

Test Booklet Code & Serial No.

प्रश्नपत्रिका कोड व क्रमांक

A

Paper-III

CHEMICAL SCIENCE

Signature and Name of Invigilator

Seat No.

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1. (Signature)

(In figures as in Admit Card)

(Name)

Seat No.

(In words)

2. (Signature)

(Name)

OMR Sheet No.

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(To be filled by the Candidate)

JAN - 33318

Time Allowed : 2½ Hours]

[Maximum Marks : 150

Number of Pages in this Booklet : 32

Number of Questions in this Booklet : 75

Instructions for the Candidates

- Write your Seat No. and OMR Sheet No. in the space provided on the top of this page.
- This paper consists of 75 objective type questions. Each question will carry two marks. All questions of Paper-III will be compulsory, covering entire syllabus (including all electives, without options).
- At the commencement of examination, the question booklet will be given to the student. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as follows :
 - To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal or open booklet.
 - Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to missing pages/questions or questions repeated or not in serial order or any other discrepancy should not be accepted and correct booklet should be obtained from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given. The same may please be noted.
 - After this verification is over, the OMR Sheet Number should be entered on this Test Booklet.
- Each question has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
Example : where (C) is the correct response.

(A)	(B)	(C)	(D)
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- Your responses to the items are to be indicated in the OMR Sheet given inside the Booklet only. If you mark at any place other than in the circle in the OMR Sheet, it will not be evaluated.
- Read instructions given inside carefully.
- Rough Work is to be done at the end of this booklet.
- If you write your Name, Seat Number, Phone Number or put any mark on any part of the OMR Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, you will render yourself liable to disqualification.
- You have to return original OMR Sheet to the invigilator at the end of the examination compulsorily and must not carry it with you outside the Examination Hall. You are, however, allowed to carry the Test Booklet and duplicate copy of OMR Sheet on conclusion of examination.
- Use only Blue/Black Ball point pen.
- Use of any calculator or log table, etc., is prohibited.
- There is no negative marking for incorrect answers.

विद्यार्थ्यांसाठी महत्वाच्या सूचना

- परिक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
- सदर प्रश्नपत्रिकेत 75 बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास दोन गुण आहेत. या प्रश्नपत्रिकेतील सर्व प्रश्न सोडविणे अनिवार्य आहे. सदरचे प्रश्न हे या विषयाच्या संपूर्ण अभ्यासक्रमावर आधारित आहेत.
- परीक्षा सुरु झाल्यावर विद्यार्थ्यांना प्रश्नपत्रिका दिली जाईल. सुरुवातीच्या 5 मिनीटांमध्ये आपण सदर प्रश्नपत्रिका उघडून खालील बाबी अवश्य तपासून घ्याव्यात.
 - प्रश्नपत्रिका उघडण्यासाठी प्रश्नपत्रिकेवर लावलेले सील उघडावे. सील नसलेली किंवा सील उघडलेली प्रश्नपत्रिका स्विकारू नये.
 - पहिल्या पृष्ठावर नमूद केल्याप्रमाणे प्रश्नपत्रिकेची एकूण पृष्ठे तसेच प्रश्नपत्रिकेतील एकूण प्रश्नांची संख्या पडताळून घ्यावी. पृष्ठे कमी असलेली/कमी प्रश्न असलेली/प्रश्नांचा चुकीचा क्रम असलेली किंवा इतर त्रुटी असलेली सदोष प्रश्नपत्रिका सुरुवातीच्या 5 मिनिटातच पर्यवेक्षकाला परत देऊन दुसरी प्रश्नपत्रिका मागवून घ्यावी. त्यानंतर प्रश्नपत्रिका बदलून मिळणार नाही तसेच वेळही वाढवून मिळणार नाही याची कृपया विद्यार्थ्यांनी नोंद घ्यावी.
 - वरीलप्रमाणे सर्व पडताळून पहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा नंबर लिहावा.
- प्रत्येक प्रश्नासाठी (A), (B), (C) आणि (D) अशी चार विकल्प उत्तरे दिली आहेत. त्यातील योग्य उत्तराचा रकाना खाली दर्शविल्याप्रमाणे ठळकपणे काळ्या/निळ्या करावा.
उदा. : जर (C) हे योग्य उत्तर असेल तर.

(A)	(B)	(C)	(D)
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- या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे ओ.एम.आर. उत्तरपत्रिकेतच दर्शवावीत. इतर ठिकाणी लिहीलेली उत्तरे तपासली जाणार नाहीत.
- आत दिलेल्या सूचना काळजीपूर्वक वाचाव्यात.
- प्रश्नपत्रिकेच्या शेवटी जोडलेल्या कोऱ्या पानावरच कच्चे काम करावे.
- जर आपण ओ.एम.आर. वर नमूद केलेल्या ठिकाणा व्यतिरिक्त इतर कोठेही नाव, आसन क्रमांक, फोन नंबर किंवा ओळख पटेल अशी कोणतीही खूण केलेली आढळून आल्यास अथवा असभ्य भाषेचा वापर किंवा इतर गैरमागीचा अवलंब केल्यास विद्यार्थ्यांना परीक्षेस अपात्र ठरविण्यात येईल.
- परीक्षा संपल्यानंतर विद्यार्थ्यांनी मूळ ओ.एम.आर. उत्तरपत्रिका पर्यवेक्षकांकडे परत करणे आवश्यक आहे. तथापी, प्रश्नपत्रिका व ओ.एम.आर. उत्तरपत्रिकेची द्वितीय प्रत आपल्याबरोबर नेण्यास विद्यार्थ्यांना परवानगी आहे.
- फक्त निळ्या किंवा काळ्या बॉल पेनचाच वापर करावा.
- कॅलक्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही.
- चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही.

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Chemical Science

Paper III

Time Allowed : 2½ Hours]

[Maximum Marks : 150

Note : This paper contains **seventy five (75)** multiple choice questions, each question carrying **Two (2)** marks. Attempt *All* questions.

