KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Tech.
Year : II

Course : CHEM 212
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

20 FEB 2025

Registration No.:

Date :

SECTION "A"
[20 Q. × 1 = 20 marks]

Select the mark [X] in the most appropriate answer.

1. Which of the following statement is **NOT** true?
   [ ] Qualitative analysis deals with what elements/compounds are present in a sample
   [ ] Micro analysis deals with samples weighing from 1 to 10 mg.
   [ ] Quantitative analysis deals with the identification of substances
   [ ] If the analyte constitute more than about 1% of the sample, it is considered as major constituent

2. Researcher I obtains a mean value of 16.59% and a standard deviation of 1.08 for the percentage purity of a sample. Researcher II obtains corresponding values of 13.12% and 0.03. The true percentage purity is 20.50%. Compared to Researcher I, Researcher II is
   [ ] Less accurate but more precise [ ] More accurate and more precise
   [ ] Less accurate and less precise [ ] More accurate but less precise

3. Gravimetric factor of Mn (atomic weight being 55) in Mn_3O_4 is
   [ ] 0.24 [ ] 0.72 [ ] 1.38 [ ] 0.33

4. Salt of weak acid Calcium oxalate is better precipitated in _____
   [ ] Weakly acidic solution [ ] Weakly alkaline solution
   [ ] Neutral solution [ ] Highly alkaline solution

5. What will be the molarity (in mol/L.) of 20.0 mg NaOH in 50.0 ml of solution?
   [ ] 10 [ ] 0.01 [ ] 0.04 [ ] 0.4

6. What will be the pH of the solution in which $[OH^-] = 0.4$?
   [ ] 0.4 [ ] 13.6 [ ] 4 [ ] 14

7. The suitable reference electrode for electrochemical analysis at temperature above 60°C is
   [ ] Silver-Silver chloride electrode [ ] Glass electrode
   [ ] Calomel electrode [ ] Platinum electrode

8. During the titration, when 20 ml of 0.2M NaOH is added to 20 ml of 0.4M HCl, what will be the color of solution, if Phenolphthalein is used as indicator?
   [ ] Pink [ ] Blue [ ] Colourless [ ] Wine red

9. A titration where the end point is found by observing the effect of titrant addition upon a measured charge is termed as

[ ] Potentiometric titration [ ] Coulometric titration
[ ] Conductometric titration [ ] Amperometric titration

10. During a complexometric titration of Ca^{2+} with EDTA in a buffer of pH 10.0, 20ml of 0.01M metal ion solution is kept initially in conical flask, 0.02 M EDTA solution is used as titrant and Erichrome black T is used as indicator. What will be value of P^{Ca} when the burette reading is 10.0 ml. [$K_{eff} = 1.8*10^{10}$]

[ ] 2.17 [ ] 9.55 [ ] 6.22 [ ] 2.0

Fill in the banks by most appropriate VALUE or WORD

11. The potential at which the current is one half of the diffusion current is called _____.

12. _____electrode is typically used as working electrode in polarography.

13. What will be the potential measured during the titration of 50.00 ml of 0.04M Sn^{2+} with 40.00 ml of 0.05M Ce^{4+}. ($E^0_{Sn} = 0.15V$; $E^0_{Ce} = 1.44V$) _____.

14. The ionic strength of 100.0 ml of 0.3 M $CaCl_2$ solution is _____.

15. In EDTA titration, the absolute stability constant is given as $4X10^8$ and the fraction of EDTA in the Y^{4-} form at pH 10 is given as 0.35. The effective stability constant will be _____.

16. What will be the logarithm of the equilibrium constant for the following reaction $Ox_1 + Red_2 = Red_1 + Ox_2$ ($E_{cathode} = 1.35V$; $E_{anode} = 0.75V$; n=2)_____ .

17. A side reaction in a titration is an example of_____ error.

18. The current flowing in a homogeneous conducting material due to the effect of the external potential is equal to _____.

19. The suitable indicator during titration of silver nitrate with potassium bromide (following Fajans Method) is_____.

20. A student obtained the results for concentration (mg/ml) of citric acid samples as 240, 265, 230, 238 and 244. Does the value 244 fall in same data set? (Q-tab for n=5 is 0.64) _____.

