

RAIN SEMESTER

CHM 242: ANALYTICAL CHEMISTRY I

INSTRUCTIONS: ANSWER ALL QUESTION

TIME: 50mins

MATICR NUMBER..... DEPARTMENT.....

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- What is the relative uncertainty in reading a class A burette (tolerance = 0.02 mL) when the burette reading is 16.41 mL: (a) 0.328 (b) 0.002 (c) 0.2 (d) 0.02 (e) 0.001
- The accuracy of a measurement is greatly reduced by: (a) none of the above (b) random error (c) indeterminate error (d) systematic error (e) precision
- The analysis of a certified reference material by Oputu & sons laboratory gives 0.0491 mg/Kg P. calculate the percentage relative error in the measurement if the accepted true value is 0.0447 mg/Kg: (a) 8.96 (b) -9.84 (c) 9.84 (d) -8.96 (e) 10.00
- The initial and final burette reading in a standardization exercise for HCl was 0.25 mL and 13.37 mL respectively. Calculate the propagated uncertainty in the reading 13.12 mL. (Tolerance for class A burette = 0.02): (a) 0.02 (b) 13.12 (c) 0.04 (d) 0.028 (e) 0.03
- Given that the burette volume in question 4 above was titrated against a 20 mL (pipette volume, tolerance = 0.03) 0.05 M NaOH. Calculate the propagated uncertainty in the determined molarity of the HCl: (a) 0.001 (b) 0.0015 (c) 0.01 (d) 0.015 (e) 0.02
- What is the absolute and percentage relative uncertainty in the volume 100 mL, delivered with four aliquots from a class A 25 mL transfer pipette (tolerance = 0.03): (a) 0.06, 0.06% (b) 0.12, 0.12% (c) 0.07, 0.07% (d) 0.03, 0.03% (e) 0.06, 0.07%
- The results for an IT intern and her Q.C manager in a medical laboratory are shown below:  
Intern:  $\bar{x}=14.57$ ;  $s=0.53$ ;  $n=6$ .  
Manager:  $\bar{x}=13.95$ ;  $s=0.42$ ;  $n=5$ .

$$m_m = M_{Ca} \times M_{(Ca)}$$

{ 1 }



Determine the value of the students  $t$  calculated by comparing the intern with her manager:

(a) 2.58 (b) 2.01 (c) 1.38 (d) 1.47 (e) 2.11

The results for replicate analysis for Sanusi are as follows: 14.51, 14.47, 14.38, 14.42, 14.39, 14.47, 11.21, 14.53, 14.49, and 14.46. Given that the accepted true value for the measurement is 14.60, calculate the relative error associated with Sanusi's measurement ( $Q_{10}=0.41$ ): (a) -0.98%

(b) 1.00% (c) 0.14% (d) 0.98% (e) -0.14%

9. For question 8 above, calculate the students  $t$  value associated with Sanusi's mean and the accepted true value: (a) 2.35 (b) 3.14 (c) 1.85 (d) 8.25 (e) 9.75

10. For question 8 above, given that the standard deviation for the true value is 0.047. calculate the variance ratio value for the precision of the analyst: (a) 1.21 (b) 1.10 (c) 0.91 (d) 0.005 (e) 2.12

11. For question 8 above, calculate the coefficient of variation of the analyst: (a) 0.35 (b) 5.2 (c) 0.052 (d) 0.017 (e) 0.14

12. In the titration of 50mL, 0.05M NaOH with 0.1M  $H_2SO_4$ , the pH of the starting solution would be dependent on NaOH alone. The pH would read: (a) 7.00 (b) 12.69 (c) 1.70 (d) 13.00 (e) 12.30

13. For question 12 above, the respective pH at 3mL and 12.5mL of the acid would be: (a) 12.55, 7 (b) 12.30, 7 (c) 1.44, 7 (d) 13.00, 7 (e) 12.55, 7

14. In the titration of 50.00mL, 0.020 MES (2-(N-morpholino) ethane sulfonic acid) with 0.100M NaOH, calculate the pH of the starting solution.  $K_a=10^{-6.15}$ ,  $n_a/n_b=1$ : (a) 3.92 (b) 4.14 (c) 3.85 (d) 4.91 (e) 2.59

15. For question 14 above, what is the pH of the solution after adding 5mL of the base: (a) 5.27 (b) 6.15 (c) 4.37 (d) 5.10 (e) 6.00

16. For question 14 above, calculate the equivalence point pH: (a) 7.71 (b) 9.18 (c) 7.14 (d) 8.47 (e) 7.00

17. The increased stability of the complexes formed from metals and chelating ligands can be explained using: (a) kinetic data alone (b) thermodynamic data alone (c) none above (d) all above (e) thermodynamic and kinetic data.