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1. The *correct* statement for atomic absorption spectroscopy (AAS) from the following :
- (A) Non-metals are determined by direct methods
(B) Beer's law is not obeyed over wide concentration range
(C) Separate lamp for each element to be determined is required
(D) Al, Ti, W, Mo and Si can be detected by AAS
2. The capacity to undergo exchange reaction by the hydrated metal ions of the same size in ion exchange chromatography follows the order :
- (A) $\text{Al}^{3+} > \text{Ca}^{2+} > \text{Th}^{4+} > \text{Na}^{+}$
(B) $\text{Th}^{4+} > \text{Al}^{3+} > \text{Ca}^{2+} > \text{Na}^{+}$
(C) $\text{Na}^{+} > \text{Ca}^{2+} > \text{Al}^{3+} > \text{Th}^{4+}$
(D) $\text{Ca}^{2+} > \text{Al}^{3+} > \text{Th}^{4+} > \text{Na}^{+}$
3. The thermal methods (I) and their parameters (II) are given below :
- | I | II |
|---------|----------------|
| (a) TG | (e) ΔT |
| (b) DTG | (f) dm/dt |
| (c) DTA | (g) dH/dt |
| (d) DSC | (h) Mass |

The *correct* match is :

- (A) (a)-(e), (b)-(f), (c)-(g), (d)-(h)
(B) (a)-(f), (b)-(g), (c)-(h), (d)-(e)
(C) (a)-(h), (b)-(f), (c)-(e), (d)-(g)
(D) (a)-(g), (b)-(e), (c)-(f), (d)-(h)

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4. The intervalence band in Mixed-valent compounds usually occurs in the region.
- (A) Ultra-violet (B) Visible
(C) Near infrared (D) Far infrared
5. In the base-catalysed substitution of Cl^- by OH^- in $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$ under strongly basic conditions, the first step in the mechanism is :
- (A) Conversion of an ammine to amido ligand
(B) Substitution of Cl^- by OH^-
(C) Dissociation of Cl^- to give 5-coordinate intermediate
(D) Association of OH^- to give 7 coordinate intermediate
6. To satisfy the 18 electron rule the value of n in the complex $[\text{Rh}(\eta^5\text{—C}_5\text{H}_5)(\text{CO})_n]$ should be :
- (A) 2 (B) 3
(C) 1 (D) 4
7. The correct order of Nephelauxetic parameter (β) of the ligands is :
- (A) $\text{CN}^- > \text{NCS}^- > \text{en} > \text{NH}_3 > \text{H}_2\text{O}$
(B) $\text{H}_2\text{O} > \text{NH}_3 > \text{en} > \text{NCS}^- > \text{CN}^-$
(C) $\text{en} > \text{CN}^- > \text{NCS}^- > \text{NH}_3 > \text{H}_2\text{O}$
(D) $\text{H}_2\text{O} > \text{NH}_3 > \text{NCS}^- > \text{CN}^- > \text{en}$
8. Jahn-Teller distortion will be exhibited by :
- (A) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ (B) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
(C) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ (D) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

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9. Rieske protein is a $[2\text{Fe-2S}]$ cluster wherein :
- (A) One Fe atom is coordinated to two terminal imidazole ligands and the other Fe atom is coordinated to two terminal cystine ligands
 (B) Both Fe atoms are coordinated to two terminal imidazole groups each
 (C) Both Fe atoms are coordinated to two terminal cystine groups each
 (D) Both Fe atoms are coordinated to one terminal imidazole and one cystine each
10. $[\text{Ni}(\text{dipyridyl})_3]\text{SO}_4$ records three transitions in electronic spectra at $12,650\text{ cm}^{-1}$, $19,200\text{ cm}^{-1}$ and $26,000\text{ cm}^{-1}$. The $10 Dq$ of the complex is :
- (A) 12650 cm^{-1} (B) 15180 cm^{-1}
 (C) 10120 cm^{-1} (D) 26000 cm^{-1}
11. In which of the following organometallic complexes, the carbon based ligands is both σ and π bonded.
- (A) $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$ (B) $[\text{PtCl}_3(\eta^2\text{-C}_2\text{H}_4)]^-$
 (C) $[\text{Co}(\text{CO})_5\text{NH}_3]^{2+}$ (D) $[\text{Al}(\text{CH}_3)_3]$
12. The EPR spectra of $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ ($^{55}\text{Mn} I=5/2$) with zero field splitting show five set of lines. Each set further consist ofhyperfine lines (At. No. Mn = 25)
- (A) 5 (B) 6
 (C) 30 (D) 1
13. In the Wacker catalytic cycle if methanol is used in place of water as nucleophile the product will be :
- (A) Ethanol (B) Methyl vinyl ether
 (C) Acetaldehyde (D) Acetone
14. 'A' type of ground Mülliken symbol in complex having oh symmetry is :
- (A) $t_{2g}^3 e_g^2$ (B) $t_{2g}^1 e_g^0$
 (C) $t_{2g}^3 e_g^1$ (D) $t_{2g}^6 e_g^3$

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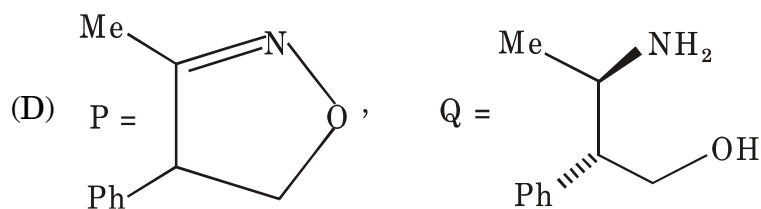
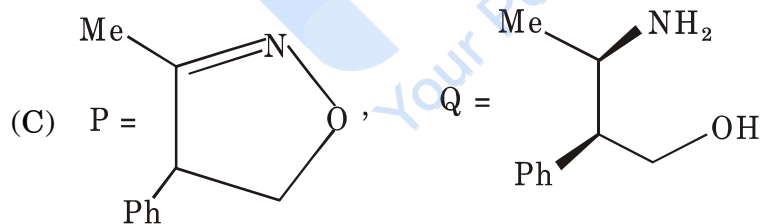
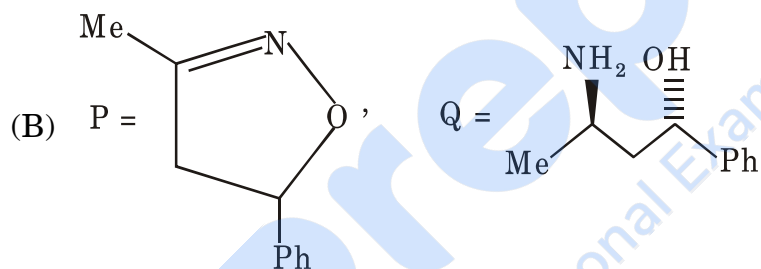
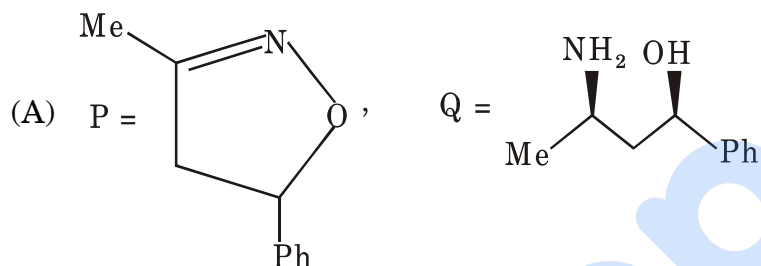
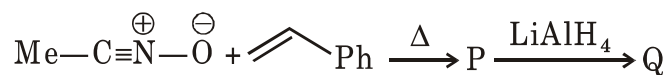
15. Which of the following pairs of coordination complexes *do not* undergo inner sphere electron transfer reaction ?
- (A) $[\text{Co}(\text{NH}_3)_5\text{NO}_3]^{2+}/[\text{V}(\text{OH}_2)_6]^{2+}$
(B) $[\text{Co}(\text{NH}_3)_5\text{I}]^{2+}/[\text{V}(\text{OH}_2)_6]^{2+}$
(C) $[\text{Co}(\text{en})_3]^{3+}/[\text{V}(\text{OH}_2)_6]^{2+}$
(D) $[\text{Co}(\text{NH}_3)_5\text{Br}]^{2+}/[\text{V}(\text{OH}_2)_6]^{2+}$
16. The d^n electron configuration of the first row transition metal ions that show 'high-spin'—'low-spin' transition are :
- (A) d^4 and d^5 (B) d^5 and d^6
(C) d^4 , d^5 , d^6 and d^7 (D) d^4 , d^5 and d^6
17. The measurement of the intensity of the scattered light as a function of the concentration of the dispersed phase form is the principle of :
- (A) Colorimetry (B) Turbidimetry
(C) Nephelometry (D) Phosphorimetry
18. Racemization of octahedral complexes containing three bidentate rings by the Ray-Dutt twist mechanism forms intermediates of point group.
- (A) D_{3h} (B) C_{2v}
(C) C_{3v} (D) D_{2h}
19. The $^{31}\text{P}\{\text{OH}\}$ NMR spectra of $\text{HPO}(\text{OH})_2$ and $\text{H}_2\text{PO}(\text{OH})$ ($I = \frac{3}{2}$, $^1\text{H} = \frac{1}{2}$) shows respectively :
- (A) doublet and triplet (B) triplet and triplet
(C) triplet and doublet (D) doublet and doublet
20. The following statement is *incorrect* with respect to ^{57}Fe Mössbauer spectra of $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ and $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$:
- (A) Both the compounds show doublet with equal quadrupole splitting
(B) Both are compounds show doublet with unequal quadrupole splitting
(C) Both the compounds are high spin complexes of Fe(II) and Fe(III) respectively
(D) Valence contribution is present in $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$ while lattice contribution is present in $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$

