Seat No. _____   Enrollment No. _____

THE CHARUTAR VIDYA MANDAL UNIVERSITY
M.Sc. (ORGANIC CHEMISTRY) – SEMESTER 2
APRIL 2023 (REGULAR) EXAMINATION

Course Title: QUANTUM CHEMISTRY & ORGANOMETALLIC CHEMISTRY

Course Code: 201330201

Total Printed Pages : 02

Date: 17/04/2023   **Time: 02:00 pm to 04:00 pm**   **Maximum Marks: 50**

Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question.
- Make suitable assumptions wherever necessary.

Q. 1   Answer the following multiple choice questions.   (04)
(I)   If $\hat{A}= d/dx$, $\hat{B}=d^2/dx^2$ and $f(x)= \sin x$, what is the relation between $\hat{A}\hat{B}f(x)$ and $\hat{B}\hat{A}f(x)$?
        (a) Equal   (b) Less   (c) greater   (d) Not equal
(II)   At the extreme point ($\pm a$) of oscillation, all the energy is_____.
        (a) electrical   (b) potential   (c) kinetic   (d) nuclear
(III)   Among the following, the unstable carbonyl species is_____.
        (a) $Mn(CO)_5Cl$ (b) $[Mn(CO)_5]^-$ (c) $[Mn(CO)_5]^+$ (d) $[Mn(CO)_5]$
(IV)   The number of metal-metal bonds in $[Ir_4(CO)_{12}]$ are_____.
        (a) 4   (b) 5   (c) 6   (d) 7

Q.2   Answer in brief and to the Point.   (06)
(I)   What are the uses of Tunneling?
(II)   Explain $V(CO)_6$ is easily reduced to $[V(CO)_6]^-$.
(III)   Calculate number of M-M bonds in $Ru_3(CO)_{12}$.

Q.3 (a) Prove that square of angular momentum and components of angular momentum commute with each other.   (05)
     (b) Prove that components of angular momentum do not commute with each other.   (05)

                                        OR

     (b) Derive the equation for particle in a box with infinite potential barrier.   (05)

Q.4 (a) Derive the equation for rotational motion of diatomic molecules in a plane.   (05)
     (b) Assuming harmonic oscillator model for   (05)

                C—C   1399 cm^{-1}

                C=C   1705 cm^{-1}

                C≡C   2110 cm^{-1}

        Calculate (1) force constant
                   (2) Lowest vibrational energy
                   (3) Energy gap between each level.

                                        OR

     (b) Derive radial equation.   (05)

Q.5 (a) Explain bonding in metal carbonyl and give evidence for synergistic (05)
bonding.

(b) Using the 18-electron rule, indicate the probable number of n and the 3d (05)
metal(M) in the following.
(i) $[W(\eta^6\text{-}C_6H_6)(CO)_n]$
(ii) $[(\eta^6\text{-}C_6H_6)Cr(CO)_n]$
(iii) $[(\eta^5\text{-}C_5H_5)M(C_2H_4)_2]$
(iv) $[Rh(\eta^5\text{-}C_5H_5)(CO)_n]$
(v) $[Ru_3(CO)_n]$

OR

(b) Explain associative and dissociative substation reactions of organometallic (05)
compound in detail.

Q.6 (a) What is oxidative addition reaction? Write important features of oxidative (05)
addition reaction.

(b) What is reductive elimination reaction? Write important features of (05)
reductive elimination reaction.

OR

(b) Classify the following species as closo, nido, archno or hypho. (05)
(1) Pb_5^{-2}.
(2) $[Fe_4N(CO)_{12}]^-$
(3) $[Fe_6(CO)_{18}]^{-2}$
(4) $[Os_5(CO)_{15}]^{-2}$
(5) $[HCo_6(CO)_{15}]^{-2}$

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Seat No. _____   Enrollment No. _____

THE CHARUTAR VIDYA MANDAL UNIVERSITY
MASTER OF SCIENCE (ORGANIC CHEMISTRY) – SEMESTER 2
APRIL 2023 (REGULAR) EXAMINATION

Course Title: Organic Chemistry-II

Course Code: 201330202

Total Printed Pages: 03

Date: 19/04/2023   **Time: 2:00 pm to 4:00 pm**   **Maximum Marks: 50**

Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question.
- Make suitable assumptions wherever necessary.