18. 25.00mL  $Pb^{2+}$  solution was treated with 25mL, 0.054M EDTA. The excess EDTA required 14.25mL, 0.02299M  $Zn^{2+}$  to titrate to a red xylenol-orange end point. Calculate the molarity of the  $Pb^{2+}$  solution: (a) 0.03664M (b) 0.01319M (c) 0.05147M (d) 0.02270M (e) 0.0409M

19. Given that the formation constant for  $FeY$  is  $1.3 \times 10^{25}$  and  $\alpha_{Y4-}$  at pH 4 =  $3.8 \times 10^{-9}$ . Calculate the concentration of free  $Fe^{3+}$  in a solution of 0.5M  $FeY$  at pH 4: (a)  $3.19 \times 10^{-9}$  (b)  $1.40 \times 10^{-9}$  (c)  $2.47 \times 10^{-9}$  (d)  $2.20 \times 10^{-9}$  (e)  $4.67 \times 10^{-9}$

20. Calculate the end point pH for the titration of 0.25M  $H_3PO_4$  with 50mL, 0.5M  $Mg(OH)_2$ : (a) 3.72 (b) 4.25 (c) 7.00 (d) 8.88 (e) 8.42

21. 25mL, 0.05M  $Pb^{2+}$  was standardized by titrating with 0.05M EDTA. Calculate  $pPb^{2+}$  at the start of the titration exercise: (a) 2.42 (b) 3.49 (c) 4.11 (d) 1.30 (e) 1.48

22. Calculate the  $pPb^{2+}$  for question 21 above after adding 5mL of EDTA: (a) 2.42 (b) 1.48 (c) 1.30 (d) 4.11 (e) 3.49

23. Calculate  $pPb^{2+}$  at 25mL EDTA given that the conditional formation constant for  $Pb^{2+}$  at the titrating pH is  $4.17 \times 10^6$ : (a) 4.11 (b) 3.49 (c) 1.30 (d) 2.42 (e) 1.48

24. Analytical measurements are used to; (i) monitor and regulate the composition of raw materials used in trade (ii) control or optimize manufacturing processes (iii) monitor impurities by-products and pollutants: (a) i only (b) ii only (c) i and ii only (d) i, ii and iii (e) i and iii only.

$-\log[H]$



25. The main causes of variability are: (a) molarity and time (b) concentration and time (c) concentration and position (d) normality and time (e) position and time.
26. Sampling techniques for gases and vapors in the work place fall into : (a) gas sampling vessels (b) static sensors and entrapment (c) real time analysis (d) all above (e) none above.
27. Gas phase molecular fluorescence is employed for : (a) ozone,  $O_3$  (b) nitrogen oxide, NO (c) sulphur dioxide,  $SO_2$  (d) nitrogen dioxide,  $NO_2$  (e) peroxyacetyl nitrate PAN
28. As defined in chemical analysis, MATRIX is the; (i) substance to be analyzed, (ii) rest of the material in which the analyte is embedded (iii) solvent under test : (a) i only (b) i and ii only (c) iii only (d) i, ii and iii (e) ii only
29. Partition coefficient is correctly defined by : (i)  $K = \frac{a_{s1}}{a_{s2}}$  (ii)  $K = \frac{a_{s2}}{a_{s1}}$  (iii)  $K a_{s2} = a_{s1}$  (iv)  $K a_{s1} = a_{s2}$  : (a) i only (b) i and iii only (c) ii only (d) i and iv only (e) none above
30. The accelerating force  $F_i$  on a charged particle i under the influence of a constant electric field  $E$  is given by: (a)  $F_i = ZeE_i$  (b)  $F_i = \frac{Z_i e}{E}$  (c)  $F_i = Z_i e E$  (d)  $F_i = \frac{E}{Z_i e}$  (e)  $F_i = \frac{Z_i}{e E}$
31. Which of the following is/are included in application of loss on drying gravimetric technique:  
I. Moisture determination in food beverage II. moisture determination in water analysis  
III. Determination of drying temperature IV. Geochemical analysis.  
A. I and II. B. II only. C. I only. D. I, III and IV. E. I and IV.
32. The similarities between Loss on decomposition and to loss on drying techniques include the following except;  
I. drying takes place at  $105^\circ C$ . II. Drying takes place at  $650^\circ C$ . III. Sample container is made of glass.  
IV. Sample container is made of porcelain crucible.  
A. I and II. B. I, II and III. C. None of the above. D. IV only. E. All of the above.
33. In electrogravimetric technique, electrodeposition of analyte is based on;  
I. Ohm's law. II. Gravimetry law III. 2<sup>nd</sup> law of Faraday. IV. Beer-Lambert's law.  
A. I, II and III. B. I and II. C. I only. D. III and IV. E. I, II, III and IV.
34. Which of the following is/are included in the application of thermogravimetry?  
I. Determination of purity of standards. II. Determination of correct drying temperature.  
III. Determination of thermal stability of materials. IV. Determination of the composition of analyte.  
A. I and II. B. I, II and III. C. III and IV. D. All of the above. E. I, III and IV.
35. The preliminary step in precipitation gravimetric includes which of the following factors?  
i. volume of the solution. ii. Concentration range of the analyte. III. Temperature of analyte solution. IV.  $P^H$  of the solution. A. All of the above. B. III and IV. C. I, II and III. D. I and II. E. I & III
36. Processes involved in precipitation step in gravimetric technique include;  
i. Ion cluster formation. ii. Oswald ripening. iii. Nucleation. iv. Crystal growth.  
A. I and ii. B. III only. C. All of the above. D. I, III and IV. E. I, II and III.
37. Relative supersaturation is reduced during precipitation in gravimetry through; precipitation from,  
I. Dilute solution. II. Hot solution. III. At high PH. IV. Concentrated solution.  
A. I and II. B. All of the above. C. I, II and III. D. III and IV. E. I, III and IV.