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21. Which of the following pairs of elements have $(n-2)f^7(n-1)d^1ns^2$ electronic configuration ?
- (A) S_m, C_m (B) G_d, C_m
(C) E_u, C_m (D) E_r, C_m
22. Which of the following statements with respect to 'trans effect' is true ?
- (A) Ammonia > Chloride (B) Water > Chloride
(C) Pyridine > Chloride (D) Chloride > Ammonia
23. In the layered structure of CdI_2 , Cd^{2+} occupies octahedral sites.
- (A) $\frac{1}{2}$ (B) $\frac{1}{3}$
(C) $\frac{1}{4}$ (D) 1
24. A dimeric Ruthenium (IV) complex $[K_4(Cl_5Ru-O-RuCl_5)]$ is diamagnetic at room temperature ($26^\circ C$) although there are two unpaired electrons per Ru(IV) ion, the magnetic behaviour can be best explained by :
- (A) Antiferromagnetic coupling (B) Ferromagnetic coupling
(C) Ferrimagnetic coupling (D) Antiferrimagnetic coupling
25. Tetragonal distorted complexes will be exhibited by :
- (A) Low spin Fe^{2+} (B) High spin Cr^{2+}
(C) High spin Mn^{2+} (D) Ni^{2+}

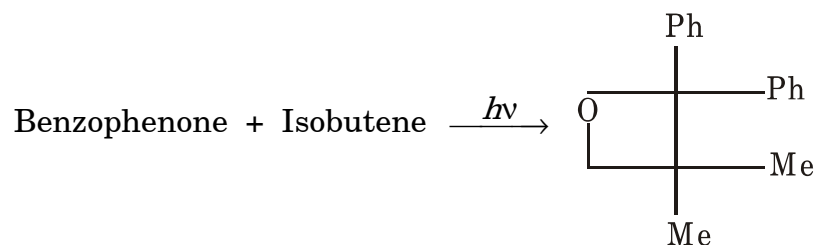
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26. The major products P and Q formed in the following reaction sequence are :



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27. The following reaction is an example of :



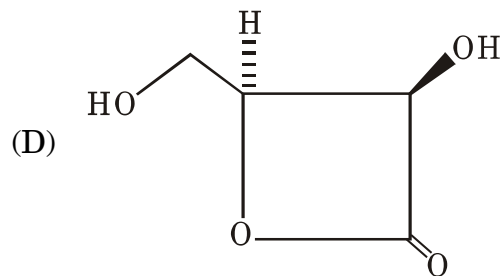
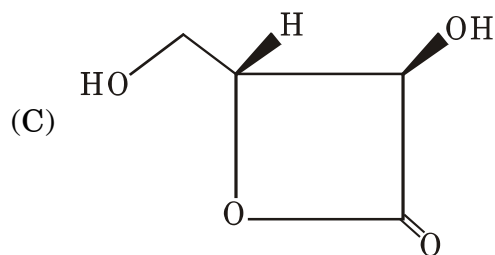
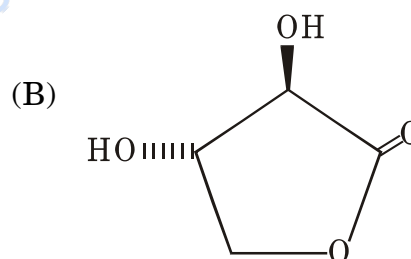
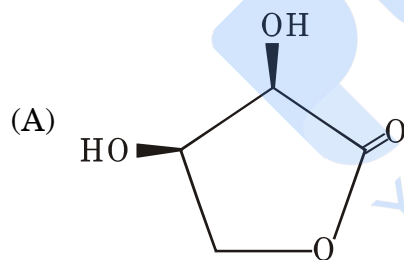
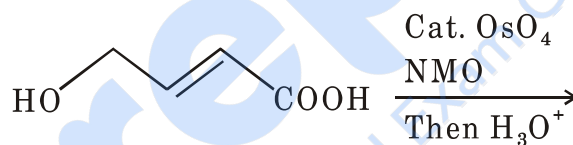
(A) Norrish type I reaction

