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^3, (b) 0.9992 kg/m^3, (c) 1.0000 kg/m^3, (d) 0.9982 kg/m^3, (e) 1.024 kg/m^3

3) The mercury in a 0.7152 g sample was precipitated with an excess of paraperioidc acid, H_5IO_6: (reaction as, $5 Hg^{2+} + 2 H_5IO_6 \rightarrow Hg_5(IO_6)_2 (s) + 10 H^+$). The precipitate was filtered, washed free of precipitating agent, dried, and found to weigh 0.3408 g. What is the percentage of Hg_2Cl_2 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^{2+} in the digested ointment is titrated with 21.3 ml of a 0.1144 M solution of NH_4SCN. Calculate the percent Hg (fw = 200.59 g) in the ointment? $Hg^{2+} + 2 SCN^- \rightarrow Hg(SCN)_2$　　　(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 $AgNO_3$ 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 ($K_a = 5.1 \times 10^{-4}$)?　　　(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_2CrO_4 is 1.1×10^{-12}, what is the concentration of chromate-ion is needed to lower the silver-ion concentration to 5.0×10^{-6} M?　　　(a) 6.5×10^{-8}, (b) 5.8×10^{-8}, (c) 6.9×10^{-8}, (d) 5.5×10^{-8} (e) 4.4×10^{-2}

10) What is the pH of a 0.100 M solution of acetic acid ($pK_a = 4.76$)?　　　(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 ($Mg_3Si_2O_5(OH)_4$) and reach equilibrium, has a Mg^{2+} molarity of $10^{-3.38}$ and a pH of 8.5, what is the H_4SiO_4 concentration in mg/L? Assume $a = m$. The dissolution of serpentine can be written as ;
$Mg_3Si_2O_5(OH)_4 + 6H^+ \leftrightarrow 3Mg^{2+} + 2H_4SiO_4 + H_2O$　　　(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 $AgNO_3$. 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 ($2 Fe^{3+} + 3 I^- \leftrightarrow 2 Fe^{2+} + I_3^-$; $2 Fe^{3+} + 2 e^- \leftrightarrow 2 Fe^{2+}$, $E^0 = 0.771 V$; $I_3^- + 2 e^- \leftrightarrow 3 I^-$, $E^0 = 0.536 V$) ?　　　(a) 8.7×10^7, (b) 2.8×10^7, (c) 3.6×10^3, (d) 8.7×10^3, (e) 2.8×10^3

見背面

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國立臺灣大學 109 學年度碩士班招生考試試題

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共 2 頁之第 2 頁

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) 5.48×10⁻³, (b) 4.58×10⁻³, (c) 9.48×10⁻³, (d) 2.88×10⁻³, (e) 1.48×10⁻³

16) Limestone, $CaCO_3$ (s), is in equilibrium with water in which carbonate, CO_3^{2-} concentration is 10^{-5} M. What is the concentration of the calcium ions, Ca^{2+} in the water? (a) 5×10⁻⁷ mol/L, (b) 5×10⁻⁴ mol/L, (c) 3×10⁻⁷ mol/L, (d) 6×10⁻⁷ mol/L, (e) 5×10⁻¹⁰ 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 O_2/H_2O 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 NH_3/0.36M NH_4Cl buffer system, pK_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)

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