

科目：分析化學

校系所組：中大化學學系 清大化學系 交大應用化學系甲組

Multiple Choice(4 points each, choose the most appropriate answer)

- What is the difference between α_0 function for acids and the β_0 function for complexes?
 - α_0 is the mole fraction of completely undissociated acid relative to the total concentration of all anion containing species (or formal concentration of acid).
 - β_0 is the mole fraction of uncomplexed metal ion in solution relative to the total concentration of all metal containing species in solution.
 - In equation form, the definitions of $\alpha_0 = [H_nA] / C_A$
 - In equation form, the definitions of $\beta_0 = [M^{n+}] / C_M$
 - All of above are correct
- A chemistry major student is beginning to prepare 100.0 mL of a solution to be labeled 20.00 mM sodium chloride. To prepare this solution, the student would
 - Weigh 1.170 grams of sodium chloride into a container and add 100.0 mL of water to dissolve the sodium chloride.
 - Weigh 1170 grams of sodium chloride into a container; add water to produce 100.0 mL of solution.
 - Weigh 11.70 grams of sodium chloride into a container, dissolve the sodium chloride in water, and then add water to produce 100.0 mL of solution.
 - Weigh 1.170 grams of sodium chloride into a container, add water to dissolve the sodium chloride, and then add water to produce 100.0 mL of solution.
 - None of above
- The Great Salt Lake, located in the Utah USA, is approximately eight times saltier than the ocean. The salinity of the lake was once reported to be as high as 27 parts per thousand sodium chloride. Please calculate the molarity of the sodium ion in the Great Salt Lake.
 - 4.6×10^{-4} Molar
 - 4.6×10^{-3} Molar
 - 1.2 Molar
 - 0.12 Molar
 - 0.46 Molar
- Write the answer to the following calculation to the proper number of significant figures.
 $154.68 \div 1.690 \times 197.000 = 18,030.74556$
 - 18,000.0
 - 18,030
 - 18,031
 - 18030.7
 - 18,030
- A hit-and-run case was reported to the police who have to identify the brand of ruby red auto paint. The percentage of iron oxide, which gives paint its red color, was determined to be $43.35 \pm 0.33\%$ by one method of analysis using five measurements. The color reference provide by the automotive manufacture is 44.21%. What can the police conclude about whether the sample matches the reference?
 - The sample matches the reference at a 95% confidence level.
 - The sample does not match the reference at a 95% confidence level.
 - There are an insufficient number of trials to determine if the sample is a match.
 - If the percentage of iron oxide was analyzed by two different methods. The results were $43.3 \pm$

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- 0.33% and $43.6 \pm 0.14\%$ with five measurements each. The conclusion would be drawn from the test results that the standard deviations are significantly different from each other at a 95% confidence level
- (E) None of above
6. A Gaussian distribution of data is symmetric if
- (A) 68.3% of the measurements lie within plus or minus two standard deviations from the mean.
(B) 4.5% of measurements lie outside the range defined by 2 standard deviations above the mean, and two standard deviations below the mean with 2.25% of the values above 2 standard deviations from the mean and 2.25% of the values below 2 standard deviations from the mean.
(C) 68.3% of the measurements lie within plus or minus one standard deviation from the mean.
(D) 4.5% of measurements lie outside the range defined by 2 standard deviations above the mean, and two standard deviations below the mean.
(E) None of above
7. During the late 1800's, hard rock miners used carbide lamps rather than candles for work in mine shafts. The lamps worked by dripping water onto calcium carbide (CaC_2) that generated acetylene gas (H_2C_2) that was burned. How many liters of acetylene gas at 1.00 atm pressure and 0.00°C are produced from 75.0 grams of calcium carbide?
- (A) 26.2 L (B) 13.1 L (C) 30.4 g (D) 52.4 L (E) None of above
8. Phenol (PhOH), once a common local anesthetic, has a pK_a of 10. Which of the following is (or are) correct.
- (A) At pH 8.00, PhO^- is the principal species
(B) At pH 11.00, PhOH is the principal species
(C) At pH 10, the quotient $[\text{PhO}^-]/[\text{PhOH}] = 1$
(D) At pH 10, the quotient $[\text{PhO}^-]/[\text{PhOH}] > 1$
(E) None of above
9. Calculate the potential of the half cell
- $$\parallel \text{FeCl}_3 (0.0010 \text{ M}), \text{FeCl}_2 (0.010 \text{ M}) \mid \text{Pt} \quad (\text{Fe}^{3+} + \text{e}^- \rightleftharpoons \text{Fe}^{2+} \quad E^\circ = 0.77 \text{ V})$$
- (A) 0.83 V (B) 0.71 V (C) 0.77 V (D) 0.740 V (E) 0.829 V
10. Sulfide ion was determined by indirect titration with EDTA. To a solution containing 25.00 mL of 0.04332 M $\text{Cu}(\text{ClO}_4)_2$ plus 15 mL of 1 M acetate buffer (pH 4.5) was added 25.00 mL of unknown sulfide solution with vigorous stirring. The CuS precipitate was filtered and washed with hot water. Then ammonia was added to the filtrate (which contains excess Cu^{2+}) until the blue color of $\text{Cu}(\text{NH}_3)_4^{2+}$ was observed. Titration with 0.03927 M EDTA required 12.11 mL to reach the murexide endpoint, i.e., the excess Cu^{2+} was directly titrated with the EDTA solution. Calculate the molarity of sulfide in the unknown.