(B) Norrish type II reaction

(C) Borton reaction

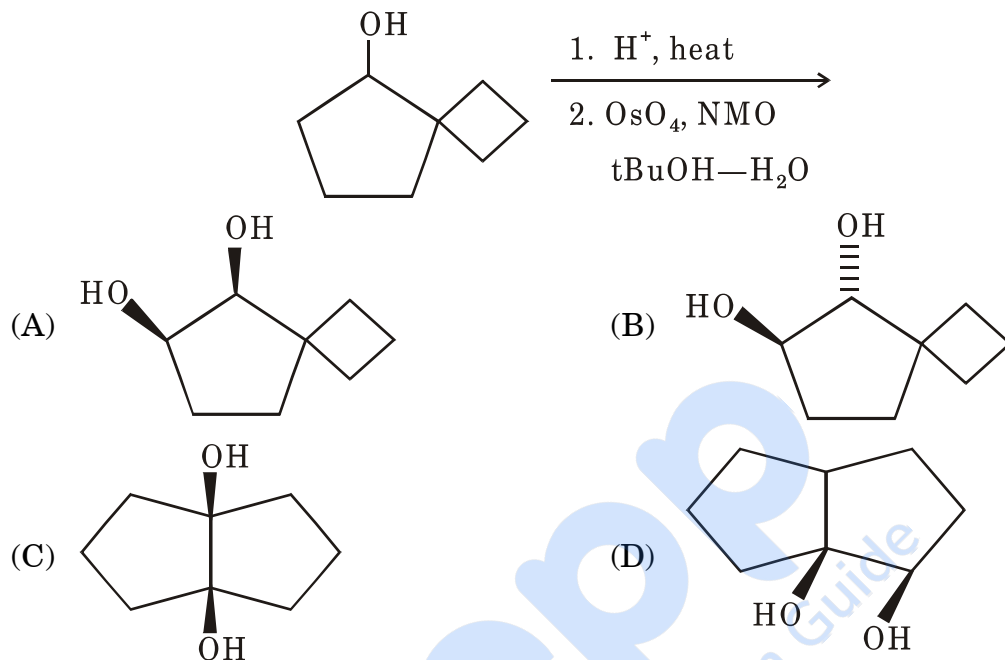
(D) Paterno-Buchi reaction

28. The major product formed in the following reaction is :

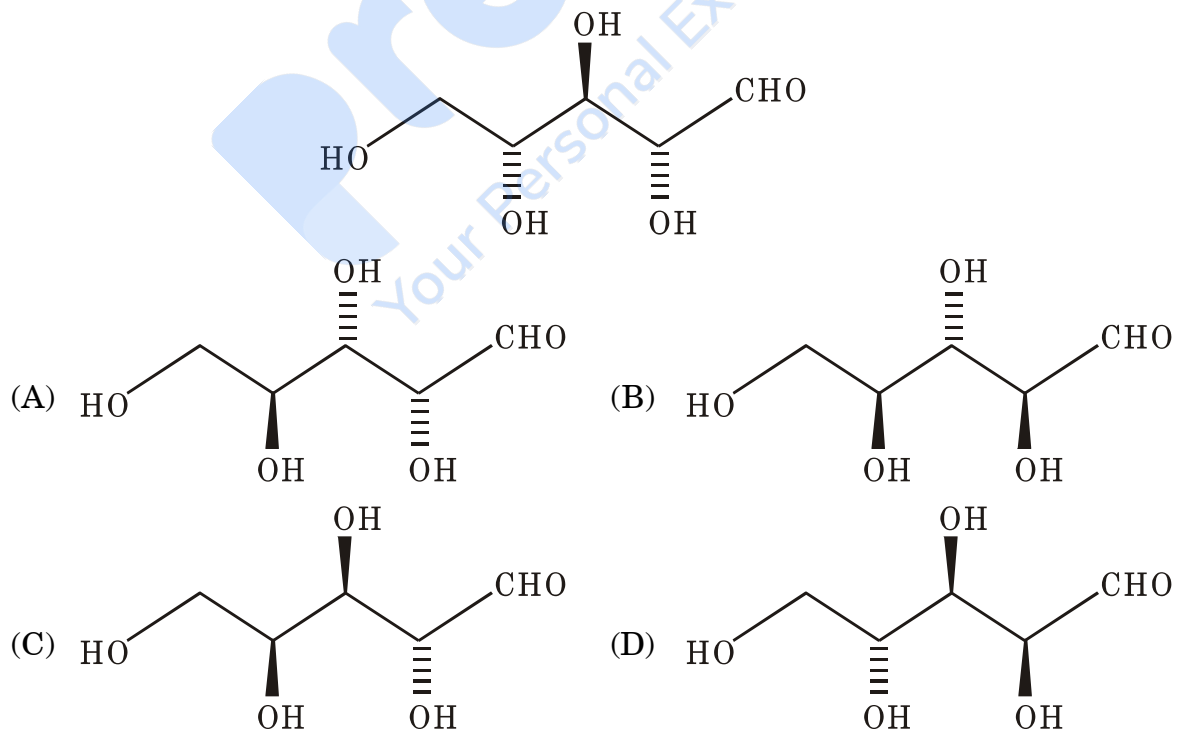


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29. Major product formed in the following reaction is :