Q. 1   **Answer the following multiple choice questions.**   **(04)**

(I)   The oxidation number of all the carbons in 3, 4- dihydroxy pentanoic acid are _____.

(a) C-1= (-3), C-2=(-2), C-3= (0), C-4=(0) & C-5=(+3)
(b) C-1= (+3), C-2=(-2), C-3= (0), C-4=(0) & C-5=(-3)
(c) C-1= (-3), C-2=(+2), C-3= (+1), C-4=(+1) & C-5=(+3)
(d) C-1= (+3), C-2=(-2), C-3= (+1), C-4=(+1) & C-5=(-3)

(II)   The enantiomeric excess of pure compound is _____.
(a) 100%   (b) 50%   (c) 0%   (d) not predicted

(III)   Which of the following alkene upon ozonolysis gives 2-methyl propanal and 2-methyl-3-hexanone as products?
(a) 2-methyl-4-isopropyl-3-heptene   (b) 6-methyl-4-isopropyl-4-heptene
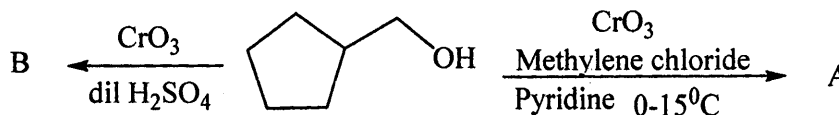(c) 2,5-dimethyl-4-propyl-3-hexene   (d) 2,5-dimethyl-3-propyl-3-hexene

(IV)   Which of the following is *NOT* true for stabilized ylied?
(a) Less reactive
(b) Stereoselectivity is controlled by formation of betain
(c) It can isolate and crystallised
(d) Betain formation is reversible

**Q.2**   **Answer in brief and to the Point.**   **(06)**
(I)   Explain working pattern of phase transfer catalyst.
(II)   Give the structure of A and B.

$$ B \xleftarrow[\text{dil } H_2SO_4]{CrO_3} \quad \text{[cyclopentane-CH}_2\text{OH]} \quad \xrightarrow[\text{Pyridine} \quad 0\text{-}15^0C]{\begin{array}{c} CrO_3 \\ \text{Methylene chloride} \end{array}} A $$
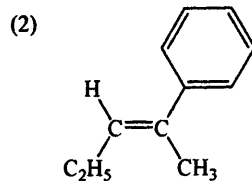
(III)   Explain Sonogashira coupling reaction via citing its two examples.

Q.3   (a)   Give the synthesis of the following compounds as per given direction and   **(05)**
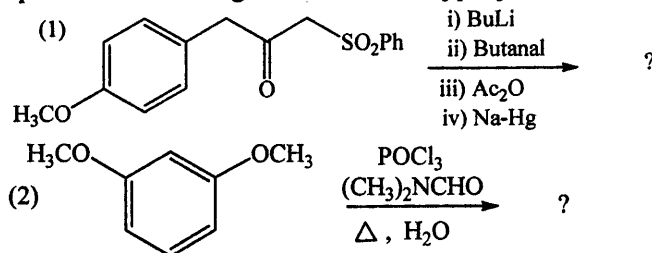explain your answer.
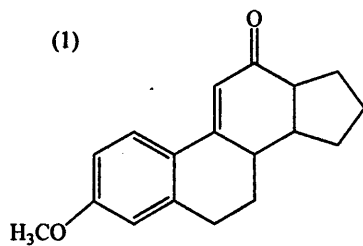
(1) (Robinson ring annulation)

(2) (Schlosser's modification)

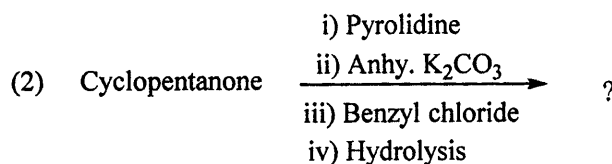(b) Complete the following reactions with appropriate mechanism. **(05)**

(1)

i) BuLi
ii) Butanal
iii) Ac$_2$O
iv) Na-Hg
⟶ ?

