KATHMANDU UNIVERSITY
End Semester Examination
July/August 2024

Level : B.E.
Year : II
Time : 2 hrs. 30mins.

06 AUG 2024

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

SECTION "B"
[5Q. × 5 = 25 marks]

Attempt ANY FIVE questions.

1.
   a. Define Good Laboratory Practices (GLP). Identify and describe three key principles of GLP. [2]
   b. Describe the steps you would take in case of a chemical spill in the laboratory. Include both minor and major spills in your response. Outline the standard procedures for the proper use and maintenance of the following laboratory apparatus: Analytical balance, Burette. [1+1+1]

2.
   a. Show your familiarity with titrimetric method of analysis? Explain what is meant by a feasible acid-base titration. [1.5+1.5]
   b. Write short note on sample handing technique in IR. [2]

3.
   a. What is the principle of conductometric titration? Draw typical conductometric titration curves for acid base titration. [2]
   b. 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]

4.
   a. Using the Beer's equation, describe the relationship between absorbance and transmittance. A compound has a molar absorptivity of 3.03×10^3 $Lmol^{-1}cm^{-1}$. What concentration of the compound would be required to produce a solution that has a transmittance of 9.53% in a 2.50 cm cell? [1+2]
   b. Explain the basic principles of chromatography. How does the separation of components in a mixture occur, and what are the key factors that influence this separation? [2]

5.
   a. Define base peak. Show your familiarity with general theory behind molecular mass spectroscopy. [1+2]
   b. What is potentiometric titration? Sketch different potentiometric titration curves. [2]

6.
   a. Describe the mechanisms by which fluorescence and phosphorescence occur. Include the roles of singlet and triplet states. [2]
   b. What are different types of molecular vibrations? Is CO2 IR active? Justify. [3]

P.T.O.

SECTION "C"

[5Q. × 6 = 30 marks]

Attempt ANY FIVE questions.

7.

a. Concentrated HCl (MW 36.5) has density of 1.19 g/ml and is 57% by weight HCl. How many milliliters of the concentrated acid should be diluted to 2.0 liters with water to prepare a 0.1M solution? [3]

b. Discuss on Von Weimarn's theory of relative supersaturation. How does the digestion improve the quality of the precipitates? [3]

8.

a. Define an asymmetric potential? Discuss about different factors that affect the pH measurement with the glass electrode. [1+2]

b. How can you utilize an anion exchange resin and a buffer at pH 4.0 to effectively separate Protein A (pI = 3.5) from the mixture containing Protein B (pI = 6.0)? Explain the chromatographic principles and techniques involved in achieving this separation [3]

9.

a. Explain the importance of background correction in atomic absorption spectroscopy (AAS). What types of interferences can affect the accuracy of measurements, and how does background correction help to mitigate these interferences? [3]

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=3]

10.

a. Compare the operational principle of light sources used in UV visible spectrophotometer. [4]

b. Define chromophore. What are the effects of substituent and conjugation on chromophores? [2]

11.

a. Discuss the principles behind Affinity Chromatography (AC) and Molecular Exclusion Chromatography (MEC). Identify the types of molecules or samples best suited for separation using AC and MEC. [3]

b. How ions of different masses are separated by magnetic sector mass analyzer? Explain. [3]

12. [2+2+2=6]

Write short notes on: (***ANY THREE***)

a. Electron impact ionization in mass spectrometry
b. Hollow Cathode Lamp in AAS
c. Photomultiplier tubes
d. Fingerprint and functional region in IR
e. Saturated calomel electrode

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Registration No.:

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SECTION "A"
[20Q. × 1 = 20 marks]

Choose and encircle the most appropriate option from each set of choices.

1. Which one of the following is not true for minimization of chemical interferences:
   [ ] Choosing the alternative wavelength
   [ ] Increasing or decreasing the flame temperature
   [ ] Using ionization suppressant
   [ ] Using protective agent

2. The energy by UV/visible radiation is susceptible for
   [ ] Electronic transition [ ] Bond fission
   [ ] Rotational transition [ ] Change in nuclear spin

3. 50 mL of 0.1M HA ($Ka = 2\times10^{-5}$), is titrated with 0.1M NaOH. The pH change at the equivalence point by the addition of 0.2mL NaOH will be:
   [ ] 1.8 [ ] 3.2 [ ] 2.6 [ ] 3.4

4. A primary standard substance should _____
   [ ] have impurities less than 0.1-0.2%
   [ ] be hygroscopic
   [ ] have high equivalent weight
   [ ] react with the secondary standard solution

5. A precipitate of $Fe(OH)_3$ is contaminated with $Mg(OH)_2$. The best way to get rid the impurity is
   [ ] Digestion [ ] Washing [ ] Ignition [ ] Reprecipitation

6. In Conductometric titrations, one of the following is evaluated by calibration with 0.1M KCl
   [ ] Distance between two electrodes
   [ ] Cell constant
   [ ] Area of cross section of each electrode
   [ ] Platinum wire of electrode

7. What is the primary advantage of the retention factor (k) in chromatography?
   [ ] It varies with the column geometry.
   [ ] It changes with the volumetric flow rate.
   [ ] It is constant for a given solute, mobile phase, and stationary phase combination, regardless of column geometry or flow rate.
   [ ] It decreases as the solute migration rate increases

8. In affinity chromatography, the target molecule is typically eluted by:
   [ ] Increasing the temperature
   [ ] Changing the pH or ionic strength
   [ ] Reducing the pressure
   [ ] Adding surfactants

9. What is the primary functional difference between a chromophore and an auxochrome in a molecule?
   [ ] A chromophore modifies the structure of an auxochrome.
   [ ] An auxochrome is responsible for the color of the molecule.
   [ ] A chromophore gives the color to the molecule, while an auxochrome enhances this color.
   [ ] An auxochrome absorbs light, while a chromophore does not.

10. The modes of vibrations in linear molecules are given by
    [ ] 3N-6 [ ] 3N-4 [ ] 3N-5 [ ] 3N-2

Fill in the blanks

11. Ordinary glass electrode suffers from_____ error when the pH of analyte solution is generally less than 0.5.

12. A colloid which has only a slight affinity for water is called_____

13. The energy source in matrix assisted laser desorption/ionization source is_____

14. _____percentage of light is transmitted through the sample when it has absorbance value 0.039.

15. The wavenumber of a beam of infrared radiation with a wavelength of 5.00 μm is_____ cm^{-1}.

16. In Reverse Phase Chromatography (RPC), the mobile phase is_____, and the stationary phase is_____

17. The potential which develops at the interface between two ionic solutions of different compositions are called_____

18. One of the most popular techniques for handling solid samples for infrared spectrum has been _____

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

20. The unit of molar extinction coefficient is_____