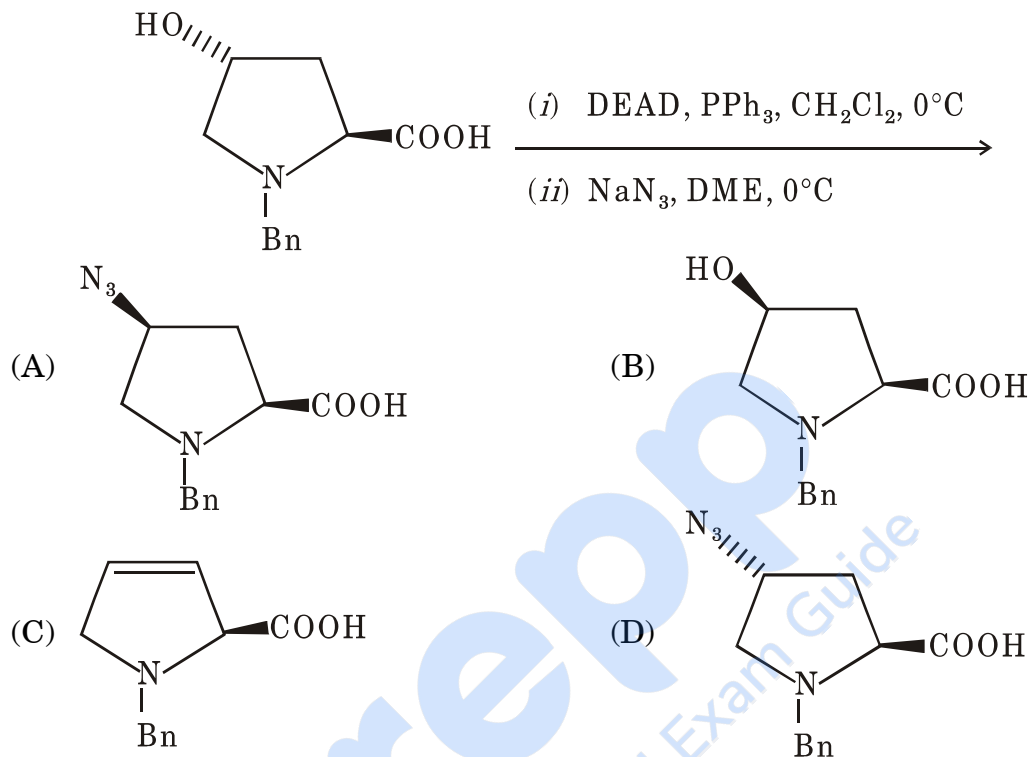


30. Find out the correct structure of L-Ribose if the structure of D-Ribose is :

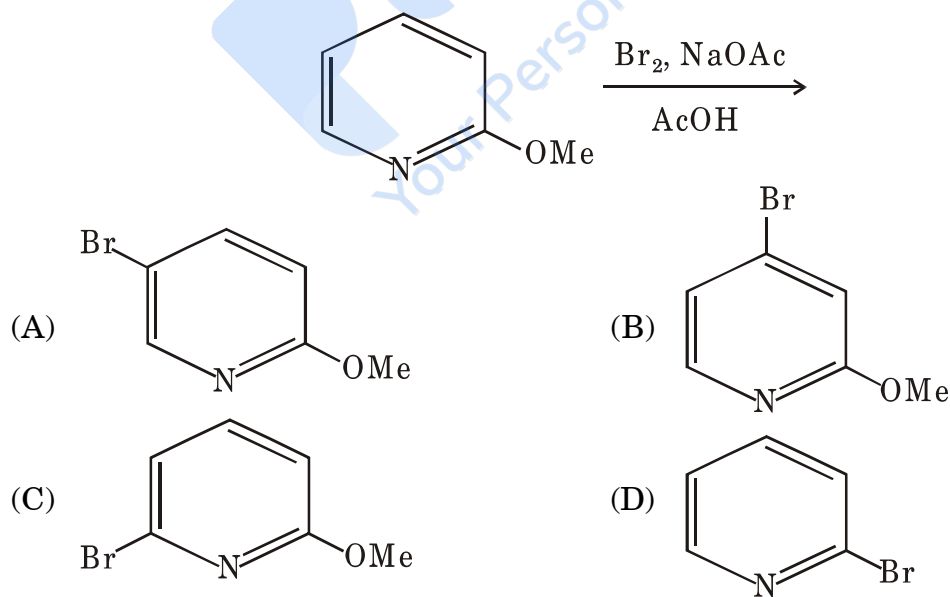


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31. Major product formed in the following reaction is :

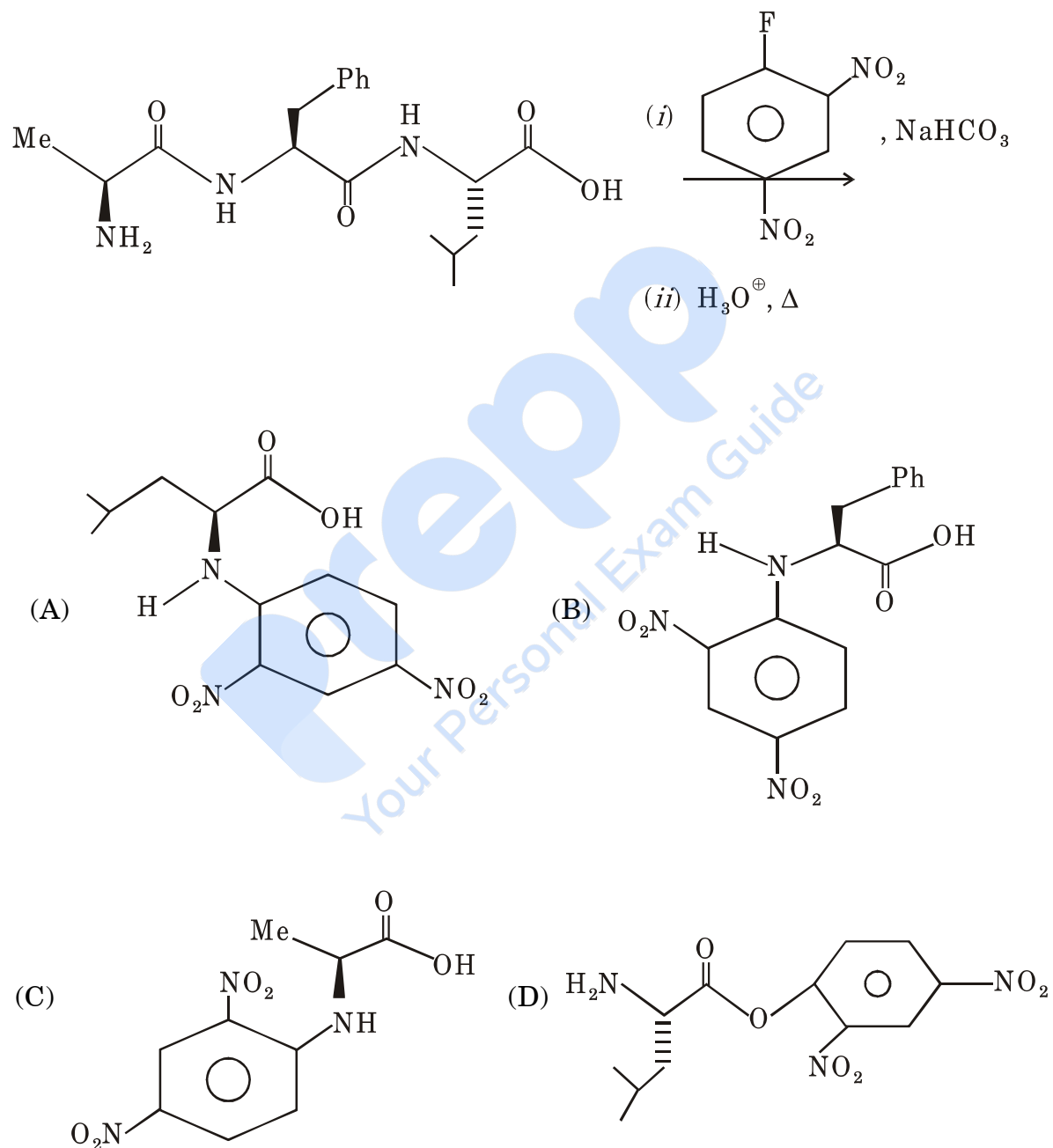


32. The major product formed in the following reaction is :



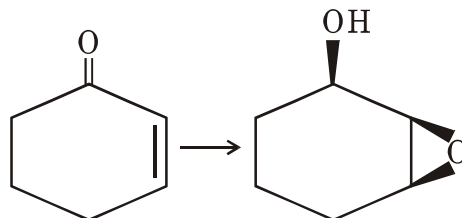
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33. Structure of the 'tagged' amino acid formed in the following reaction is :



