Date:

Registration number:

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

BCH221 – Physical and Organic Chemistry

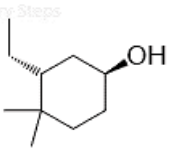
Time- 2 hrs Max Marks-60

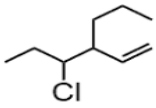
This question paper contains three printed pages and three parts

PART- A

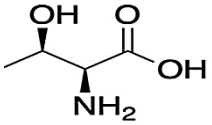
Answer any 10 questions out of 12 10 x 2 = 20

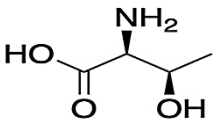
1. Write the (a) Dash formula (b) Bond line formula of the following molecule: 5-chloro-2,3-dimethylhexane.
2. Give the IUPAC nomenclature for the following molecules:

(i) 

(ii) 

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





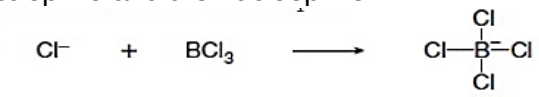
4. Draw the most stable and least stable conformer of cyclohexane?
5. Why S_N2 reactions are called concerted reactions?
6. What do you mean by state function? Name any one thermodynamic property which is a state function.
7. For the following general form of reactions
   (i) A + 2B + 3C ⟶ Product
   (ii) A + 3B + 2C ⟶ D + 2E
   Write the differential instantaneous rate equations.
8. Write two important applications of emulsions in lipid chemistry.
9. Give any two differences between ideal and non-ideal solutions.
10. Write the expressions for total change in entropy for both reversible and irreversible processes.
11. Write down the Arrhenius equation and explain the terms involved.
12. Draw the boiling temperature versus composition curve of ethanol-H_2O system.

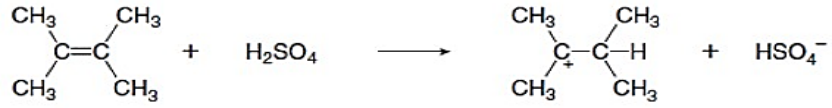
PART- B

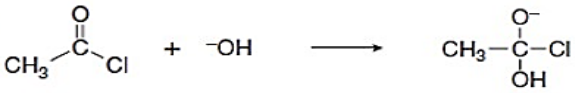
Answer any 5 questions out of 7 5 x 6 = 30

13. What is a racemic mixture? What does one mean by the term resolution? Using an appropriate example explain how racemic mixtures can be resolved using amines?

14. With the help of a potential energy diagram explain the relative stabilities of the various conformers of butane?
15. (a) Arrange the following in increasing order of acid strength and justify order: CH_3COOH, $CHCl_2COOH$, CH_2ClCH_2COOH, CCl_3COOH
    (b) Using curved arrows indicate the flow of electrons and label the electrophile and the nucleophile:

(i) 

(ii) 

(iii) 

16. (a) With a suitable example explain how polar protic solvents favour S_N1 reactions?
    (b) Give the overall reaction and the mechanism for the reaction of tertiary butyl chloride with water.
17. (a) What is the principle of Differential Scanning Calorimetry.
    (b) Derive Kirchoff's equation?
18. (a) Define half-life period of a reaction. Calculate the half-life period of a reaction whose rate constant is $5.5 \times 10^{-14}\ s^{-1}$.
    (b) Calculate the overall order of the following general reactions whose rate laws are given below
    (i) $r = k [A]^{1/2} [B]^{3/2}$
    (ii) $r = [A]^{3/2} [B]^{-1}$
19. Define phase. Explain phase diagram of KI-water system?

PART- C

Answer any 2 questions out of 3 2 x 5 = 10

20. A student has prepared compound D in the lab. She is sure the compound contains no impurities; a number of physical analyses have confirmed the structure and purity of the compound. A sample of compound D (0.10 g) is dissolved in methanol (2.0 mL) and the solution is placed in a 1.0 dm cell. Three polarimetry readings are recorded with the sample: 0.995°, 0.904°, 0.936°.
    (a) What is [α]?
    (b) The optical rotation of D has previously been reported as 25°. What is the optical purity of this sample?
    (c) What is the enantiomeric excess of this sample?
    (d) What is the composition of this sample?
    (e) Why did the previous analyses show that there was only one compound present? (1+1+1+1+1)

21. (a) State what happens to the position of the equilibrium in each of the following cases?

$$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)} + \text{heat}$$

(i) Temperature is increased and ammonia is added.
(ii) Nitrogen is added and the volume is reduced.
(iii) Nitrogen and ammonia are both added.

(b) The value of K_p for the following reaction is 1.06×10^5 at 25°C. Calculate $\Delta_r G^o$.

$$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2\,(g)} + H_{2\,(g)}$$

22. Predict whether substitution or elimination will occur in the following reaction? What is the most likely mechanism(s) (S_N1, S_N2, E1, E2)
Draw the structure(s) of the resulting product(s) and do not forget stereochemistry in your product(s) if applicable.