(2)

POCl$_3$
(CH$_3$)$_2$NCHO
Δ, H$_2$O
⟶ ?

OR

(b) Compare Shapiro and Bamford Steven reactions with reference to following **(05)** aspects.
(a) Starting material and Products   (b) Type of base used
(c) Intermediate formed   (d) Type of solvent   (e) Percentage of product

Q.4 (a) Complete the following reactions with appropriates mechanism. **(05)**

(1)   p-Chloro toluene + Acetamide $\xrightarrow[\text{NaOt-Bu}]{\text{Pd(PPh3)2}}$?

(2)   Cyclopentanone
i) Pyrolidine
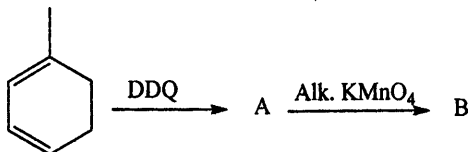ii) Anhy. K$_2$CO$_3$
iii) Benzyl chloride
iv) Hydrolysis
⟶ ?

(b) Answer the following. **(05)**
(1) "Hydroboration reaction is a diastereoselective and regioselective." Justify with appropriate reaction mechanism.
(2) How *cis*-alkene can be synthesised from alkyne using hydroboration and oxidation reaction?
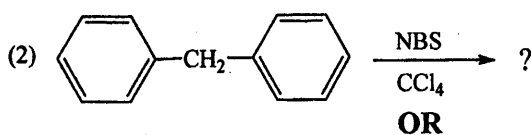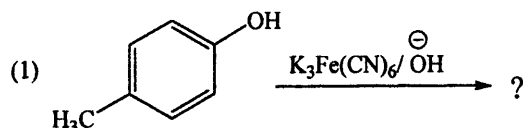
OR

(b) "Prevost hydroxylation of alkene using is stereospecific reaction." Justify the **(05)** statement via citing suitable example.

Q.5 (a) Complete the following reaction with detail mechanism for the formation of **(05)** product A and B.

 $\xrightarrow{\text{DDQ}}$ A $\xrightarrow{\text{Alk. KMnO}_4}$ B

(b) Complete the following reactions with appropriate mechanism. **(05)**

(1)

$$\text{4-methylphenol} \xrightarrow[\text{}]{K_3Fe(CN)_6 / \; ^\ominus OH} \; ?$$

(2)

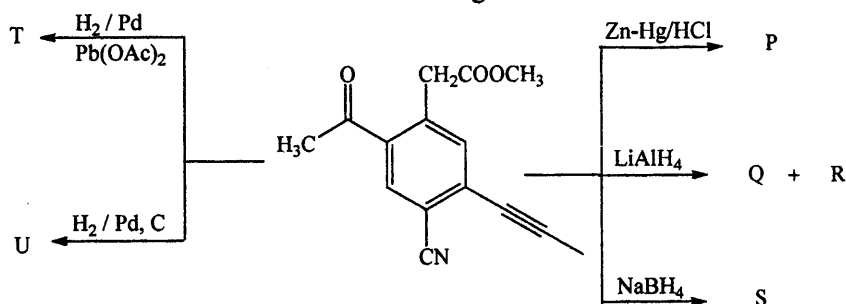$$\text{diphenylmethane} \xrightarrow[\text{CCl}_4]{\text{NBS}} \; ?$$

OR

(b) Discuss the following. (05)

    (1) Upon Riegee oxidation, compound X gives 3 mole of formic acid, 1 mole of glyoxylic acid and 1 mole of formaldehyde. Suggest the structure of compound X.

    (2) How ester can be synthesised from ketone using HgO?

Q:6 (a) Give the structures of P to U in the following reaction web. (05)

(b) Answer the following. (05)

    (1) "Phenyl magnesium bromide when reacted with 2-butanone it gives optically inactive products." Justify the statement.

    (2) Write the mechanism for the formation of amide and peracid using DCC.

OR

(b) Answer the following. (05)

    (1) "Alkyl lithium is more reactive than Grignard reagent." Explain via citing suitable example.