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34. The correct reagents to effect the following conversion are :



(A) (i) NaBH_4 , CeCl_3 , MeOH

(ii) $m\text{-CPBA}$, CH_2Cl_2 , 0°C

(B) (i) NaBH_4 , CeCl_3 , MeOH

(ii) H_2O_2 , NaOH , 0°C

(C) (i) $m\text{-CPBA}$, CH_2Cl_2 , 0°C

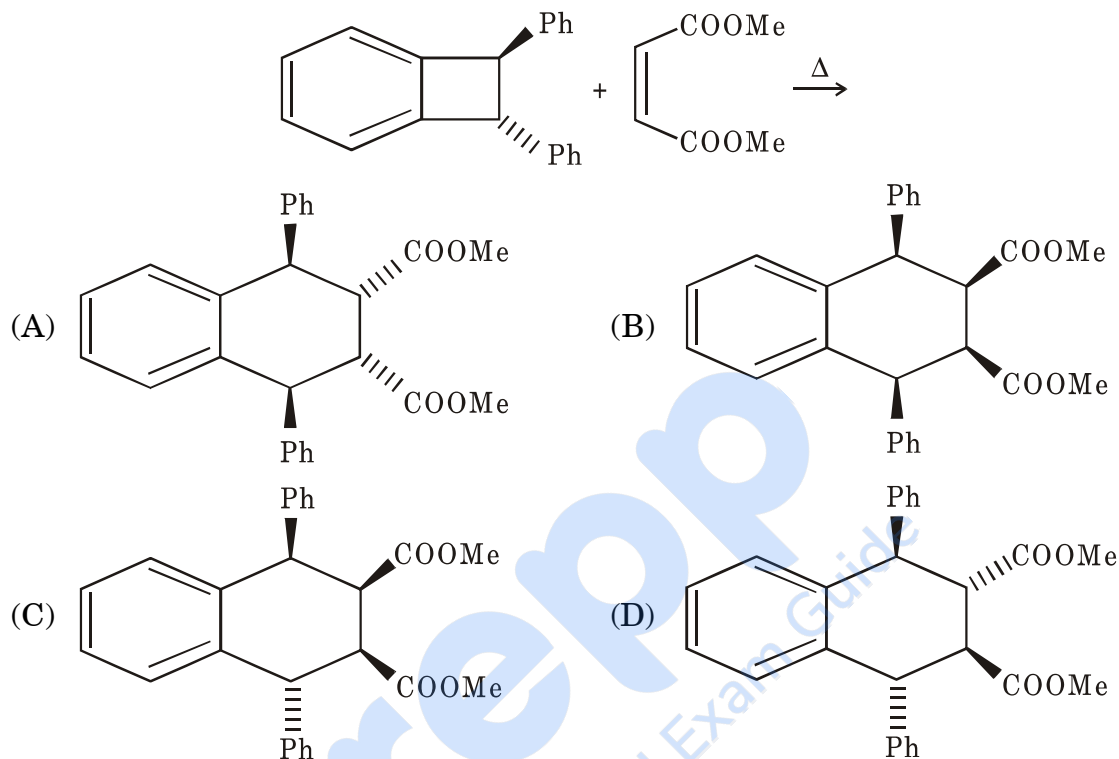
(ii) LiAlH_4 , THF , $0^\circ\text{C} \rightarrow \text{rt}$

(D) (i) H_2O_2 , NaOH , $0^\circ\text{C} \rightarrow \text{rt}$

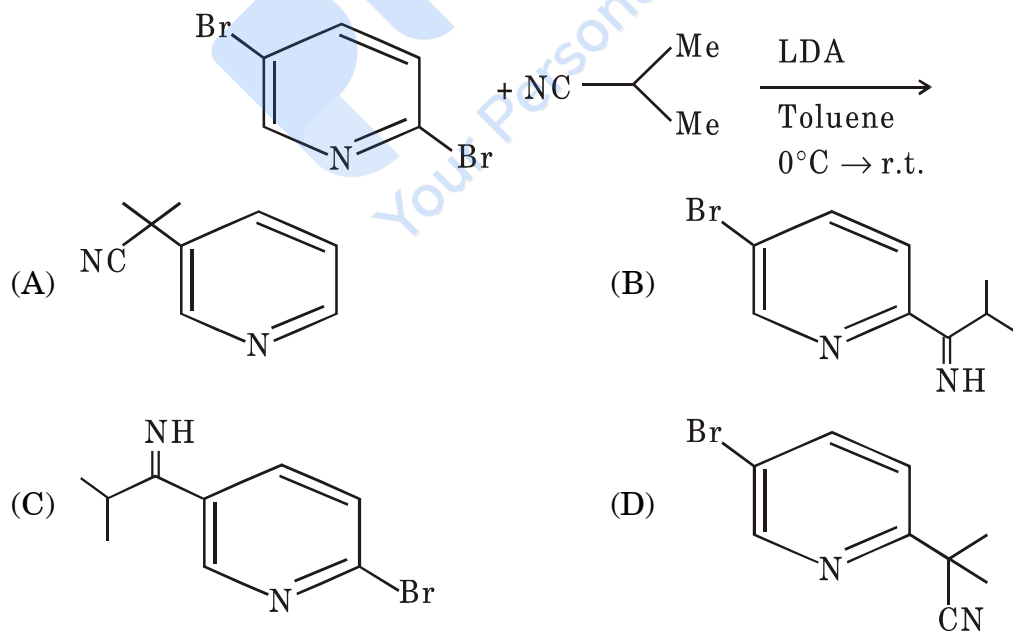
(ii) LiAlH_4 , THF , $0^\circ\text{C} \rightarrow \text{reflux}$

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35. Major product formed in the following reaction is :



