2019/TDC/ODD/SEM/CHMHCC–301T/133

TDC (CBCS) Odd Semester Exam., 2019

CHEMISTRY

(3rd Semester)

Course No. : CHMHCC–301 T

(s-, p-Block Elements and Metallurgy)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks
for the questions

PART—A

(Marks : 20)

Answer **ten** questions, taking **two**
from each Unit

UNIT—I

1. *(a)* Define catenation. Cite one example.

$1\frac{1}{2}+\frac{1}{2}=2$

(b) Phosphine has lower boiling point than ammonia. Explain. 2

(c) Draw the structure of P_4O_{10}. Mention the number of P—O bonds in it. $1\frac{1}{2}+\frac{1}{2}=2$

(Turn Over)

(2)

UNIT—II

2. *(a)* Mention one use of each, helium (He) and argon (Ar). 1+1=2

   (b) How does Ar originate in air? Discuss the isolation of Ar from N_2/O_2 mixture. 1+1=2

   (c) Name the noble gas which is—

   (i) most abundant in atmosphere;

   (ii) radioactive. 1+1=2

UNIT—III

3. *(a)* What are the limitations of Brönsted-Lowry theory of acids and bases? 2

   (b) Identify the stronger Lewis acid among Na^+ and Ag^+ and justify it. 2

   (c) Write the conjugate acid of the base HS^- and the conjugate base of the acid HSO_4^-. 1+1=2

UNIT—IV

4. *(a)* Define inorganic polymers. Mention the basic differences between organic and inorganic polymers. 1+1=2

(3)

   (b) Write the properties of inorganic polymers. 2

   (c) Write a short note on 'siloxane polymers'. 2

UNIT—V

5. *(a)* Write the features of Ellingham diagrams. 2

   (b) Mention the principle of electrolytic refining. 2

   (c) What is hydrometallurgy? 2

PART—B

(Marks : 30)

Answer **five** questions, taking **one** from each Unit

UNIT—I

6. *(a)* What is inert-pair effect? 1

   (b) Draw the structure of H_3BO_3. How does it react with ethanol? 1½+1½=3

   (c) What are the different oxoacids of chlorine? Arrange them in the increasing order of acid strength. 1+1=2

(4)

7. (a) Define diagonal relationship considering the example of Li and Mg. 2

(b) What are different types of interhalogen compounds? Give examples. 2

(c) Illustrate with explanation the shape of ICl_4^- species. 2

UNIT—II

8. (a) How can a mixture sample of noble gases be isolated from air? 3

(b) Write with the equation, the preparation of oxides and fluorides of Xe (VI). Draw its structure. 2+1=3

9. (a) How can XeO_3 and $XeOF_4$ be prepared? What are their structures? 2+1=3

(b) Explain the structures of XeF_4 and XeF_6 following VSEPR theory. 1½+1½=3

UNIT—III

10. (a) Discuss Brönsted-Lowry theory of acids and bases with suitable examples. 3

(b) What is HSAB principle? Explain why $AgI_2^{\ominus}$ is stable but $AgF_2^{\ominus}$ is non-existence. 1+2=3

(5)

11. (a) What is solvent levelling? Explain with suitable examples. 1+2=3

(b) What are hard and soft acids and bases? Give suitable examples. 3

UNIT—IV

12. (a) What are silicates? Draw the structure of silicates. Why are they so important? 1+1+1=3

(b) Cite an example of cross-linked silicones. Draw its structure and mention one use of it. 1+1+1=3

13. (a) Briefly describe the silicones, their general formula and one characteristic property. 1+1+1=3

(b) What is inorganic benzene? Draw its structure and make an analogy with benzene. 1+1+1=3

UNIT—V

14. (a) What are Ellingham diagrams? Mention the uses of Ellingham diagram. 1½+1½=3

(b) How are metals refined by electrolytic process? 3

(6)

15. *(a)* Which metal is extracted by hydro-metallurgy? Why hydrometallurgy cannot extract zinc? 1+2=3

(b) Explain zone refining method for purification of metals. 3

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2019/TDC/ODD/SEM/CHMHCC–302T/134

TDC (CBCS) Odd Semester Exam., 2019

CHEMISTRY

(3rd Semester)

Course No. : CHMHCC–302 T

(Organic Chemistry)

