromine 35 Br 79.904	36 krypton 36 Kr 83.80												
37 rubidium 37 Rb 85.468	38 strontium 38 Sr 87.62	39 yttrium 39 Y 88.906	40 zirconium 40 Zr 91.224	41 niobium 41 Nb 92.906	42 molybdenum 42 Mo 95.94	43 technetium 43 Tc [98]	44 ruthenium 44 Ru 101.07	45 rhodium 45 Rh 102.91	46 palladium 46 Pd 106.42	47 silver 47 Ag 107.87	48 cadmium 48 Cd 112.41	49 indium 49 In 114.82	50 tin 50 Sn 118.71	51 antimony 51 Sb 121.76	52 tellurium 52 Te 127.60	53 iodine 53 I 126.90	54 xenon 54 Xe 131.29												
55 cesium 55 Cs 132.91	56 barium 56 Ba 137.33	57-70 lanthanoids * Lu 174.97	71 lutetium 71 Lu 174.97	72 hafnium 72 Hf 178.49	73 tantalum 73 Ta 180.95	74 tungsten 74 W 183.84	75 rhenium 75 Re 186.21	76 osmium 76 Os 190.23	77 iridium 77 Ir 192.22	78 platinum 78 Pt 195.08	79 gold 79 Au 196.97	80 mercury 80 Hg 200.59	81 thallium 81 Tl 204.38	82 lead 82 Pb 207.2	83 bismuth 83 Bi 208.98	84 polonium 84 Po [209]	85 astatine 85 At [210]	86 radon 86 Rn [222]											
87 francium 87 Fr [223]	88 radium 88 Ra [226]	89-102 actinoids ** Lr [260]	103 lawrencium 103 Lr [260]	104 rutherfordium 104 Rf [261]	105 dubnium 105 Db [262]	106 seaborgium 106 Sg [263]	107 bohrium 107 Bh [264]	108 hassium 108 Hs [265]	109 meitnerium 109 Mt [266]	110 darmstadtium 110 Ds [267]	111 roentgenium 111 Rg [268]	112 copernicium 112 Cn [269]	113 nihonium 113 Nh [270]	114 flerovium 114 Fl [271]	115 moscovium 115 Mc [272]	116 livermorium 116 Lv [273]	117 tennessine 117 Ts [274]	118 oganesson 118 Og [275]	119 unbinilium 119 Uub [276]	120 unbinilium 120 Uut [277]	121 unbinilium 121 Uuq [278]	122 unbinilium 122 Uup [279]	123 unbinilium 123 Uuh [280]	124 unbinilium 124 Uuo [281]					
*lanthanoids		57 lanthanum 57 La 138.91	58 cerium 58 Ce 140.12	59 praseodymium 59 Pr 140.91	60 neodymium 60 Nd 144.24	61 promethium 61 Pm [145]	62 samarium 62 Sm 150.36	63 europium 63 Eu 151.96	64 gadolinium 64 Gd 157.25	65 terbium 65 Tb 158.93	66 dysprosium 66 Dy 162.50	67 holmium 67 Ho 164.93	68 erbium 68 Er 167.26	69 thulium 69 Tm 168.93	70 ytterbium 70 Yb 173.05														
**actinoids		89 actinium 89 Ac [227]	90 thorium 90 Th 232.04	91 protactinium 91 Pa 231.04	92 uranium 92 U 238.03	93 neptunium 93 Np [237]	94 plutonium 94 Pu [244]	95 americium 95 Am [243]	96 curium 96 Cm [247]	97 berkelium 97 Bk [247]	98 californium 98 Cf [251]	99 einsteinium 99 Es [252]	100 fermium 100 Fm [257]	101 mendelevium 101 Md [258]	102 nobelium 102 No [259]														