36. The major product formed in the following reaction is :



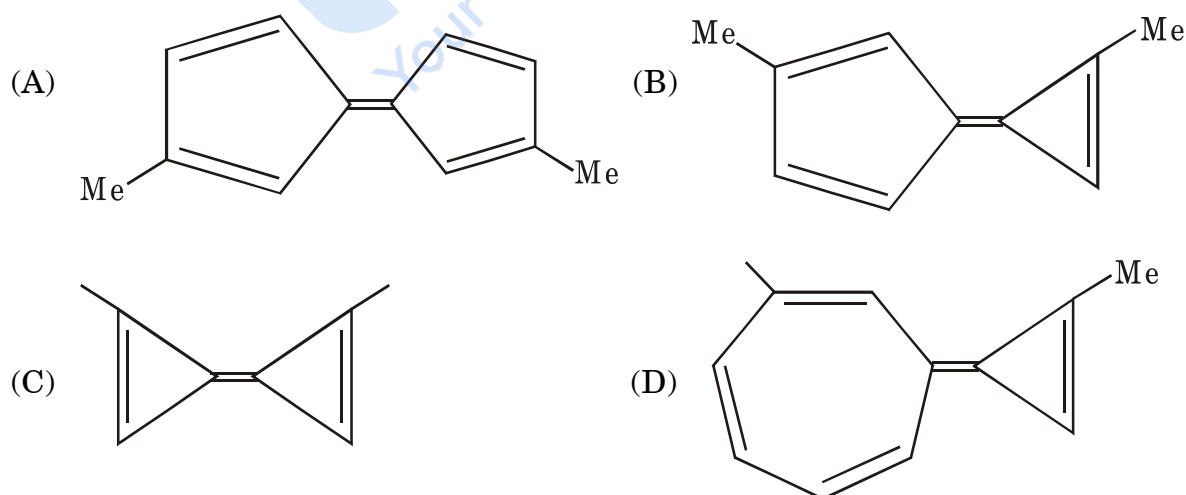
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37. The correct match of natural products in Column-I with class in Column-II is :

Column-I	Column-II
(P) Cholesterol	(i) Polysaccharide
(Q) Cellulose	(ii) Steroid
(R) Quinine	(iii) Vitamin
	(iv) Alkaloid

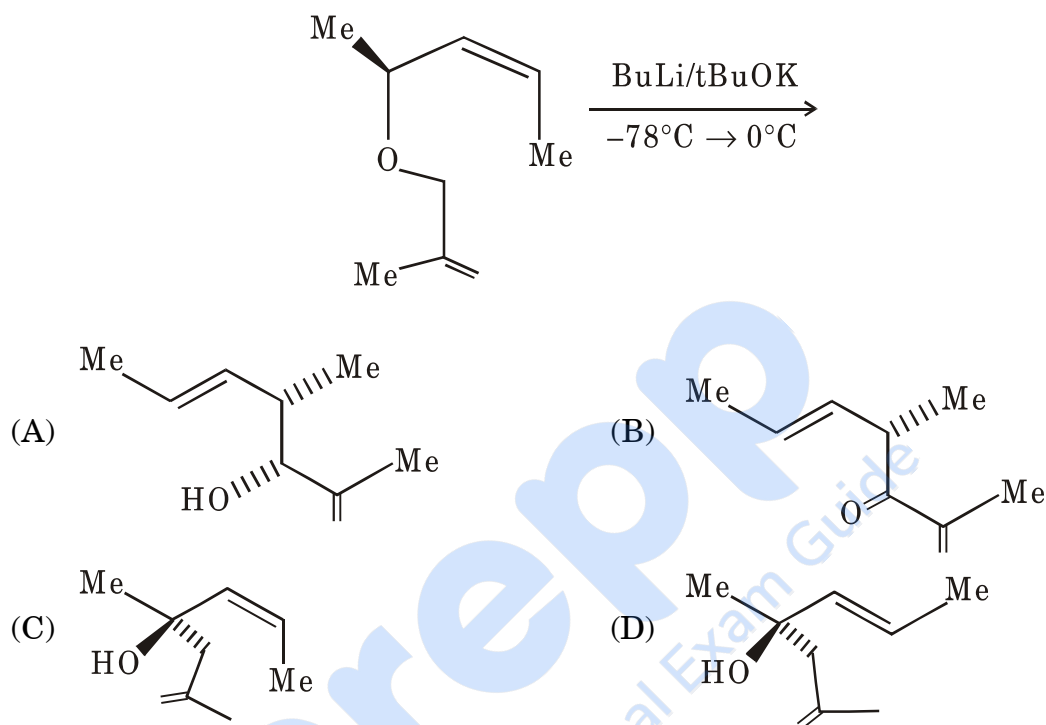
- (A) (P)—(iii), (Q)—(i), (R)—(iv)
 (B) (P)—(ii), (Q)—(iv), (R)—(i)
 (C) (P)—(ii), (Q)—(i), (R)—(iv)
 (D) (P)—(i), (Q)—(iii), (R)—(iv)

38. Amongst the following the rate of cis-trans isomerisation is expected to be highest in :



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39. The major product formed in the following reaction is :