Full Marks : 50
Pass Marks : 20

Time : 3 hours
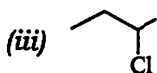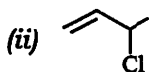
*The figures in the margin indicate full marks
for the questions*

GROUP—A

Answer **two** questions from each Unit in this Group

UNIT—I

1. *(a)* Arrange the following three chlorides in decreasing order towards S_N1 reactivity :   1

    (i)   ∨∨Cl

    (ii)   (structure with Cl)

    (iii)   (structure with Cl)

(2)

(b) For the reaction
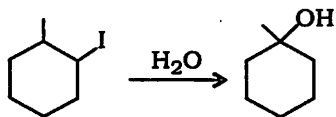
show the mechanism of formation of intermediate carbocation.   1

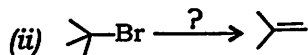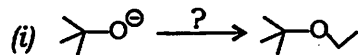2. (a) Which of the following reacts faster in S_N1 reaction and why?   1
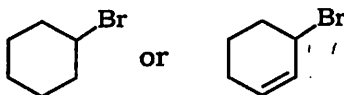
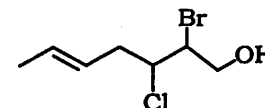(b) Which of the following will exhibit higher S_N2 reaction rate and why?   1

(i)

(ii)
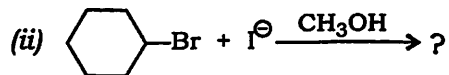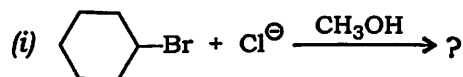
3. Provide the appropriate reagent for each of the following conversions :   ½×4=2

(i)

(ii)

(iii)

(iv)
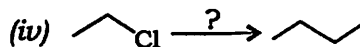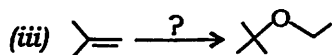
(3)

UNIT—II

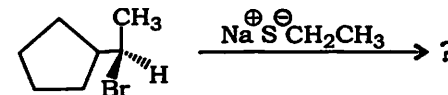4. (a) Write the IUPAC name of the following compound :   ½

(b) (i) Predict the following product :   ½

$$CH_3Br + CH_3CH_2O^{\ominus}Na^{\oplus} \rightarrow ?$$
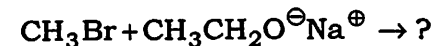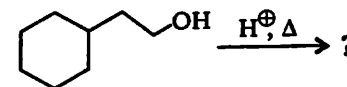
(ii) Identify the following product with stereochemistry :   1

5. (a) What is Lucas reagent? Arrange the following compounds in increasing order of reactivity towards Lucas reagent :   ½+1=1½
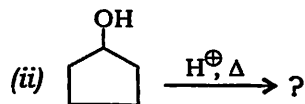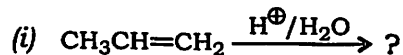
$$CH_3CH_2OH, \ CH_3CH(OH)CH_3, \ (CH_3)_3COH$$

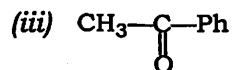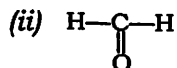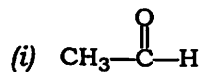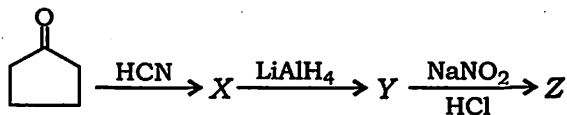(b) Predict the following product :   ½

6. (a) Phenols generally do not undergo substitution of OH group like alcohol. Why?   1

(4)

(b) Identify the following products : $\frac{1}{2} \times 2 = 1$

(i) $CH_3CH{=}CH_2 \xrightarrow{H^{\oplus}/H_2O}$?

(ii) cyclopentanol-OH $\xrightarrow{H^{\oplus}, \Delta}$?