28

178

116

38. Calculate the gravimetric factor for the analysis of  $\text{SiO}_2$  which was precipitated as  $\text{KAlSi}_3\text{O}_8$ . Given that; K=39; Al=27, Si=28.

- A. 0.456 B. 0.578 C. 0.512 D. 0.647 E. 0.649

39. Electronic transition which is responsible for majority of electronic spectra in visible and uv regions is;

- i.  $\pi \rightarrow \pi^*$  ii.  $n \rightarrow \sigma$  iii.  $\sigma \rightarrow \sigma^*$  iv.  $n \rightarrow \pi^*$   
A. I and III. B. I and II C. II and IV. D. I, II, III and IV E. I, II and III.

40. The technique that is based on measurement of radiation emitted by atoms in excited state is;

- A. Atomic absorption spectrometry. B. Atomic fluorescence spectrometry. C. Atomic emission spectrometry. D. Infra-red spectrometry. E. Molecular absorption spectrometry.

Source of radiation for Atomic Emission Spectrometry technique includes;

i. Hollow cathode lamp. ii. Laser. iii. Plasma iv. Xenon arc lamp.

- A. i and ii B. None of the above. C. ii, iii and iv. D. All of the above. E. i and iii.

42. Calculate the Gravimetric Factor for the analysis of  $\text{As}_2\text{O}_3$  which was precipitated as  $\text{Ag}_3\text{AsO}_4$

Ag=108, O=16, As=75.

- A. 1.214 B. 0.1342 C. 0.214 D. 0.314 E. 1.214

43. In which region of the electromagnetic radiation does electronic transition takes place?

- i. Radio & microwave. ii. Visible & near IR. iii. Visible & ultra violet. iv. Ultra violet & IR.  
A. i & ii B. i & iii. C. i & iv D. iii only. E. All of the above.

44. Which of this statement is true of vibrational transition?

- i. It occurs together with electronic transition. ii. Different excited vibration levels result in a spectrum of peaks. iii. It is due to stretching and contracting of bonds. iv. Occur at long wavelength in far infra-red region.

- A. ii and iii. B. i and ii. C. ii and iv. D. i, ii and iii. E. iii and iv.

45. A solution containing 3.500mg/l in 100ml was observed to transmit 87% of the incident light. What is the Absorbance at this wavelength?

- A. 1.17 B. 1.71 C. 0.05 D. 0.06 E. 0.155

46. What advantages do organic precipitating agents have over others?

- i. produces precipitate which is sparingly soluble. ii. Produce coloured precipitate. iii. Have high molecular mass which yield large amount of precipitate. iv. They do not undergo post-precipitation.

- A. i and ii. B. ii and iv. C. i, ii and iii. D. iii and iv. E. i and iv.

47. What is the necessary criterion for a molecule to absorb in the IR region?

- A. The molecule must contain chromophore. B. There must be change in electric dipole moment of the molecule. C. The molecule must be able to fluorescence. D. The molecule must be IR inactive. E. The molecule must be able to undergo electronic and vibrational transition.

48. Why is digestion necessary during precipitation gravimetry?

- A. To improve purity of the precipitate. B. To reduce peptization of the precipitate. C. To remove surface adsorbed ions. D. To minimize supersaturation. E. To avoid occlusion.

49. A mixture containing only AgCl and AgBr weighs 2.500g. It is quantitatively reduced to silver metal, which weighs 1.500g. Calculate the weight of AgCl in the original mixture.

- A. 0.36 B. 0.84 C. 0.47 D. 0.27 E. 0.15

50. Using the information in question 19, calculate the weight of AgBr in the original mixture.

- A. 2.00 B. 2.14 C. 1.23 D. 2.15 E. none of the above.

41. 2.14