

Date:

Registration number:



ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27  
B.Sc. BIOCHEMISTRY - II SEMESTER  
SEMESTER EXAMINATION: April 2022

**Supplementary**

(Examination conducted in July 2022)

**BCH220 –Physical and Organic Chemistry**

Time- 2 1/2 hr

Max Marks-70

This question paper contains three printed pages and four parts

**PART-A**

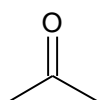
**Answer any 16 questions out of 18**

**16 x 1 = 16**

1. Why does 2,2-dimethylbutane have a lower boiling point than n-butane?
2. What is a racemic mixture?
3. Draw a second resonance structure for **a)** and **b)**



4. What are azeotropes?
5. What is a binary mixture?
6. What is 1,2-diaxial interaction?
7. Give the condensed formula for:



8. How many moles of oxygen bind to 1 mole of haemoglobin?
9. In conformational analysis we study the rotation about which bond (single, double or triple bond)?
10. Give the relationship between Gibb's free energy and equilibrium constant of a reaction.
11. Write the Arrhenius equation?
12. Give an example of a two component system?
13. Classify the following as electrophiles or nucleophiles:  $\text{AlCl}_3$ ,  $^+\text{CH}_2\text{CH}_3$ ,  $^-\text{CH}_3$ ,  $\text{H}_2\text{O}$
14. Draw the most stable conformer of cyclohexane?

15. Which solvent would you use if you wish to ensure that  $S_N2$  mechanism is preferred to an E2 mechanism?
16. Why does rearrangement occur when some alkyl halides undergo a nucleophilic substitution reaction?
17. What is a regioselective reaction?
18. Give the step of the reaction that is common to both  $S_N1$  and E1 mechanisms?

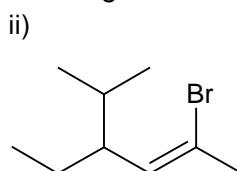
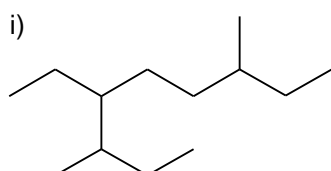
### PART-B

**Answer any 10 questions out of 12**

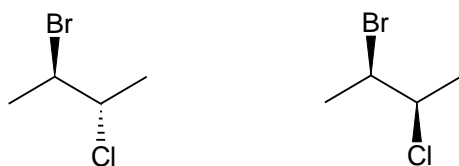
**10 x 2 = 20**

19. Write the (a) Dash formula (b) Bond line formula of the following molecule: 4-chloro-2,3-dimethylhexane.

20. Give the IUPAC nomenclature for the following molecules:



21. Are the pair given below identical, constitutional isomers, enantiomers, diastereomers or not the same molecule?



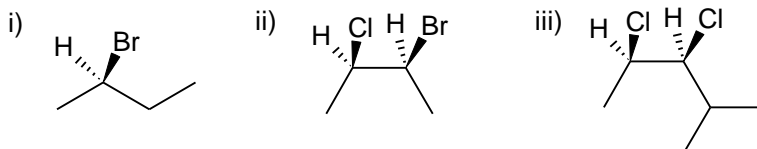
22. Draw the most stable and least stable conformer of butane?
23. Suggest any two factors that would ensure that the reaction proceeds via an E2 mechanism?
24. Give an expression for work-done for a irreversible process? Explain the terms involved.
25. Suppose that a reaction has  $\Delta H = -28 \text{ kJ}$  and  $\Delta S = -60 \text{ J/K}$ . At what temperature will it change from spontaneous to non-spontaneous??
26. Identify the reaction order from the following expressions:
  - (i)  $k = 5.6 \times 10^{-4} \text{ L mol}^{-1} \text{ s}^{-1}$
  - (ii)  $k = 5.6 \times 10^{-4} \text{ s}^{-1}$
27. Cite two factors that affect the rate of a reaction?
28. Calculate the number of components and degree of freedom for an aqueous solution of glucose.
29. State Henry's law and give its mathematical form.
30. Write any two important properties of lyophilic colloids. Give an example.

## PART-C

Answer any 8 questions out of 10

8 x 3 = 24

31. Indicate whether the following compounds have an R or S configuration at their chiral centres?



32. How can a racemic mixture be resolved biochemically?

33. Draw the potential energy diagram and briefly explain the relative stabilities of the conformers of ethane?

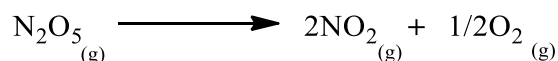
34. Arrange the following in increasing order of acidity and explain why you chose this order:  $\text{CF}_3\text{COOH}$ ,  $\text{CHCl}_2\text{COOH}$ ,  $\text{CH}_2\text{ClCH}_2\text{COOH}$ ,  $\text{CH}_3\text{CCl}_2\text{COOH}$

35. Why do aprotic solvents favour  $\text{S}_{\text{N}}2$  reactions, explain with a suitable example?

36. Give the overall reaction and the mechanism for a 1,2-elimination reaction.

37. Give the expression for molar heat capacity at constant volume and at constant pressure. Explain the terms.

38. The initial concentration of  $\text{N}_2\text{O}_5$  in the following first order reaction was  $1.24 \times 10^{-2} \text{ mol L}^{-1}$  at 318K. The concentration of  $\text{N}_2\text{O}_5$  after 60 min's was  $0.20 \times 10^{-2} \text{ mol L}^{-1}$ . Calculate the rate constant of the reaction at 318K.



39. Draw the phase diagram for the water-phenol system? Indicate the region where the two systems are completely miscible? What is it called? Is it valid for all temperatures?

40. Illustrate how impurities affect the critical solution temperature?

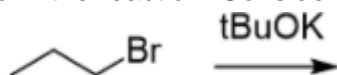
## PART-D

Answer any 2 questions out of 3

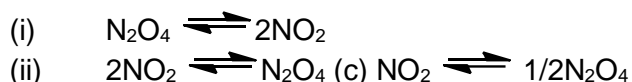
2 x 5 = 10

41. The chromatographic purification of 1 g of (-)-ethyl lactate of an enantiomeric excess of 85%, yields without any loss of material the optically pure (-) enantiomer. How many grams of the (+) enantiomer were isolated?

42. Predict the mechanism as  $\text{S}_{\text{N}}1$ ,  $\text{S}_{\text{N}}2$ ,  $\text{E}1$  or  $\text{E}2$  and draw the major organic product formed in the reaction. Consider any stereoselectivity if applicable:



43. (a) Write the equilibrium constant expressions for the following equations. Explain how these expressions are related.



(b) Calculate  $K_p$  for the reaction  $3/2\text{O}_2 \text{ (g)} \rightleftharpoons \text{O}_3 \text{ (g)}$  at 298K.

(Given:  $\Delta_r G^\circ = 163.43 \text{ kJ mol}^{-1}$ ).

(3 + 2)