

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
June/July 2024

Marks Scored:

Level : B.Pharm./B.Tech.  
Year : II

Course : CHEM 212  
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date **03 JUL 2024**

SECTION "A"

[20Q. × 1 = 20 marks]

Mark [X] in the most appropriate answer.

- Which of the following statement is incorrect, while using precipitating titration with Volhard indicator?  
 Thiocyanate ( $\text{SCN}^-$ ) is the common titrant.  
  $\text{Fe}^{3+}$  acts as the indicator.  
 Titration should be carried in acidic condition.  
 Indirect titration for determination of  $\text{Br}^-$  and  $\text{I}^-$  is not possible.
- 0.1 M weak acid (HA)  $K_a = 1.0 \times 10^{-8}$  is to be titrated with 0.1M NaOH, which of the following indicator is suitable for this titration?  
 methyl orange, (pH range 3-4.6)       P-nitrophenol, (pH range 5.6-7.6)  
 phenolphthalein, (pH range 8-9.6)       Thymolphthalein, (pH range 8-9.6)
- In an analysis of replicate samples, data are obtained: 0.215, 0.218, 0.22, 0.228 and 0.230. Is any of the outlier data be rejected for further analysis? [Given: Q for,  $n = 5$  at 90% CL is 0.64]  
 0.215       0.230  
 both 0.215 and 0.230       none of them
- Symbol  $\alpha_4$  is often used in titrations involving EDTA. What does this indicates?  
 equilibrium constant of reaction.  
 fraction of unreacted EDTA in the mixture  
 relative amount of  $\text{Y}^{4-}$  among all unreacted EDTA species  
 concentration of M-EDTA complex
- Which of the following solution possess larger ionic strength?  
 0.3 M NaCl       0.2 M  $\text{MgSO}_4$   
 0.2 M  $\text{CaCl}_2$        0.3 M  $\text{Na}_2\text{SO}_4$
- Metallic indicator electrode, whose potential depends on concentration of certain anion in the solution is  
 First kind metallic indicator       Second kind metallic indicator  
 Third kind metallic indicator       Inert metallic indicator
- For the redox reaction:  $\text{Sn}^{2+} + 2\text{Ce}^{4+} \rightleftharpoons \text{Sn}^{4+} + 3\text{Ce}^{3+}$  [  $\text{Sn}^{4+}$  ( $E^0 = 1.44\text{V}$ ) with  $\text{Ce}^{4+}$  ( $E^0 = 1.5\text{V}$ )], the most suitable indicator among the list is  
 phenosafranine (transition pot. 0.28V)       methylene blue (transition pot. 0.53V)  
 ferroin (transition pot. 1.11V)       indigo tetrasulfonate (transition pot. 0.36V)

8. Instrument for measuring samples are frequently calibrated with suitable standards to minimize  
 methodic error  operative error  
 instrumental error  scatter ness of data
9. When analyte in a solution are precipitated from homogeneous solution  
 precipitating reagent is added very slowly with constant stirring  
 temperature is controlled, since it affects solubility  
 precipitating reagent is generated by slow chemical reaction  
 solvent is slowly evaporated to precipitate analyte species
10. Equation for direct potentiometric could be applied, for determining lead in the sample, in this determination a plot of  $E_{\text{cell}}$  vs pPb will have the slope of  
 - 0.0296  - 0.0592  0.0592  0.1184

**Fill in the banks by most appropriate VALUE or WORD.**

11. A measurement which indicates how closely a measured quantity agrees with the true value is called \_\_\_\_\_
12. A colloidal particle that has only a small affinity for solvent is called \_\_\_\_\_
13. In acid base titration, carbonate error is originated by absorption of \_\_\_\_\_ gas by NaOH solution.
14. The major cause of residual current in polarography measurement is \_\_\_\_\_
15. If 60 mL of 0.1 M  $\text{AgNO}_3$  and 40 mL of 0.1 NaCl are mixed together, what will be the concentration of  $\text{Cl}^-$  ion at equilibrium? \_\_\_\_\_ [given:  $K_{\text{sp}}(\text{AgCl}) = 1.0 \times 10^{-10}$ ]
16. A solution that resists the change in potential on addition of oxidizing or reducing agent is called \_\_\_\_\_ solution.
17. The unit of equivalent conductance is \_\_\_\_\_
18. In a solution with high concentration of alkali metals, measured pH by glass electrode will be less than actual pH, this error is called as \_\_\_\_\_
19. In potentiometric titration, more accurate result can be obtained from \_\_\_\_\_ curve.
20. The potential of redox couple when the analytical concentration of Ox and Red are same and other constituents of the solution (buffer, and whatever are specified is called \_\_\_\_\_ potential.

KATHMANDU UNIVERSITY  
End Semester Examination [C]  
June/July 2024

Level : B.Pharm./B.Tech.  
Year : II  
Time : 2 hrs. 30 mins.

03 JUL 2024

Course : CHEM 212  
Semester : II  
F. M. : 55

SECTION "B"  
[5Q × 5 = 25 marks]

Attempt *ANY FIVE* questions.

