2025

CHEMISTRY — HONOURS

Paper : SEC-1

(Quantitative Analysis and Basic Laboratory Practices)

Full Marks : 75

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question nos.*** **1, 2, 3, 4** and ***any four*** from ***question nos.*** **5** to **10**.

1. Answer ***any ten*** questions : 2×10

(a) The result of an analysis is 32.63 g, compared to the accepted value of 32.50 g. Calculate the relative error in parts per thousand.

(b) Write the names of any two indicators used in precipitation titration.

(c) Mention two environmental significance of measurement of DO in water bodies.

(d) How much water should be added to 400 ml of $^{N}/_{10}$ H_2SO_4 to make it exactly $^{N}/_{15}$?

(e) Find out the number of significant figures for the following :

0.218, 2.18×10^2, 0.0218, 21.08

(f) What is the first aid for acid splashes in eye?

(g) Write the expression for colour change interval of a redox indicator mentioning the significance of each term in it.

(h) What do you understand by sensitivity and selectivity of a chemical analysis?

(i) Draw the representative acid-base titration curves for weak acid vs strong base and strong acid vs weak base.

(j) Write two points to justify that the calibration of glassware is necessary.

(k) State two conditions a primary standard solution must satisfy.

(l) Mention two methods of minimisation of determinate error.

2. (a) (i) Write short note on absolute error and relative error.

(ii) 'Good precision does not assure good accuracy.'— Justify the statement. 3+2

Or

(b) A student analysed the sample of gold and obtained the following results :

107.861, 107.870, 107.881, 107.892, 107.843, 107.821

Calculate the mean, median, standard deviation, range and variance. 5

3. (a) Discuss the selection criteria for an indicator in acid—base titration. Why is phenolphthalin preferred in a weak acid—strong base titration? 5

Or

(b) Explain co-precipitation with a suitable example. How is it minimized? 5

4. (a) Write a short note on ion exchange process for softening of water. 5

Or

(b) What do you mean by disinfection of water? Suggest suitable ways in which it can be done. 5

5. (a) Write down four differences between determinate error and indeterminate error.

(b) 100 mL 0.1 (N) CH_3COOH is titrated with 0.1 (N) NaOH. What will be the pH of the titration mixture when 100 mL NaOH solution is added?

Given K_a of $CH_3COOH = 1.8\times10^{-5}$.

(c) What precautions are to be taken while handling of toxic chemicals? 4+3+3

6. (a) A 50 mL hard water sample requires 6.1 mL of $(^{M}/_{100})$ Na_2H_2 EDTA solution for complete titration in presence of EBT indicator. Calculate the hardness of water in ppm unit. Given that 25 mL 1.002 $(^{M}/_{100})$ Zn $(OAC)_2$ solution needs 25.6 mL of $(^{M}/_{100})$ Na_2H_2 EDTA solution.

(b) Describe the method of determination of COD of waste water sample using $K_2Cr_2O_7$ solution.

(c) Illustrate the least squares method in external standard calibration. 4+3+3

7. (a) Define sampling. How can sample be performed for solid and liquid samples?

(b) Write down the significance of standard deviation in relation to Gaussian curve for random errors.

(c) A sample of H_2SO_4 (density 1.787 g. mL^{-1}) is labelled as 86% by weight. What is molarity of the sample? 4+3+3

8. (a) What is limit of detection (LOD) in a chemical analysis? Why is it significant?

(b) Discuss the characteristics of wash liquid in gravimetric analysis.

(c) Why is it necessary to rinse pipettes and burettes with the solution to be used during titration? 4+3+3

9. (a) Explain the principle of Volhard's method to estimate chloride ion.

   (b) Mention the standard parameters to be maintained for water to be used for potable purpose.

   (c) Write down three limitations of an analytical method of your choice. 4+3+3

10. (a) A waste water treatment plant receives 1000 L of water containing organic waste with a BOD of 150 mg L^{-1}. Calculate the total amount of oxygen (in g.) required to decompose the organic matter in this water.

    (b) Burette readings of three consecutive standardisation are 25.25 mL, 25.20 mL and 25.30 mL. Find out the standard deviations when you consider (i) three significant figures (ii) four significant figures.

    (c) Calculate the amount of oxalic acid required to prepare 500 mL ($^{N}/_{10}$) oxalic acid solution.

    4+3+3