02 MAY 2023

KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

Marks Scored:

Level : B.Sc./B.Tech.
Year : II
Course : CHEM 215
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 20

Registration No.:
Date :

SECTION "A"
[20Q. × 1 = 20 marks]

Mark [×] for the most appropriate alternative from each set of choices.

1. In Good Laboratory Practice (GLP), what is the primary purpose of the quality control (QC) process?
   [ ] To ensure the laboratory personnel wear appropriate PPE.
   [ ] To ensure all laboratory equipment is calibrated and maintained.
   [ ] To verify the accuracy and reliability of test results.
   [ ] To validate the methods used in the laboratory.

2. What is the principle behind potentiometric measurements?
   [ ] Measuring the flow of current
   [ ] Measuring the voltage across a resistor
   [ ] Measuring the potential difference between two electrodes
   [ ] Measuring the resistance of a solution

3. Which mass spectrometry technique is best suited for determining the molecular mass of a large biomolecule such as a protein?
   [ ] Electron Impact (EI) Mass Spectrometry
   [ ] Matrix-Assisted Laser Desorption/Ionization (MALDI) Mass Spectrometry
   [ ] Electrospray Ionization (ESI) Mass Spectrometry
   [ ] Fast Atom Bombardment (FAB) Mass Spectrometry

4. What is the purpose of using primary standard substance in titration?
   [ ] To calibrate the titration equipment.
   [ ] To standardize the secondary standard substance.
   [ ] To adjust the pH of the titration solution.
   [ ] To measure the concentration of the analyte accurately.

5. The process of dispersing an insoluble material into a liquid as a colloid is called:
   [ ] coagulation [ ] peptization [ ] nucleation [ ] occlusion

6. Titrator A obtains a mean value of 12.96% and a standard deviation of 0.05for the purity of a sample. Titrator B obtains corresponding values of 13.12% and 0.08. The true percent purity is 13.08. Compared to titrator B, titrator A is
   [ ] more accurate and more precise [ ] less accurate and less precise
   [ ] more accurate but less precise [ ] less accurate but more precise

7. Which of the following is not a common application of mass spectrometry?
   [ ] Environmental analysis [ ] DNA sequencing
   [ ] Protein identification [ ] Drug discovery and development

8. Which of the following elements is typically used as the radiation source in atomic absorption spectroscopy?

[ ] Sodium (Na) [ ] Mercury (Hg)
[ ] Hollow cathode lamp (HCL) [ ] Tungsten (W)

9. In IR spectroscopy, which functional group is characterized by a strong and broad absorption peak in the range of 3200-3600 cm-1

[ ] Carbonyl group (C=O) [ ] Hydroxyl group (OH)
[ ] Alkene group (C=C) [ ] Amine group (NH2)

10. What will be the absorption if %Transmittance is 80?

[ ] 0.5 [ ] 0.05 [ ] 0.097 [ ] 0.97

Fill in the blank with appropriate words/symbols/values:

11. The process by which impurity is deposited after the complete precipitation of the analyte is _____.

12. A water sample is found to contain 0.00026 M in $CaCO_3$. The concentration of $CaCO_3$ is_____ ppm.

13. If you double the wavenumber of electromagnetic radiation, you _____ the energy.

14. A determinate error whose size varies with the size of the sample is called _____.

15. _____percentage of light is transmitted through the sample when it has absorbance value 0.046.

16. Smith-Hieftje background correction uses a single hollow-cathode lamp pulsed with first _____ and then with _____.

17. The sample container used in the ultra violet (UV) region is made up of the material _____.

18. In Infra Red Spectroscopy, the number of vibrational modes for SO_2 molecule is _____.

19. _____ corresponds to an analyte molecule that has not undergone fragmentation in mass spectrum.

20. 100 mL of 0.1M solution of weak acid ($Ka=1x10^{-7}$) is titrated with 0.1M NaOH. The pH at the half equivalence point will be_____

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End Semester Examination [C]
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D 2 MAY 2023

Level : B.Sc./B.Tech.
Year : III
Time : 2 hrs. 30 mins.

Course : CHEM 215
Semester : I
F.M. : 55

SECTION "B"

[5Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

1. a. What are the consequences of non-compliance with GLP regulations? [2]

   b. The normality of a solution is determined by four separate titrations, the results being 0.2041, 0.2049, 0.2039 and 0.2043. Calculate the mean, median, range, average deviation, standard deviation and coefficient of variation. [3]

2. a. State gravimetric factor. What size sample containing 14.4% chlorine (Cl) should be taken for analysis to obtain a precipitate of AgCl which weighs 0.440 g? [1+2]

   b. State the desirable properties of primary standard substances. [2]

3. a. Define spectral band mass or effective bandwidth. Why is iodine sometimes introduced into a tungsten lamp? [1+2]

   b. Sketch different types of curve used to determine the end point in potentiometric titration. [2]

4. a. Write general principles of titrimetric method of analysis. Calculate the pH of the solution made by mixing 100ml of 0.05 M NaOH and 100 ml of 0.05M CH_3COOH. The K_a of CH_3COOH is 1.0×10^{-5}. [3]

   b. Show your familiarity with mass spectrometer [2]

5. a. What is the largest peak in a mass spectrum? How do you analyse mass spectrum? [1+2]

   b. What is Doppler effect in AAS? How does it cause line broadening in AAS? [2]

6. a. Explain briefly the concepts of bathochromic shift. A 0.00396 M solution of compound 'X' exhibited an absorbance of 0.624 at 238nm in a 1cm cuvet; a blank solution containing only solvent had an absorbance of 0.029 at the same wavelength. Find the molar absorptivity of compound 'X'. [1+1.5]

   b. What is figure of merit? What are the differences between dynamic range and detection limit? [1+1.5]

SECTION "C"

[5Q. × 6 = 30 marks]

Attempt *ANY FIVE* questions.

7. a. What are the key principles of GLP? How should laboratory equipment and instruments be maintained and calibrated to comply with GLP? [1+2]

b. Discuss on Von Weimarn's theory of relative supersaturation. How does the digestion improve the quality of the precipitates? [1.5+1.5]

8. a. Why is it necessary for the glass in the membrane of a pH sensitive electrode to be appreciably hygroscopic? Derive the relation between boundary potential and pH of the solution. [1+2]

b. Define equivalent conductance. The specific conductance of 0.02M KCl solution at 298K is $0.002765 ohm^{-1}cm^{-1}$ and resistance of the cell containing this solution is 80 ohms. calculate the cell constant. [1+2]

9. a. State Beer's law. A typical simple infrared spectrophotometer covers a wavelength range from 3 to 15 μm. Express its range (a) in wavenumbers and (b) in hertz. [1+2]

b. Show that how do you determine an unknown concentration of analyte using standard addition calibration method. [3]

10. a. Show your familiarity with hollow cathode Lamp used as radiation source in AAS. [3]

b. How is t- test applied for comparison of two means obtained for the same sample. [3]

11. a. Justify why CO_2 does not appear in IR spectrum. Also find the total vibrational modes in CO_2. [2+1]

b. Define continuum source. Why does a deuterium lamp produce a continuum rather than a line spectrum in the UV region? [1+2]

12. Short notes on: (*ANY THREE*) [3×2 =6]

a. Fingerprint and functional region in IR
b. Saturated calomel electrode
c. Infrared detector
d. photomultiplier tubes