

單/複選混合考題 (每題 2 分, 共 40 分): ※ 本大題請於試卷內之「選擇題作答區」依序作答。

- 1) What is the molarity of NaCl in ground water if it contains 2.7g NaCl per 100ml ?
(a) 0.46 M, (b) 0.056 M, (c) 0.066 M, (d) 0.56 M, (e) 0.66 M
- 2) What is the density of water at 20°C ?
(a) 0.98210 g/ml, (b) 0.99921 g/ml, (c) 1.00000 g/ml, (d) 0.99821 g/ml, (e) 1.0024 g/ml
- 3) The hydrogen sulfide in 50.0g of marine sediment was collected in a solution of CdCl₂ by distillation. The precipitated CdS was then filtered, washed, and ignited to CdSO₄. Please calculate the percentage of H₂S in the sediment if 0.108g of CdSO₄ was recovered ?
(a) 0.0353%, (b) 5.43%, (c) 0.543%, (d) 0.0543%, (e) Silver Nitrate
- 4) A 100.0 ml of rain water contain Iron (II) was treated with 25.00 ml of 0.002107 M K₂Cr₂O₇, and then back-titrated with 7.47 ml of 0.00979 M Fe²⁺. What is the concentration of iron in this rain water ?
 $6\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 6\text{Fe}^{3+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$
(a) 23.57 ppm, (b) 135.7 ppm, (c) 148.6 ppm, (d) 235.7 ppm, (e) 14.86 ppm
- 5) Who received Nobel Prize of Chemistry in 1903 for his revolutionary ideas regarding ionic dissociation in solution ? He was also one of the first scientists to suggest the relationship between carbon dioxide concentration in the atmosphere and global temperature, a phenomenon later known as "green-house effect".
(a) Robert Boyle, (b) William Dittmar, (c) Joseph Louis Gay-Lussac, (d) Svante Arrhenius, (e) Alfred C. Redfield
- 6) Please calculate the weight of silver chloride produced when 0.364 g of AgI is heated in a stream of chlorine ?
 $2\text{AgI}(\text{s}) + \text{Cl}_2 \rightarrow 2\text{AgCl}(\text{s}) + \text{I}_2(\text{g})$
(a) 0.328g (b) 0.278g, (c) 0.283g, (d) 0.222g, (e) 0.264g
- 7) What is the pH of a solution formed by dissolving 5.00 g of HClO₄ (MW:100.5g/mol) in 250ml of water ?
(a) 0.928, (b) 0.839, (c) 0.701, (d) 0.532, (e) 0.656
- 8) What is called for a compound behave as both an acid and a base ?
(a) Amphiprotic species, (b) Adiabatic species, (c) Aerobic species, (d) Agostic species, (e) Alicyclic species
- 9) The solubility-product constant for Ag₂CrO₄ is 1.1×10^{-12} , what is the concentration of chromate-ion is needed to initiate precipitation from a solution that is 4.00×10^{-3} M in Ag⁺?
(a) 6.5×10^{-8} , (b) 5.8×10^{-8} , (c) 6.9×10^{-8} , (d) 5.5×10^{-8} (e) 5.9×10^{-8}
- 10) What is the pH of a 0.100 M solution of hydrogen cyanide (pK_a=9.2)?
(a) 5.73, (b) 4.84, (c) 6.52, (d) 3.69, (e) 3.25
- 11) Which compounds are strong electrolytes ?
(a) HCl, (b) NaOH, (c) HC₂H₃O₂, (d) HClO₄, (e) NaC₂H₃O₂
- 12) Please calculate the ionic strength of a 0.1 M solution of Na₂SO₄ ?
(a) 0.2, (b) 0.1, (c) 0.3, (d) 0.5, (e) 0.4
- 13) Which alkali metal ions have the highest standard redox potentials ?
(a) Li⁺, (b) Na⁺, (c) K⁺, (d) Rb⁺, (e) Cs⁺
- 14) What is the ratio of the Cu²⁺ (cupric) ion to the CuOH⁺ in the water if the OH⁻ concentration is 10⁻⁴ M (Cu²⁺ + OH⁻ → CuOH⁺; log k = 6.3) ?
(a) 0.009, (b) 0.008, (c) 0.007, (d) 0.006, (e) 0.005
- 15) Please calculate the K'_{sp} for Zn(OH)₂ (K_{sp} = 4.5 × 10⁻¹⁷) in a solution that has an ionic strength of 0.050.
(a) 5.8 × 10⁻¹⁷, (b) 4.8 × 10⁻¹⁷, (c) 3.8 × 10⁻¹⁷, (d) 2.8 × 10⁻¹⁷, (e) 1.8 × 10⁻¹⁷