UNIT—III

7. (a) Arrange the following compounds in decreasing order of reactivity with Grignard reagent : $\frac{1}{2}$

(i) $CH_3{-}\overset{O}{\overset{\|}{C}}{-}H$

(ii) $H{-}\overset{}{\underset{\underset{O}{\|}}{C}}{-}H$

(iii) $CH_3{-}\overset{}{\underset{\underset{O}{\|}}{C}}{-}Ph$

(b) Identify X, Y and Z in the following reaction : $1\frac{1}{2}$

cyclopentanone $\xrightarrow{HCN} X \xrightarrow{LiAlH_4} Y \xrightarrow[HCl]{NaNO_2} Z$

8. (a) Arrange the following in increasing order of reaction rate towards nucleophilic addition reaction : 1

(i) Ph—CHO

20J/1167 (Continued)

(5)

(ii) $O_2N{-}\langle\bigcirc\rangle{-}CHO$

(iii) $H_3CO{-}\langle\bigcirc\rangle{-}CHO$
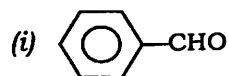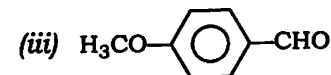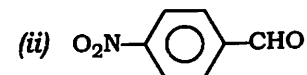
(b) Choose the correct answer : 1

Which of the following reagents is appropriate for the reaction?

$\langle\bigcirc\rangle{-}CH{=}CH{-}\overset{}{\underset{\underset{O}{\|}}{C}}{-}CH_3 \longrightarrow$

$\langle\bigcirc\rangle{-}CH{=}CH{-}COOH$
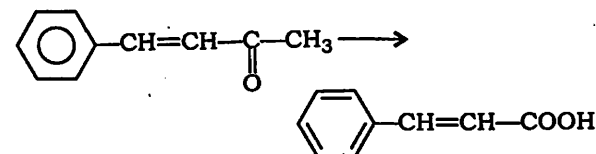
(i) $KMnO_4$, Δ followed by $H^{\oplus}$

(ii) $I_2/NaOH$ followed by $H^{\oplus}$

(iii) H_2/Pt

(iv) $LiAlH_4$

9. (a) Choose the correct answer : $\frac{1}{2}$
Cannizzaro reaction is
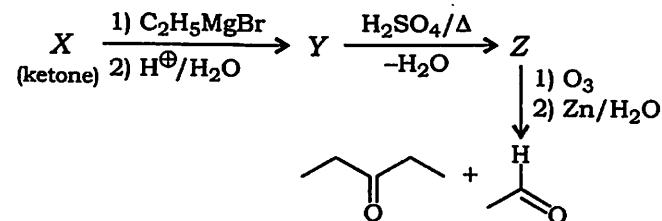
(i) oxidation reaction

(ii) reduction reaction

(iii) ion exchange reaction

(iv) disproportionation reaction

20J/1167 (Turn Over)

(6)

(b) Identify X, Y and Z in the following reaction : 1½

$$X \xrightarrow[\text{2) } H^{\oplus}/H_2O]{\text{1) } C_2H_5MgBr} Y \xrightarrow[-H_2O]{H_2SO_4/\Delta} Z$$
(ketone)

$Z \xrightarrow[\text{2) } Zn/H_2O]{\text{1) } O_3}$

UNIT—IV

10. (a) At ordinary temperature, maleic acid forms anhydride, but fumaric acid does not. Explain. 1

(b) What happens when benzene-1,2-dicarboxylic acid is heated with P_2O_5? 1

11. (a) Name the reaction and the reagents used for the conversion of acid chloride to the corresponding aldehyde. 1

(b) What happens when lactic acid is treated with Fenton's reagent? 1

12. (a) Which of the following is more reactive towards nucleophilic substitution? Give reason : 1

(i) Acid chloride

(ii) Acid amide

(7)

(b) Convert phthalic acid into phthalimide. (Give equation only) 1

UNIT—V

13. (a) Why is the Grignard reagent prepared in anhydrous condition? 1

(b) A Grignard reagent reacts with methanal to form $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2OH$.

Identify the Grignard reagent. 1

14. (a) Write various tautomeric forms of $CH_3COCH_2COOCH_2CH_3$. 1

(b) Explain why methylenic hydrogen in ethylacetoacetate is acidic in nature. 1

15. (a) What is oleum? 1

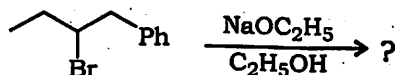(b) Why SO_3 acts as an electrophile, though it is a natural molecule? 1

(8)

GROUP—B

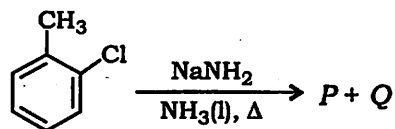Answer **one** question from each Unit in this Group