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Time : 2 hrs. 30 mins.

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

SECTION "B"
[5 Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

1 a. A student analyzed a sample of Cl by precipitating and weighing AgCl. A 0.8625g sample gave a precipitate of AgCl weighing 0.7864g. By mistake the student used the atomic weight of Cl as 35.345 rather than the correct value of 35.453. Calculate the error in the percentage Cl the student would make (MW of AgCl 143.321). [3]

b. A 0.8165g sample containing chloride is analyzed by the Volhard's method. The sample is dissolved in water, and 50ml of 0.1214M $AgNO_3$ is added to precipitate chloride ion. The excess $AgNO_3$ is titrated with 11.76ml of 0.1019M KSCN. Calculate the percentage of Cl^- in the sample. [2]

2 a. 25.0 ml of 0.20 M HCl is titrated with 0.20 M NaOH. Calculate the pH of solution after addition of 5 ml, 25ml and 30 ml of titrant. [3]

b. 40.0ml of 0.010M M^{2+} is titrated with 0.010M EDTA. Calculate the value of K_{eff} so that when 39.95 ml of titrant has been added, the reaction is essentially complete and the pM changes by 2.00 units on the addition of two more drops (0.10ml) of titrant. [2]

3 a. Calculate the number of moles of ammonia present in 4.9ml of ammonia solution that contains 2.3% by weight of ammonia and the density 0.99g/ml. [2]

b. What is the suitable pH in the titration of sodium chloride with silver nitrate using potassium chromate as indicator? What happens if pH is low or very high (illustrate with reaction). [3]

4 a. Why too much buffer is not added during complexometric titration using EDTA as titrant? [2.5]

b. Calcium Fluoride has a Ksp of 4×10^{-11}. Predict whether a precipitate forms of not when 100 ml of 2×10^{-4} M Ca^{2+} and 100 ml of 2×10^{-4} M F^- are mixed? [2.5]

5 a. Define specific conductance. Draw and explain conductometric titration curve for weak acid and strong base. [3]

b. 50.0 ml of 0.10 M acetic acid is titrated with 0.10 M sodium hydroxide. Calculate the pH of solution at the equivalence point? [2]

6 a. 0.4852 g sample of iron ore is dissolved in acid, and iron is oxidized to the +3 state and then precipitated as the hydrous oxide, $Fe_2O_3.xH_20$. The precipitate is filtered, washed, and ignited to Fe_2O_3, which is found to weigh 0.2481 g. Calculate the percentage of iron in the sample (AW Fe= 55.85). [3]

b. Draw well labelled diagram of a silver-silver chloride electrode. Also write cell reaction and representation for it. [2]

P.T.O.

SECTION "C"

[5 Q. × 6 = 30 marks]

Attempt *ANY FIVE* questions.

7 a. What is an error? Write about distribution of random errors. [3]

b. Explain why occluded impurities are not removed by washing? What procedure is helpful in removing occluded impurities? [3]

8 a. What requirements must be satisfied for a reaction to be used in titration? [3]

b. What are true redox indicators? Show that how much potential (at least) is needed to bring about a change in color of a true redox indicator? [3]

9 a. Explain what is meant by a feasible acid base titration. What factors determine the size of the ΔpH at the equivalence point? [3]

b. Define (i) Poised solution (ii) Specific indicator (iii) Redox couple [3]

10 a. What is an indicator electrode? Show the clear sketch and representation of the glass electrode. [3]

b. Write short note on metallochromic indicators. [3]

11 a. Define (i) Potentiometric titration (ii) Liquid junction potential (iii) Reference electrode. [3]

b. With a labeled diagram of typical polarogram explain about, residual current, and diffusion current. [3]

12 a. What is dropping mercury electrode? What are advantages and disadvantages of dropping mercury electrode? [3]

b. What is stepwise formation constant? Why chelating agent (as "trien") is used as titrant during the titration of metal ions (as copper) instead of monodentate ligand (as NH_3)? [3]

13 a. What are the rates of nucleation and particle growth? Do these rates impact on size of precipitate? What are the optimal laboratory conditions for obtaining larger sized and purer precipitate? [3]

b. Write short note on Volhard method of formation of colored complex? [3]