    (2) Why Wolf-Kishner reduction is not applicable to reduction of carbonyl group having halogen at α-position to carbonyl group?

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Seat No. _____   Enrolment No. _____

THE CHARUTAR VIDYA MANDAL UNIVERSITY
M. Sc. (Organic Chemistry)– SEMESTER 2
APRIL 2023 (REGULAR) EXAMINATION

Course Title: TOPICS IN PHYSICAL CHEMISTRY - II

Course Code: 201330203

Total Printed Pages : 03

Date: 21/04/2023   Time: 02:00 PM to 04:00 PM   Maximum Marks: 50
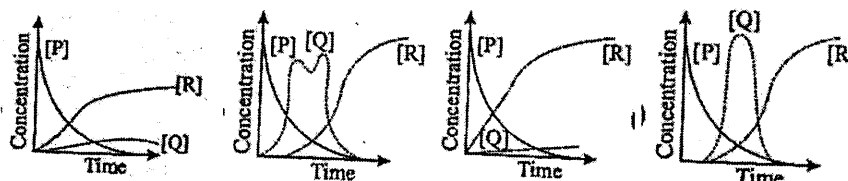
Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question.
- Make suitable assumptions wherever necessary.

Q. 1   **Answer the following multiple choice questions.**   **(04)**

(I)   For first order consecutive reaction $P \rightarrow Q \rightarrow R$, under the steady state approximation to [P], [Q] and [R] with time are best represents by;

(A)   (B)   (C)   (D)

(II)   If the activation energy of forward reaction is 15 kcal/mole and heat of the reaction is 5 kcal/mole, the activation energy of backward reaction is,
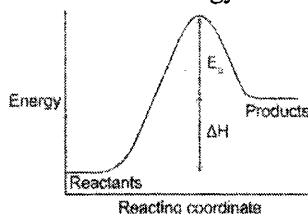
(A) 10   (B) 15   (C) 20   (D) -10

(III)   The symmetric mode(s) of **PCl$_3$** is/are:

(A) A_1 symmetric: only IR active

(B) A_2 symmetric: Both IR & Raman active

(C) E symmetric: only Raman active

(D) A_1 symmetric: Both IR & Raman active

(IV)   For Mulliken symbol $\left(B_{2u}''\right)$ the correct statement(s) among the following is/are:

(I) It is two dimensional and asymmetric w.r.t. principle axis.

(II) It is one dimensional and asymmetric w.r.t. molecular plane.

(III) It is asymmetric w.r.t. inversion.

(IV) It is symmetric w.r.t. principle axis.

(A) Only II & III   (B) Only III & IV   (C) Only I & III   (D) All I to IV

Page 1 of 3

Q.2   **Answer in brief and to the point.**   **(06)**

(I)   What is fast reaction? Briefly explain temperature jump.

(II)   Write the matrix(ces) for the following operations is/are:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} \xrightarrow{C_4(x)}$$

(III)   Find out the missing characters represented by x, y, z in the given character table.

	E	$2C_3$	$3C_2$
τ_1	x	-1	0
τ_2	1	z	1
τ_3	1	1	y

Q.3   **(a)**   The turnover number for an enzyme is known to be 5000 min^{-1}. From the   **(05)** following set of data calculate the K_M and total amount of enzyme present in this experiment.

$\dfrac{1}{[S]}$	$\dfrac{1}{V_0}$
1.0000	0.005980
0.5000	0.004000
0.2500	0.002990
0.1666	0.002659
0.0100	0.002008
0.0010	0.002004

   (b)   Justify with mathematical derivation that the ratio of concentration of   **(05)** product 'B' and 'C' is always equal to $\dfrac{K_1}{K_2}$ in a reaction type:

$$A \begin{cases} \xrightarrow{K_1} B \\ \xrightarrow{K_2} C \end{cases}$$
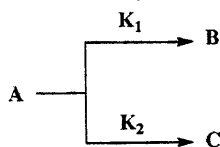
OR

   (b)   **Define the terms:** Homogeneous reaction, Heterogeneous reaction,   **(05)** Stability, Enzyme inhibitor, Flash photolysis.