UNIT—I

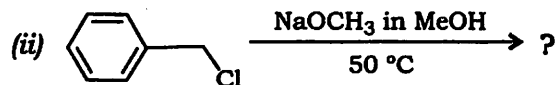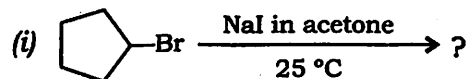**16.** *(a)* Predict the major product and provide the mechanism : 2

(b) Identify *P* and *Q*, and propose plausible mechanism : 2

(c) Select, with reasons, whether the following combination of reactants will react following $S_N 1$ or $S_N 2$ pathway. Write the corresponding products of the reactions : 1+1=2
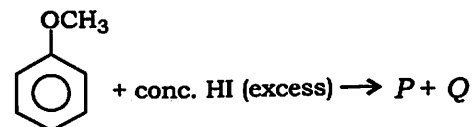
(i)

(ii)

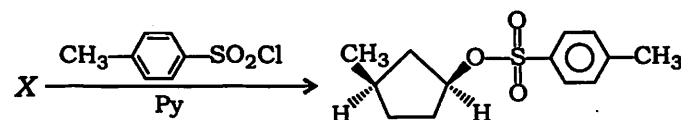**17.** *(a)* Haloarenes undergo nucleophilic substitutions less readily than haloalkanes. Explain. 1½

20J/1167 (*Continued*)

(9)

(b) Identify *P* and *Q* from the following reaction : 1
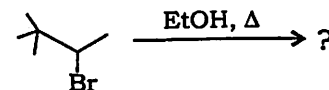

$+ \text{conc. HI (excess)} \longrightarrow P + Q$

(c) Identify *X*, and propose a mechanism for the following reaction : 1½

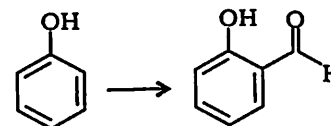*(d)* Complete the following elimination reaction and provide mechanism : 2

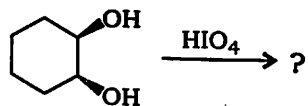$\xrightarrow{\text{EtOH, } \Delta}$?

UNIT—II

18. *(a)* What is the electrophile in Reimer-Tiemann reaction? How is it generated and how can this be useful in bringing the following conversion? Explain with mechanism taking appropriate reagent(s) : ½+½+2=3
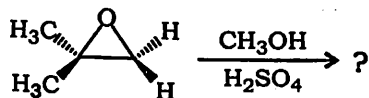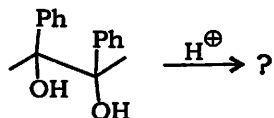
(10)

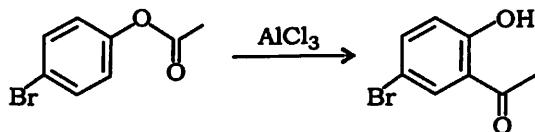*(b)* Predict the following product (with mechanism) : 1½

$\xrightarrow{HIO_4}$?

(c) What is the predominant product of the following reaction? Provide mechanism : 1½

$\xrightarrow[H_2SO_4]{CH_3OH}$?

19. *(a)* Complete the following reaction and provide plausible mechanism : 2

$\xrightarrow{H^{\oplus}}$?

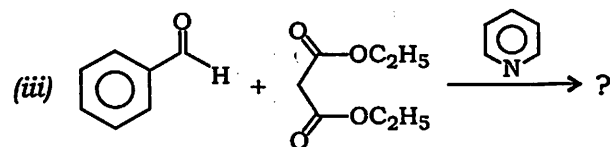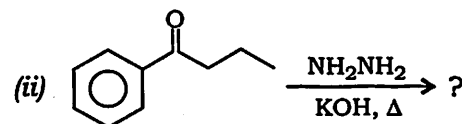*(b)* Provide mechanism from the following reaction : 2

$\xrightarrow{AlCl_3}$

(c) Predict the product and depict reasonable mechanism for the following reaction : 2

$\xrightarrow[2)\ H_3O^{\oplus}]{1)\ LiAlH_4}$?
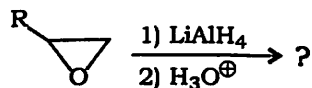
(11)

UNIT—III

20. Predict the products and depict the mechanisms for the following reactions : 2×3=6

(i)

$\longrightarrow$?

(ii)

$\xrightarrow[KOH, \Delta]{NH_2NH_2}$?

