

3. Which of the following statement(s) is/are true about product analysis? CO2 [K₃]
- P. Three-dimensional conformation may be studied in great detail by X-ray crystallography or NMR spectroscopy
- Q. Protein secondary and tertiary structure can be predicted by using far-UV circular dichroism.
- R. Proton-NMR cannot applied to studying higher orders of protein structure.
- S. N-terminal sequencing used to find the last 20–30 amino acid residues of the protein product
- a) P,R b) P,S
- c) P,Q d) Q,R
4. The broth containing 7.3 mg/l of protein is recovered with t-butanol. The equilibrium constant (K) and ratio of broth to solvent (H/L) is 210 and 96, respectively. The fraction of protein that have recovered after extraction is CO3 [K₄]
- a) 42% b) 67%
- c) 68% d) 98%
5. Assertion (A): SDS polyacrylamide gel electrophoresis (SDS-PAGE) is used as an analytical technique in the assessment of final product purity. CO6 [K₃]
- Reason(R): Use of silver-based stains increases the detection sensitivity up to 100 fold
- a) Both A and R are Individually true b) Both A and R are Individually true but
and R is the correct explanation of A R is not the correct explanation of A
- c) A is true but R is false d) A is false but R is true
6. The ideal adsorbent should be CO3 [K₂]
- a) Chemical active towards solute b) Low surface area
- c) Chemical active towards solvent d) Mechanically stable
7. You are planning to purify the protein of interest using ion exchange chromatography. CO4 [K₃]
 Arrange the steps involved in this process.
1. Elute the column using suitable elution buffer.
 2. Equilibrate the column matrix using equilibrium buffer.
 3. Load the sample in the column.
 4. Wash the column using wash buffer.
- a) 2-3-4-1 b) 1-3-2-4
- c) 3-4-1-2 d) 4-1-3-2
8. The fragments of peptide can be separated using CO6 [K₂]
- a) two-dimensional electrophoresis b) Precipitation techniques
- c) Gel filtration chromatography d) Affinity chromatography

9. **Assertion (A):** Crystallization of protein is very difficult to perform due to its irregular in shape CO5 [K₂]

Reason (R): Presence of non-covalent bonds that holds together the lattice through the several layer of solvent molecules

- a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
c) A is true but R is false d) A is false but R is true

10. Below the triple point, water in solid phase gets into water in vapour phase without going liquid phase. This process is known as CO5 [K₃]

- a) Freeze drying b) lyophilization
c) sublimation d) condensation

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. Define sedimentation coefficient. CO2 [K3]
12. What is cavitation? How does it help in the process of cell lysis? CO2 [K3]
13. List the two characteristics of an ideal solvent for liquid extraction. CO3 [K2]
14. List the advantages of using ammonium sulphate in protein precipitation? CO3 [K3]
15. Give any two isotherm used for adsorption studies. CO3 [K2]
16. How do you determine the void volume of given matrix in gel filtration chromatography? CO4 [K3]
17. List the different types of membrane modules. CO4 [K3]
18. Highlight on any two factors that affects the biological activity of given protein CO6 [K2]
19. Give any two methods to attain the supersaturation in crystallization. CO5 [K2]
20. Comment on the role of condenser used in freeze drying? CO6 [K3]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. With a neat diagram, explain the various method of cell disruption techniques used in downstream processing. CO2 [K3]

22. Using a test filter, we find the following data for the broth containing antibiotic erythromycin and added filter. The filter leaf has a total area of 0.1 ft² and filtrate has a viscosity of 1.1 cp. The pressure drop is 20 inch Hg and the feed contains 0.05 kg dry cake/liter. Determine the specific cake resistance (α) and medium resistance (R_m). CO2 [K₄]

| | | | | |
|--------------------------|------|-------|------|-------|
| Filtrate Time (sec) | 5 | 10 | 20 | 30 |
| Volume of filtrate (lit) | 0.04 | 0.055 | 0.08 | 0.095 |

23. You are planning to purify enzymes which have the property to attach with lectin molecules. Based on this information, explain the working principles and application of this chromatography used in the above task CO4 [K₄]

24. i. Explain the operation of Osla crystallization. with suitable diagram. (10) CO5 [K₂]
 ii. Explain the different stages of crystallization (4)

25. i. Apply various precipitation methods with organic solvents and polymers for purification of enzymes (10) CO3 [K₃]
 ii. Write a note on various method of membrane preparation (4)

26. i. Describe the construction details of the industrial freeze dryer (7) CO5 [K₃]
 ii. Give an account of different stages of freeze drying. (7)

27. Lysozyme is to be purified by cation exchange adsorption in the batch mode from 1000 liters of egg white protein solution (total protein concentration =10 g/L). Lysozyme makes upto 5 % of egg white proteins on a weight basis. Preliminary laboratory-scale lysozyme binding experiments were carried out using two cation exchanger adsorbents and the free and bound concentration determined are shown below: CO3 [K₅]

| Lysozyme concentration in solution (g/L) | Adsorbent 1 Bound Lysozyme concentration (g/L) | Adsorbent 2 Bound Lysozyme concentration (g/L) |
|--|--|--|
| 0.2 | 15 | 10 |
| 0.4 | 18 | 15 |
| 0.6 | 20 | 20 |
| 0.8 | 22 | 25 |
| 1.0 | 23 | 28 |

Comment on the nature of the adsorption isotherms. Which adsorbent will be better for the above mentioned separation?