Q.4   **(a)**   Hydroxide ion is involved in the mechanism of the following reaction but is   **(05)** not consumed in the overall reaction.

$$OCl^-_{(aq)} + I^-_{(aq)} \xrightarrow{OH^-} OI^-_{(aq)} + Cl^-_{(aq)}$$
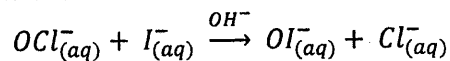
$[OCl^-], M$	$[I^-], M$	$[OH^-], M$	Rate formation; $[IO^-], M \cdot s^{-1}$
0.0040	0.0020	1.00	4.8×10^{-4}
0.0020	0.0040	1.00	5.0×10^{-4}
0.0020	0.0020	1.00	2.4×10^{-4}
0.0020	0.0020	0.50	4.6×10^{-4}
0.0020	0.0020	0.25	9.4×10^{-4}

(a) From the data given, determine the order of the reaction with respect to OCl^-, I^-, and OH^-.

(b) What is the overall reaction order?

(c) Write the rate equation, and determine the value of the rate constant (k).

(b)   For decomposition of ethane show that: **(05)**

$$R = \langle \frac{K_1}{2K_3} + \left[\left(\frac{K_1}{2K_3}\right)^2 + \left(\frac{K_1 K_4}{K_3 K_5}\right) \right]^{1/2} \rangle [C_2 H_6].$$

OR

(b)   Discuss in details oscillatory reaction with suitable example.   **(05)**

Q.5 (a)   Assign each of following molecules/structures to the correct point group: **(05)**
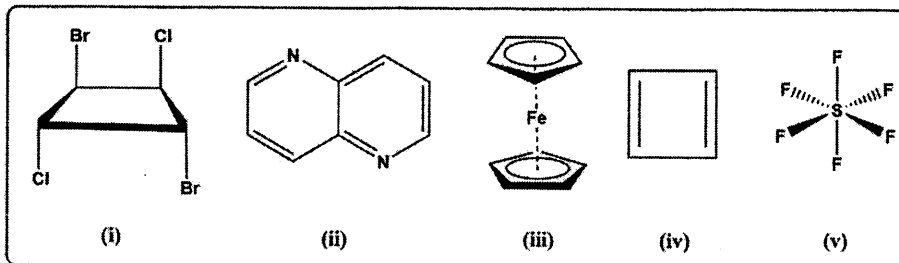
(b)   What is the prominence of symmetry? Give the general notations to constitute the character table.   **(05)**

OR

(b)   How altered form of ethane gives different symmetry. Explain and elaborate the features with neat sketch.   **(05)**

Q.6 (a)   Benzene is good example of relatively high class of symmetry; by using 3-cartesian method, find out the reducible representation associated with it.   **(05)**

(b)   Find out the total modes of vibration in given type of molecule.   **(05)**
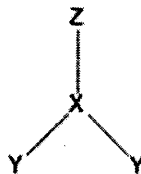
OR

(b)   Explain the IR & Raman active vibrations in BF_3 molecule using 3-cartesian as a basis set.   **(05)**

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THE CHARUTAR VIDYA MANDAL UNIVERSITY
M. Sc. (Organic Chemistry – SEMESTER 2
APRIL 2023 (REGULAR) EXAMINATION

Course Title: ANALYTICAL CHEMISTRY

Course Code: 201330208

Total Printed Pages : 02

Date: 25/04/2023   Time: 02:00 PM to 04:00 PM   Maximum Marks: 50

Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question
- Make suitable assumptions wherever necessary.

Q. 1   **Answer the following multiple choice questions.**   **(04)**

(I)   The full name of ASTM is:
(A) American Society for Testing Material.
(B) African Standard for Testing Material.
(C) American Society for Transferring Material.
(D) American Standard for Testing Material.

(II) 10^{-24} is SI prefix as:
(A) Attoliter   (B) Yottaliter   (C) Yoctoliter   (D) Petaliter

(III)   Which of the following is a three-level laser?
(A) ND: YAG
(B) Ruby
(C) He-Ne
(D) Semiconductor laser

(IV)   Which of the following approaches can be used to perform gas chromatography?
(A) Only in columns
(B) Only on plane surfaces
(C) Either in columns or on plane surfaces
(D) Neither in columns nor on plane surfaces

Q.2   **Answer in brief and to the point.**   **(06)**
(I)   List out the categories of verification and validation.
(II)   Determine the wavelength of electron moving with one third the speed of light.
(III)   Write the factors affecting to the paper chromatography along with advantages and precautions.