(iii)

$\longrightarrow$?
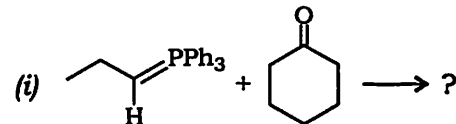
21. Complete the following reactions and provide plausible mechanisms : 2×3=6

(i)

$\xrightarrow[HCl, \Delta]{Zn(Hg)}$?

(ii)

$\xrightarrow[H_2O/C_2H_5OH]{CN^{\ominus}}$?

(iii)

$\xrightarrow[\Delta]{NaOH}$?
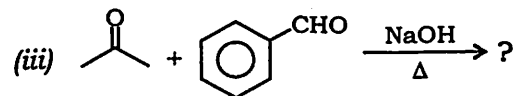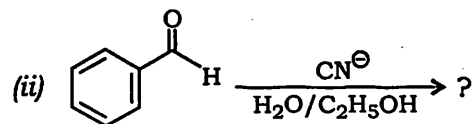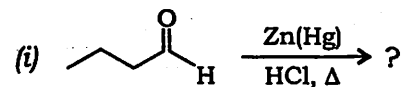
(12)

UNIT—IV

22. *(a)* Provide the equation for acidic hydrolysis of ethylbutanoate and provide the mechanism. 2

(b) Complete the following reactions and show the mechanisms : 2×2=4

(i) + $\xrightarrow[\text{2) } H_3O^\oplus]{\text{1) Zn}}$?

(ii) $\xrightarrow[\text{2) } \Delta]{\text{1) } NaN_3}$?
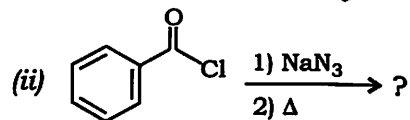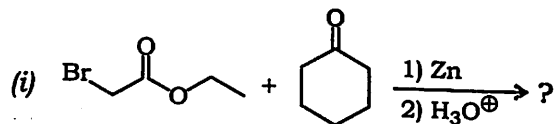
23. Predict the products from the following reactions (with mechanisms) : 2×3=6

(i) + $\xrightarrow[\text{2) } H_3O^\oplus]{\text{1) } NaOC_2H_5}$?

(ii) $\xrightarrow{Br_2/KOH}$?

(iii) $\xrightarrow{KOH/H_2O}$?

(Continued)

(13)

UNIT—V

24. *(a)* Complete the following reactions and propose suitable mechanisms : 1½×2=3

(i) $\xrightarrow[\text{2) } H_3O^\oplus]{\text{1) } CH_3Li}$?

(ii) + $\xrightarrow{H_2O}$?
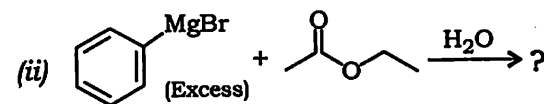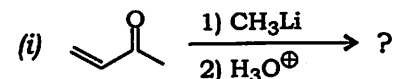
(b) Carry out the following syntheses : 1½×2=3

(i) Succinic acid from diethylmalonate

(ii) 3-phenyl propenoic acid from ethyl-acetoacetate

25. *(a)* Predict the products and propose reasonable mechanisms for the following reactions : 1½×2=3

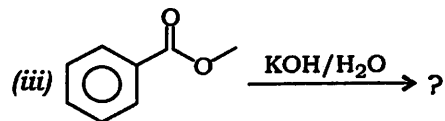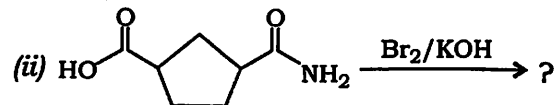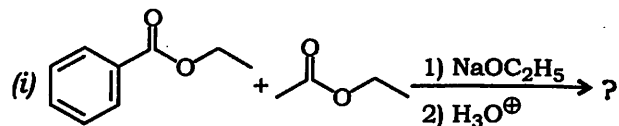*(i)* $\xrightarrow[\text{2) } H_3O^\oplus]{\text{1) } \text{cyclohexyl-MgCl}}$?

(ii) $\xrightarrow[\text{2) } H_3O^\oplus]{\text{1) isopropyl-MgBr (Excess)}}$?