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- (A) 0.6074 Molar (B) 1.083 Molar (C) 0.02430 Molar (D) 0.2430 Molar (E) 0.04860 Molar
11. Can Fe^{3+} and Mg^{2+} be separated quantitatively ($> 99\%$) as hydroxides from a solution that is 0.010 M in each cation? Based on the given K_{sp} information, which of the following state(s) true.
 $\text{Fe}(\text{OH})_3 \rightleftharpoons \text{Fe}^{3+} + 3\text{OH}^- (K_{sp} = 2 \times 10^{-39})$
 $\text{Mg}(\text{OH})_2 \rightleftharpoons \text{Mg}^{2+} + 2\text{OH}^- (K_{sp} = 7.1 \times 10^{-12})$
 (A) No, it is NOT possible to quantitatively separate Fe^{3+} in the presence of Mg^{2+}
 (B) Yes, it is possible to quantitatively precipitate Fe^{3+} in the presence of Mg^{2+}
 (C) The practical working OH^- concentration limit for the separation of Fe^{3+} and Mg^{2+} is 2.7×10^{-4} M.
 (D) The lower limit of $[\text{OH}^-]$ can be given by the $[\text{OH}^-]$ required to precipitate 99% of the Fe^{3+} , which is calculated to be 3×10^{-13} M
 (E) There is not sufficient information to judge if Fe^{3+} and Mg^{2+} can be separated
12. What principle does an adsorption indicator work on?
 (A) The change in pH of the solution causes the indicator to shift from the acid form to the conjugate base or the base form to the conjugate acid producing a change in color.
 (B) The charge on the surface of a colloidal particle changes, attracting the indicator to the surface of the particle producing a change in color.
 (C) The removal of the analyte allows the reaction of an ion previously added to the analyte to form a soluble colored complex.
 (D) The metal ions in the solution react with electron-pair donors to form colored coordination compounds or complexes
 (E) None of above
13. 8-hydroxyquinoline (8-hq, H_2A) is a diprotic acid that has been implicated in atmospheric transformations of polyaromatic hydrocarbons to the more toxic nitro-analogues. It is unclear if one or both of the acidic protons is (are) a key player in the chemical reaction. Therefore, pH conditions are very important. For this acid, with $K_1 = 1.23 \times 10^{-5}$ and $K_2 = 1.55 \times 10^{-10}$.
 (A) At pH = 4.91, $[\text{H}_2\text{A}] = [\text{HA}^-]$
 (B) At pH = 9.81, $[\text{HA}^-] = [\text{A}^{2-}]$
 (C) The principal species is H_2A at pH 2.45
 (D) At pH = 7.50, the principal species is HA^-
 (E) All of above
14. Which of the following ISO standard us currently used for chemical laboratory accreditation,
 (A) ISO 9000 (B) ISO 25 (C) ISO 14000 (D) ISO 17025 (E) ISO 23
15. Which of the following method is considered primary,
 (A) ID-MS (B) ICP-MS (C) GC-MS (D) LC-MS (E) MS-MS
16. Which of the following solvent is commonly used to extract polybrominated diphenyl ethers (PBDEs)

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for subsequent GC analysis,

(A) methylene chloride (B) toluene (C) hexane (D) ethyl acetate (E) pentane

17. Supercritical CO₂ is considered a green solvent for a variety of use, partially due to its solubility is similar to

(A) water (B) acetonitrile (C) hexane (D) ethyl acetate (E) ethyl alcohol

18. Which of the following chemical does not have a referenced level for indoor air quality by Taiwan EPA,

(A) HCHO (B) O₃ (C) NH₃ (D) CO₂ (E) TVOC

19. Which of the following sample generates the simplest UV absorption spectra,

(A) benzene in hexane (B) biphenyl in hexane (C) toluene in hexane
(D) toluene vapor (E) benzene vapor

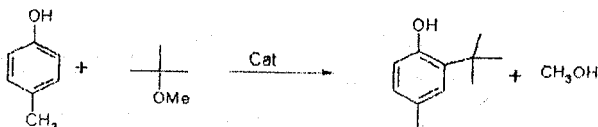
20. Which of the following detector is not suitable for UV-Visible spectrometer,

(A) silicon diode (B) charge-transfer detector (C) photomultiplier tube
(D) photoconductor (E) photographic plate

21. Green chemistry fails to reduce the using or generating of

(A) energy (B) waste (C) material (D) cost (E) none of the above

22. Alkylation of *p*-cresol using heterogeneous acid catalyst.



The experimental conditions: *p*-cresol (19.61g, 0.22 mol), MTBE (24.31g, 0.22mol) and a silica / zirconia catalyst (3.5 wt %) were heated at 100°C for 3 hr. After cooling the products were identified by gc. The main product was 2-*t*-butyl-*p*-cresol (13.0g), 10.78g of *p*-cresol remained unreacted. What is the % atom efficiency?

(A) 97% (B) 84% (C) 50% (D) 44% (E) 25%

23. Which of the following frequency does not appear in both IR spectrum of toluene and benzoic acid?

(A) 1350~1450 cm⁻¹ (B) 1600~1640 cm⁻¹ (C) 1650~1750 cm⁻¹
(D) 2850~2950 cm⁻¹ (E) 3000~3100 cm⁻¹

24. 4-bromofluorobenzene is commonly used for tuning mass spectrometer. Regarding to its mass spectrum, which of the following fragmentation ion represents the base peak?

(A) 75 (B) 95 (C) 174 (D) 175 (E) 176

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25. Which of the following chemical is not a Toxic Chemical Substances controlled by the Taiwan EPA.
(A) methylene chloride (B) vinyl acetate (C) acetaldehyde (D) acetonitrile
(E) methyl-tert-butyl ether

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