Q.3   (a)   Define the acronyms: **WSC, BIS, NIH, CMC, COI, FD & C, COA,**   **(05)**
AOCS, cGTP, IEC.
     (b)   What is GMPs? Discuss in details its components.   **(05)**
                 OR
     (b)   Give the detail classification of analytical techniques.   **(05)**

Q.4   (a)   **Define the terms:** Repeatable analysis; Reproducible analysis; Accuracy;   **(05)**
Precision; Outliers.

(b) Define the term 'significant figures' and write the significant figure for (05)
(i) Log (1.8×10^{-9}); (ii) $\frac{9.37 \times 10^6}{2.4 \times 10^2}$; (iii) Antilog (-10.74);
(iv) $(7.86 \times 10^3) \cdot (5.4 \times 10^2)$.

OR

(b) Replicate of silicon alloys are analysed and determined to contain 95.61, (05)
95.67, 95.71, 95.60 % of Ag. Calculate (a) the standard deviation of the
mean (b) median (c) the relative standard deviation (d) Variance (e) co-
efficient of variation.

Q.5 (a) Discuss the photo detector and heat detector used in optical instruments (05)
along with its properties.

(b) Explain "Photoelectric effect" and "Compton effect". (05)

OR

(b) Discuss in details monochromator. (05)

Q.6 (a) What is chromatography? Explain its terminology. (05)

(b) What do you mean by separation techniques? With the neat sketch explain (05)
seeding and evaporation.

OR

(b) For TLC, explain the spotting, development, visualization and give the (05)
merits and demerits along with applications.

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Seat No. _____   Enrollment No. _____

THE CHARUTAR VIDYA MANDAL UNIVERSITY
MASTER OF SCIENCE (ORGANIC CHEMISTRY) – SEMESTER 2
APRIL 2023 (BACKLOG) EXAMINATION

Course Title: Organic Chemistry-II

Course Code: 101330202

Total Printed Pages: 02

Date: 19/04/2023   Time: 2:00 pm to 4:00 pm   Maximum Marks: 60

Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question.
- Make suitable assumptions wherever necessary.

Q. 1   Answer the following multiple choice questions.   (04)

(I)   The oxidation number of all the carbons in 3-hydroxy butyric acid are _____.
(a) C-1= (-3), C-2=(-2), C-3= (0) & C-4=(+3)
(b) C-1= (+3), C-2=(-2), C-3= (0) & C-4=(-3)
(c) C-1= (-3), C-2=(+2), C-3= (+1) & C-5=(+3)
(d) C-1= (+3), C-2=(-2), C-3= (+1) & C-5=(-3)

(II)   The enantiomeric excess of pure optically active compound is _____.
(a) 100%   (b) 50%   (c) 0%   (d) Not predicted

(III) Ozonolysis of which alkene gives 2-Methyl propanal and 2-butanone as products?
(a) 2,4-dimethyl-3-hexene   (b) 3,5-diethyl-3-hexene
(c) 2-ethyl-4-methyl-2-pentene   (d) 4-ethyl-2-methyl-3-pentene

(IV)   Which of the following is *NOT* true for stabilized ylied?
(a) Less reactive
(b) Stereoselectivity is controlled by formation of betain
(c) It can isolate and crystallised
(d) Betain formation is reversible

Q.2   Answer in brief and to the Point.   (08)

(I)   Explain working pattern of phase transfer catalyst.
(II)   Explain Sonogashira coupling reaction with two examples.
(III) Write a note on OsO_4.
(IV)   Complete the following reaction with appropriate mechanism.

3- Hexene —————$\xrightarrow{?}$————— 1-Hexanol
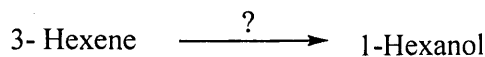
Q.3 (a) Give the synthesis of the following compounds as per given direction and explain   (06)
your answer.