(Turn Over)

(**14**)
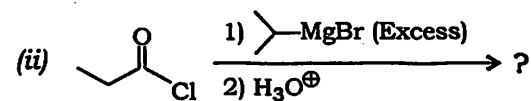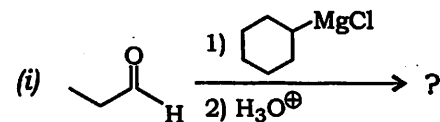
(b) Carry out the following syntheses :

$$1\frac{1}{2}\times2=3$$

(i) But-2-enoic acid from diethyl-malonate

(ii) Pentan-2-one from ethyl-acetoacetate

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2019/TDC/ODD/SEM/CHMHCC–303T/135

TDC (CBCS) Odd Semester Exam., 2019

CHEMISTRY

(3rd Semester)

Course No. : CHMHCC–303 T

(Phase Equilibria and Chemical Kinetics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

SECTION—A

(*Marks* : 20)

Answer **ten** questions, taking **two** from each Unit

UNIT—I

1. State and explain reduced phase rule equation. 2

2. Define congruent and incongruent melting points. 2

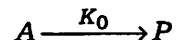3. Calculate the number of components and degrees of freedom in an aqueous solution of NaCl. 2

(*Turn Over*)

(2)

UNIT—II

4. Explain CST. 2

5. Give a brief idea about minimum boiling azeotropes. 2

6. What is lever rule? Give one example. 1+1=2

UNIT—III

7. For a zero-order reaction

$$A \xrightarrow{K_0} P$$

show that half-life period $t_{1/2}$ is equal to $[A]_0 / 2K_0$. 2

8. Write two limitations of collision theory of bimolecular gaseous reactions. 2

9. Define and explain temperature coefficient of a reaction. 2

UNIT—IV

10. What is auto-catalysis? Give one example. 1+1=2

11. "A catalyst provides an alternate path of lower or higher activation energy." Explain the statement. 2

(Continued)

(3)

12. Give one example each of an acid-base and enzyme catalysis reaction. 1+1=2

UNIT—V

13. "Chemisorption is irreversible but physisorption is reversible." Explain why. 2

14. Write four factors which influence adsorption. $\frac{1}{2} \times 4 = 2$

15. Define adsorption isostere and explain it graphically. 1+1=2

SECTION—B

(*Marks : 30*)

Answer **five** questions, taking **one** from each Unit

UNIT—I

16. Discuss and draw the phase diagram for sulphur system. What are metastable equilibria? Explain. 4+2=6

17. *(a)* Derive Clausius-Clapeyron equation for either solid-vapour or liquid-vapour equilibrium. 3

(Turn Over)

(4)

(b) Explain Pattinson's process for the desilverization of lead, using Ag-Pb phase diagram. Also mention how you can obtain argentiferous lead.   2+1=3

UNIT—II

18. (a) Derive Gibbs-Duhem-Margules equation.   4

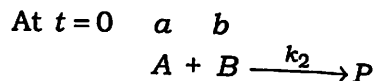(b) Write the two essential prerequisites for validation of the Nernst distribution law.   2

19. (a) Determine the equilibrium constant of the following reaction using distribution law :   4

$$KI + I_2 \rightleftharpoons KI_3$$
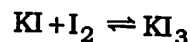
(b) Explain steam distillation with a suitable example.   2

UNIT—III

20. Derive rate constant expression for the following second-order reaction :

At $t = 0$ a b
$$A + B \xrightarrow{k_2} P$$
At $t = t$ x

Show that if $a \gg b$ or $b \gg a$, then the reaction will follow first-order kinetics.   4+2=6

(5)

21. Write 5-step mechanism for H_2—Br_2 chain reaction and derive expression for rate of formation of HBr, using steady-state approximation.   2+4=6

UNIT—IV

22. (a) Derive Michaelis-Menten equation.   4

(b) Differentiate between catalytic promoter and poison with suitable example.   2

23. (a) A hydrogenation reaction is carried out at 500 K. If the same reaction is carried out in presence of a catalyst at the same rate, the temperature required is 400 K. Calculate the activation energy of the reaction, if the catalyst lowers the activation energy of the reaction by 20 kJ.   4

(b) Give the mechanism of catalyzed reactions at solid surfaces.   2

UNIT—V

24. Give the main points of Langmuir theory of adsorption and hence deduce the Langmuir adsorption isotherm equation. Show that Freundlich isotherm is a special case of Langmuir isotherm.   2+3+1=6

25. *(a)* Show different types of adsorption isotherm with the help of diagrams. 4

(b) What do you understand by positive and negative adsorptions? 2

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