見背面

- 16) What is the solubility of goethite ($\text{Fe}(\text{OH})_3$, the equilibrium constant is 4×10^{-38}) in water?
 (a) 5×10^{-17} mol/L, (b) 4×10^{-17} mol/L, (c) 3×10^{-17} mol/L, (d) 6×10^{-17} mol/L, (e) 2×10^{-10} mol/L
- 17) Which of the following acid-base indicators can be used to identify a rain water sample with a pH of 3.5?
 (a) Bromophenol Blue ($\text{C}_{19}\text{H}_{10}\text{Br}_4\text{O}_5\text{S}$, 溴酚蘭), (b) Phenol Red ($\text{C}_{19}\text{H}_{14}\text{O}_5\text{S}$, 酚紅), (c) Methyl Yellow ($\text{C}_{14}\text{H}_{15}\text{N}_3$, 甲基黃), (d) Phenol phthalein ($\text{C}_{20}\text{H}_{14}\text{O}_4$, 酚酞), (e) Nile Blue ($\text{C}_{20}\text{H}_{20}\text{ClN}_3\text{O}$, 尼羅藍)
- 18) Please calculate the electrode potential of a silver electrode immersed in a 0.0500 M solution of NaCl with $E_{\text{Ag}^+}^0 = 0.799$ V? (K_{sp} of AgCl is 1.82×10^{-10})
 (a) 0.359 V, (b) 0.229 V, (c) 0.239 V, (d) 0.259 V, (e) 0.299 V
- 19) In the 1800, who was the physicist known especially for the invention of the first battery (electric cell)?
 (a) Alfred Werner, (b) Erenst Rutherford, (c) Luigi Galvani, (d) Alessandro Volta, (e) Walther Nernst
- 20) A 0.200 g sample containing copper is analyzed iodometrically. Copper (II) is reduced to copper (I) by iodide, $2\text{Cu}^{2+} + 4\text{I}^- \rightarrow 2\text{CuI} + \text{I}_2$, what is percent copper in the sample if 20.0 ml of 0.100 M $\text{Na}_2\text{S}_2\text{O}_3$ are required for titration of the liberated I_2 ?
 (a) 63.5%, (b) 35.6%, (c) 73.8%, (d) Transmittance, (e) Fluorescence

問答與計算考題 (共 60 分)：※ 本大題請於試卷內之「非選擇題作答區」標明題號依序作答。

- 1). Please briefly describe "Beer-Lambert Law"? (10 分)
- 2). What are the pH and the concentrations of all aqueous species in a 5×10^{-4} M solution of aqueous boric acid ($\text{B}(\text{OH})_3$)? (Hint: $\text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^-$, $K_w = 10^{-14}$; $\text{B}(\text{OH})_3 + \text{H}_2\text{O} \leftrightarrow \text{B}(\text{OH})_4^- + \text{H}^+$, $K_a = 7 \times 10^{-10}$)? (10 分)
- 3). Please complete and balance the following redox reactions: (10 分)
 (1) $\text{FeS}_2 + \text{O}_2 \leftrightarrow \text{Fe}(\text{OH})_3 + \text{SO}_4^{2-}$
 (2) $\text{C}_2\text{H}_6 + \text{NO}_3^- \leftrightarrow \text{HCO}_3^- + \text{NH}_4^+$
 (3) $\text{IO}_3^- + \text{I}^- \leftrightarrow \text{I}_2 + \text{H}_2\text{O}$
 (4) Metallic iron dissolved in nitric acid (products: NO_2 , Fe^{3+})
 (5) Potassium permanganate oxidizes sodium oxalate (products: CO_2 , Mn^{2+})
- 4). Please briefly describe the theory and application concepts (types) of High Performance Liquid Chromatography. (10 分)
- 5). What is the concentration of Ni^{2+} in a solution (pH=3.00) mixed with 50.0 ml of 0.0300 M Ni^{2+} and 50.0 ml of 0.0500 M EDTA. (K_{MY} for EDTA-Ni Ion Complexes: 4.2×10^{18} , the dissociation constants for the deprotonation of H_4Y are $K_1 = 1.02 \times 10^{-2}$, $K_2 = 2.14 \times 10^{-3}$, $K_3 = 6.92 \times 10^{-7}$, $K_4 = 5.50 \times 10^{-11}$, (10 分)
- 6). Calculate the pH of the 0.30M NH_3 /0.36M NH_4Cl buffer system, $\text{p}K_a = 9.25$. And, what is the pH after the addition of 20.0 ml of 0.050 M NaOH to 80.0ml of the buffer solution? (10 分)

試題隨卷繳回