(1)   (2)

(Robinson ring annulation)   (Schlosser's modification)
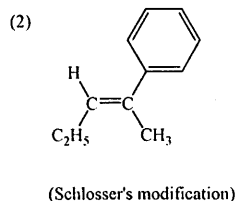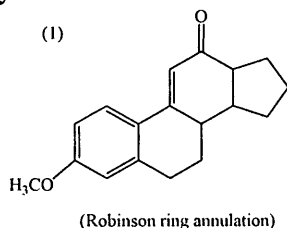
(b)   Give the comparison of Shapiro and Bamford Steven reactions.   (06)
OR

(b)   Write a note on   (06)
      (1) Petersion Olefination Reaction
      (2) Julia Olefination Reaction

Q.4 (a)   "Carbonylation of organoborane compound is an excellent tool for organic   (06)
           synthesis." Justify the statement via citing suitable examples.
     (b)   Answer the following.   (06)
           (1) "Reaction of aldehyde with allyl borane is enantioselective." Justify with
               appropriate reaction mechanism.
           (2) Complete the following reaction with appropriate mechanism.

           i) Pyrrolidine/Anhy. K$_2$CO$_3$
           ii) CH$_2$=CH-CN   ?

                              OR
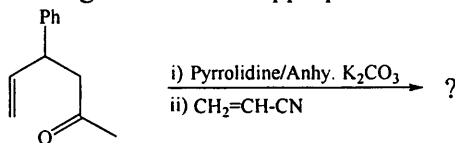
     (b)   Complete the following reactions with required mechanism.   (06)

B. $\xleftarrow{\text{Woodward}}{\text{Hydroxylation}}$ $\xrightarrow{\text{Prevost}}{\text{Hydroxylation}}$ A
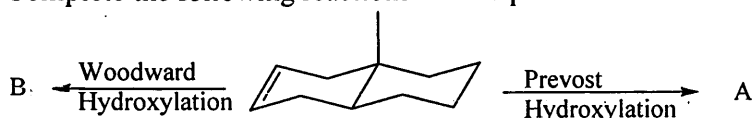
Q.5 (a)   How KMnO4 behave differently in acidic, alkaline and neutral medium? Explain with   (06)
           suitable reactions.
     (b)   Write a note on following.   (06)
           (1) Oppenauer Oxidation
           (2) Malaprade Oxidation
                              OR
     (b)   Complete the following reactions with appropriated mechanism.   (06)

     (1)   K$_3$Fe(CN)$_6$
                $\xrightarrow{\ominus\ OH}$?

     (2)   2DDQ
                $\xrightarrow{}$?
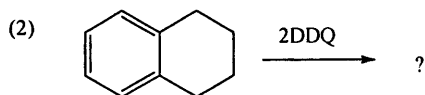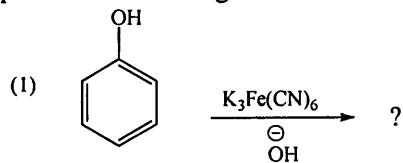
Q.6 (a)   Give the structure of the products from A to F in the following reaction web.   (06)
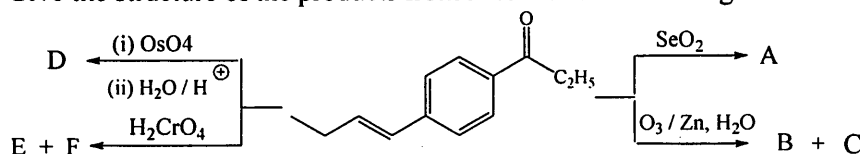
     (b)   Answer the following.   (06)
           (1) "Alkyl lithium is more reactive than Grignard reagent." Explain via citing
               suitable example.
           (2) Write a note on Wolf-Kishner reduction with its one modification.
                              OR
     (b)   Answer the following.   (06)
           (1) Write the mechanism for the formation of Amide and Peracid using DCC.
           (2) Discuss in detail MPV reduction.