1.
  - a. Point out major advantages and disadvantages of dropping mercury electrode as compared to metallic disk micro electrode. [3]
  - b. What size sample containing 32.0% Fe<sub>3</sub>O<sub>4</sub> should be taken for analysis to obtain precipitate of Fe<sub>2</sub>O<sub>3</sub> which weighs 1.80 gm? Given MW Fe<sub>3</sub>O<sub>4</sub> = 231.53 and, Fe<sub>2</sub>O<sub>3</sub> = 159.69 [2]
2.
  - a. The normality of solution is determined by four separate titrations, the results being 0.0241, 0.0249, 0.0239 and 0.0243 calculate the standard deviation of the result? [2]
  - b. If you are going to titrate 50 mL of 0.2 M KBr solution with 0.1M AgNO<sub>3</sub>, state a suitable indicator that you choose, also explain its working principle. [1+2=3]
3.
  - a. Draw diagram and explain on silver/silver chloride reference electrode. [2]
  - b. 50.00 mL of 0.100 M solution of the weak acid, HA, is titrated with 0.100 M NaOH (strong base), when volume of base was increased from 49.95 to 50.05 mL, pH changes by 3 units. Calculate the dissociation constant (K<sub>a</sub>) of the acid. [3]
4.
  - a. Explain how is Debye–Huckel equation helpful to determine activity of (i) an ion (ii) binary electrolyte, from their respective molar concentrations? What are its basic limitations? [3]
  - b. Give the simple sketch of curves in conductometric titration of, [2]
    - (i) Strong acid with strong base
    - (ii) Weak acid with strong base
    - (iii) Strong acid with weak base
    - (iv) Weak acid with weak base
5.
  - a. 50 mL of a solution which is 0.01 M in Ca<sup>2+</sup> and buffered at pH 10 is titrated with 0.01 M EDTA solution. Calculate the value of pCa at following conditions. [Given: K<sub>abs</sub> for CaY<sup>2-</sup> = 5.0 × 10<sup>10</sup>, α<sub>4</sub> at pH 10 = 0.35] [3]
    - (i) after addition of 15 mL EDTA.
    - (ii) at equivalence point
    - (iii) after addition of 55 mL EDTA
  - b. In a 0.1M solution: acetic acid (HOAc) is found to be 1.34% dissociated. Calculate its dissociation constant at that temperature. [2]

P.T.O.

- 6.
- What is a true redox indicator? Justify that a change potential of  $\sim 0.12\text{V}$  is required to bring about the change in colour of such indicator. [1+2=3]
  - Give an example of crystalline membrane electrode and explain its working mechanism? [2]

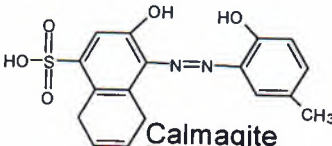
SECTION "C"  
[5Q  $\times$  6 = 30 marks]

Attempt *ANY FIVE* questions.

- 7.
- Write Ilkovic equation for the diffusion current in polarography, elaborate all the terms as present in the equation. [1.5]
    - Explain the nature of different kinds of curves in amperometric titrations? [1.5]
  - Are the following reactions below; feasible for titrimetric analysis? Give sufficient justifications for your answer. [3]
    - complex formation reaction:  $\text{Cu}^{2+} + 4\text{NH}_3 \rightleftharpoons \text{Cu}(\text{NH}_3)_4^{2+}$   $K = 8.1 \times 10^{12}$
    - acid base reaction:  $\text{H}_3\text{O}^+ + \text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{H}_2\text{O}$   $K = 1.8 \times 10^9$

- 8.
- Define and explain student's *t* test. How is this test applicable for
    - Determining confidence limit of a measurement.
    - Identifying two means whether they are significantly different or not at a given degree of freedom.
  - List the four major desirable characteristics of primary standard substances. What is basic limitation of  $\text{CaCO}_3$  as primary substance and how it can be solved?

- 9.
- Calmagite, a triprotic acid (*given structure*), is an excellent indicator for determination of  $\text{Mg}^{2+}$  in EDTA titration.
 



$pK_{a1} = \text{very small}$

$pK_{a2} = 8.1$

$pK_{a3} = 12.4$

- Explain the role of pH and pM for this indicator for indicating the equivalent point. [3]
  - Why is this indicator not applicable for  $\text{Ca}^{2+}$  determination? [1]
- b. List the sources for residual current in polarography? [1]

- 10.
- Why digestion is applied only for crystalline precipitates not to curdy precipitates and gelatinous precipitates? [2]
  - Colloidal particles do not undergo easy coagulation. Mention two methods that could be applied for coagulation of these particles. [2]
  - "In the titration of  $\text{Cl}^-$  with  $\text{Ag}^+$  the concentration of both reagents should not be much less than  $0.10\text{M}$ ". Give reason. [2]

11.

- a. State some of possible sources of indicator error in acid base titration. How can these errors be minimized? [2+1=3]
- b. Distinguish between determinate and indeterminate error. When multiplication or division is involved to calculate the final result, justify that relative *determinate errors* are transmitted directly into the result. [1+2=3]

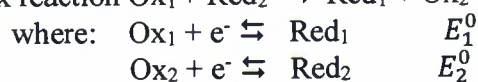
12.

Draw a simple figure and explain on glass membrane electrode. Also derive a relation that shows the dependency of boundary potential of this electrode on pH of solution. [3+3=6]

13.

a. Derive a relation  $\Lambda_{\text{eq}} = \frac{k \times 1000}{C}$  terms used possess the usual meaning. [2]

b. For the redox reaction  $\text{Ox}_1 + \text{Red}_2 \rightleftharpoons \text{Red}_1 + \text{Ox}_2$  [3+1=4]



- (i) Calculate the value of equilibrium constant for conditions: 50 mL of 0.1 M Red<sub>2</sub> is treated with 0.1 M Ox<sub>1</sub>, when 49.95 mL of titrant is added, the reaction is complete. On addition of two more drops (0.10mL) of titrant, the pRed<sub>2</sub> changes by 2.0 units.
- (ii) Calculate the difference between  $E_1^0$  and  $E_2^0$ .

