

2023

## 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) Identify the mode for the following data set :  
26, 79, 62, 26, 66, 26, 66, 48, 79, 66, 79, 63, 94, 66.
  - (b) What will be the pH of the solution when 225 mL of water is added to 25 mL of 0.1 M NaOH solution?
  - (c) What is TDS of a water sample?
  - (d) The result of a quantitative analysis is 27.69 g compared with the accepted value of 27.75 g. What is the relative error in parts per thousand?
  - (e) Give example of one metal ion indicator and one redox indicator.
  - (f) Pure water is neutral, with pH close to 7.0 at 25°C, but normal rainfall has pH of approximately 5.6. Comment.
  - (g) What is the product of 12.63 and 0.063 in correct significant figure?
  - (h) Between Molarity (M) and Molality (m), which one is temperature dependent and why?
  - (i) Mention one condition for an ion to be estimated using back titration method. Give example of such an ion.
  - (j) What is Limit of Detection (LOD)?
  - (k) Name the titrant and the indicator used in the precipitation titration by Volhard's method.
  - (l) Why should we not rinse a conical flask with the solution to be titrated?
2. (a) For titrating 10 mL of a 0.2 (N) solution with a 0.2 (N) titrant, the following volumes of the titrant were recorded by the analyst.
- Analyst A : 9.80, 9.90, 9.85, 10.06, 10.25 mL
- Analyst B : 10.09, 10.12, 10.10, 10.12, 10.08 mL.
- Calculate the mean and standard deviation for the above two results and hence comment on the accuracy and precision of the results.

Or,

- (b) Differentiate between determinate and indeterminate errors. 5
3. (a) Write a short note on determination of hardness of water. 5
- Or,
- (b) Write a short note on gravimetric analysis of an ion mentioning the stages in the analysis and the prerequisite of gravimetric analysis. Name an ion that can be gravimetrically estimated. 2+2+1
4. (a) Write a short note on 'disinfection of water'. 5
- Or,
- (b) Explain 'softening of water' using ion exchange process. 5
5. (a) What do you mean by selectivity and sensitivity?
- (b) Draw and explain titration curve for a weak acid against a strong base. Suggest a suitable indicator for this titration.
- (c) Discuss in brief about any three types of chemical parameters to determine the quality of water. 4+(2+1)+3
6. (a) In the titration of 25 mL 0.1 (N)  $\text{Fe}^{2+}$  solution in 1 (N)  $\text{H}_2\text{SO}_4$  by 0.1 (N)  $\text{Ce}^{4+}$  solution, what will be the potential when (i) 24.9 mL and (ii) 25.1 mL of  $\text{Ce}^{4+}$  solution is added.
- Given  $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^{\circ} = 0.77 \text{ V}$
- $E_{\text{Ce}^{4+}/\text{Ce}^{3+}}^{\circ} = 1.44 \text{ V}$ .
- (b) Discuss about any one water treatment method for household.
- (c) What do you mean by accuracy and precision in quantitative chemical analysis? (2+2)+3+3
7. (a) What is BOD? How can you determine BOD of water sample?
- (b) Calculate the absolute error with reference to the given data  
 $(15.02 \pm 0.02) \text{ mL} \times (0.2000 \pm 0.001) \text{ mmol mL}^{-1}$
- (c) Compare Volhard's and Mohr's methods for precipitation titration. 4+3+3
8. (a) Differentiate between absolute and relative errors. Suggest methods for minimization of errors.
- (b) Calculate the volumes of HCl and water required to prepare 200 mL 1 (N) HCl solution from a stock of 4 (N) HCl.
- (c) What is the significance of DO of a water sample? (2+2)+3+3
9. (a) 25 mL 1(N) HCl is titrated against 1(N) NaOH solution. Calculate pH of the solution at the following stages of NaOH solution added (i) 0.0 mL, (ii) 5.0 mL, (iii) 25.0 mL, (iv) 26.0 mL.
- (b) How do you calibrate a burette and a pipette?
- (c) If  $y^2 = 4x$  and 0.1% error is incurred for  $x$ , what is the percentage of error involved in  $y$ ?

10. (a) Mention the precautions to be taken while handling concentrated/fuming acids and organic solvents.
- (b) Comment on figures of merit of analytical methods.
- (c) Distinguish between co-precipitation and post-precipitation. (2+2)+3+3
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