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Seat No. _____   Enrolment No. _____

THE CHARUTAR VIDYA MANDAL UNIVERSITY
M. Sc. (Organic Chemistry)– SEMESTER 2
APRIL 2023 (BACKLOG) EXAMINATION

Course Title: TOPICS IN PHYSICAL CHEMISTRY - II

Course Code: 101330203

Total Printed Pages : 02

Date: 21/04/2023   Time: 02:00 PM to 04:00 PM   Maximum Marks: 60

Instructions:
- Attempt all questions.
- Numbers to the right indicate full marks for each question.
- Make suitable assumptions wherever necessary.

Q. 1   **Answer the following multiple choice questions.**   **(04)**

(I)   Which one of the following statements is correct?

(A) Sequential reactions are also called consecutive reactions

(B) parallel reactions are also known as consecutive reactions

(C) Competing reactions have more than one step

(D) Consecutive reactions do not have intermediates

(II)   Which of the following statements for order of reaction is not correct?

(A) Order can be determined experimentally

(B) Order cannot be fractional

(C) Order of a reaction is equal to the sum of the power of concentration terms in differential rate law

(D) It is not affected with the stoichiometric coefficients of the reactants

(III) BF_3 molecule belongs to_____ point group.

(A) C_2v (B) C_3V (C) D_3h (D) D_2h

(IV)   The number of degrees of vibrational freedom possessed by acetylene is:

(A) 9   (B) 4   (C) 6   (D) 7

Q.2   **Answer in brief and to the point.**   **(08)**

(I)   Explain the competitive and uncompetitive inhibition with plot.

(II)   Explain steric factor.

(III)   By giving suitable example, explain how principle axis can be selected.

(IV)   What is SALS approach for binding in water molecule?

Q.3   (a)   **Define the terms:** Activation energy; Simple reaction, Complex reaction, Ionic strength, Stability, Fast reaction.   **(06)**

(b)   What is consecutive reaction? Show that for consecutive reaction involving reactant [A], intermediate [B] and product [C], the concentrations, [A]: $[A] = [A]_0 e^{-K_1 t}$. Explain any two cases.   **(06)**

OR

(b)   What is turnover number of enzyme? The turnover number for an enzyme is known to be 5000 min^{-1}. From the following set of data calculate the K_M and total amount of enzyme present in this experiment.   **(06)**

$\dfrac{1}{[S]}$	$\dfrac{1}{V_0}$
1.0000	0.005980
0.5000	0.004000
0.2500	0.002990
0.1666	0.002659
0.0100	0.002008
0.0010	0.002004

Q.4 (a) Derive the equation of rate constant (K) for the first order reaction for the (06) determining rate law. And explain the characteristics.

(b) Discuss in details the kinetics and thermodynamics control of chemical (06) reaction.

OR

(b) What is photochemical reaction? For photochemical reaction kinetic, show (06) that:

$$[H] = \frac{K_2\left(K_1/K_5\right)^{1/2} \cdot (I_{abs})^{1/2}[H_2]}{K_3[Br_2] + K_4\,[HBr]}.$$

Q.5 (a) **Assign each of following molecules to the correct point group:** (06)
(i) Diborane (B_2H_6) (ii) BrF_5 (iii) CH_4 (iv) SF_4 (v) 1,4-dichlorobenzene
(vi) trans H_2O_2.

(b) Consider the character table: (i) Which point group it is belong? Give an (06) example (ii) Deduced the values of a – f.

?	E	$2C_5$	$2C_5^2$	$5\sigma_v$
Γ_1	1	1	1	1
Γ_2	1	1	1	-1
Γ_3	2	a	b	c
Γ_4	2	d	e	f

OR

(b) Construct the matrix for $C_{n(Z)}$ rotation and explain how it is different for (06) clockwise and anticlockwise rotation.

Q.6 (a) By using internal co-ordinate method for H_2O molecule, show that (06) $\Gamma_{int} = 2A_1 + 1B_2$ coefficient.

(b) Write the symmetry elements and point group to which naphthalene (06) molecule belongs. Work out to show the characters for $\chi(E)$, $\chi(C_{2(x)})$, $\chi(C_{2(z)})$ and $\chi(C_{2(y)})$ are 10, 0, 0 and -2 respectively.

OR

(b) Show that Γ_h has one A_1 and one T_2 coefficient for the tetrahedral (AB_4) (06) molecule.

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