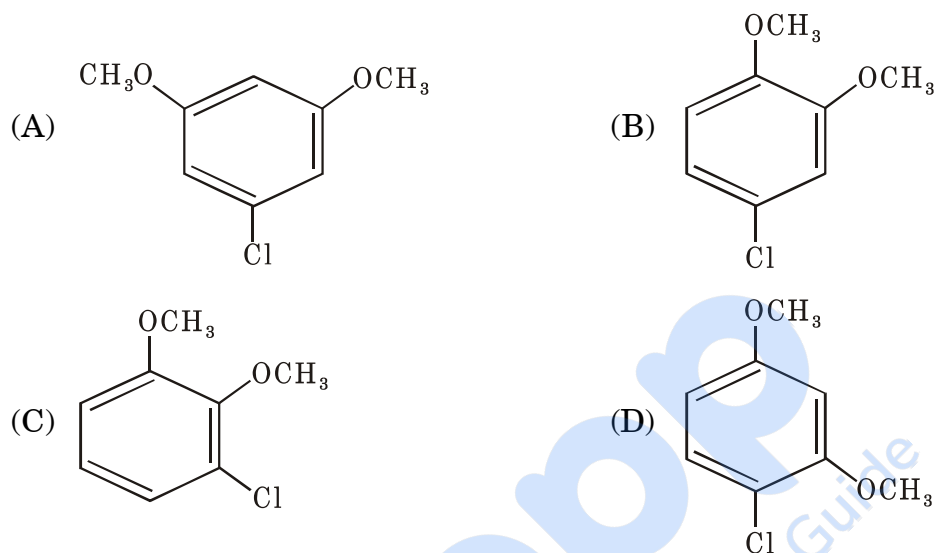


40. The proton decoupled ^{13}C NMR spectrum of $\text{HF}_2\text{C}-\text{CH}_2\text{Cl}$ will show :

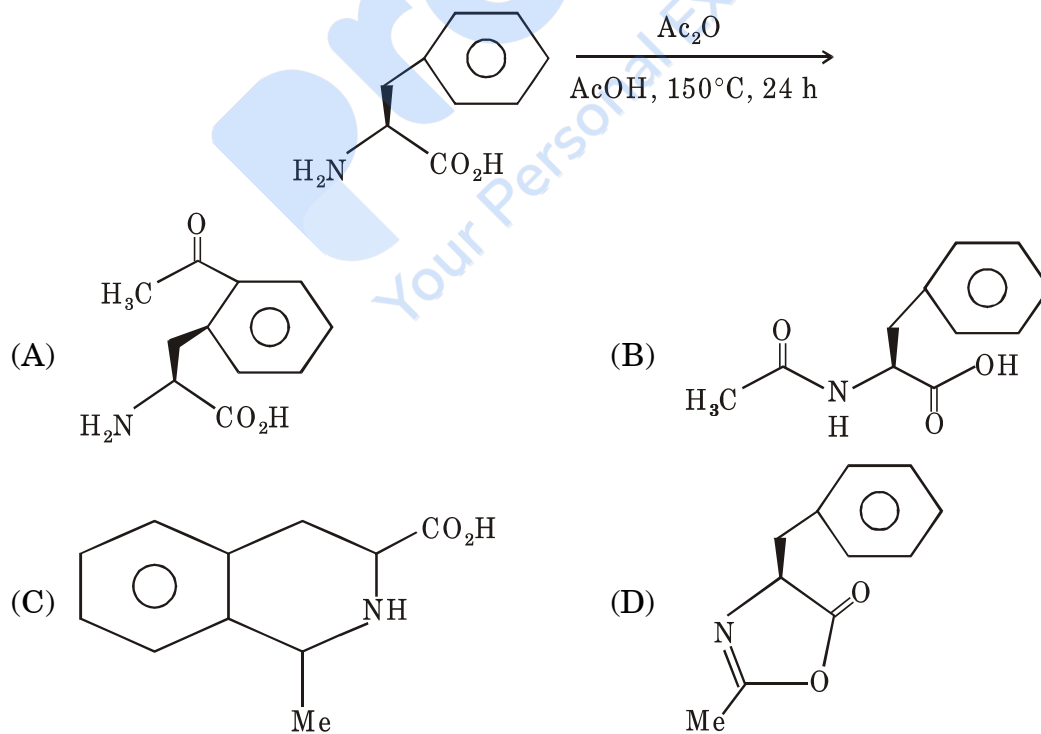
- (A) C_1 as singlet and C_2 as singlet
- (B) C_1 as triplet and C_2 as triplet
- (C) C_1 as triplet and C_2 as singlet
- (D) C_1 as doublet and C_2 as singlet

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41. The correct structure of a compound that exhibits the following $^1\text{H-NMR}$ spectral data is :
 δ 3.8 (s, 3H), 3.9 (s, 3H), 6.82 (dd, $J = 8$ and 2 Hz, 1H), 7.06 (t, $J = 8$ Hz, 1H), 7.15 (dd, $J = 8$ and 2 Hz, 1H)

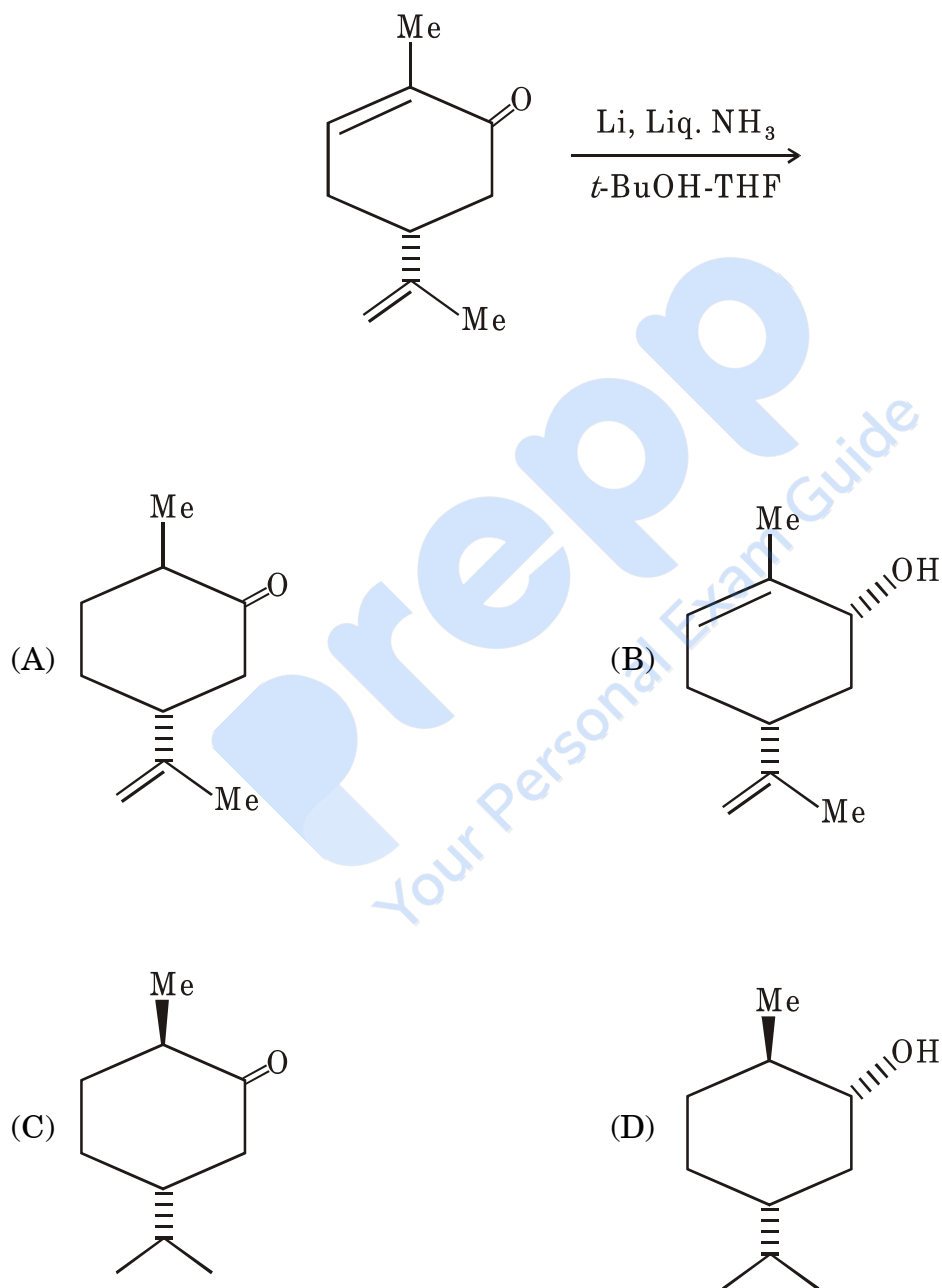


42. Major product formed in the following reaction is :



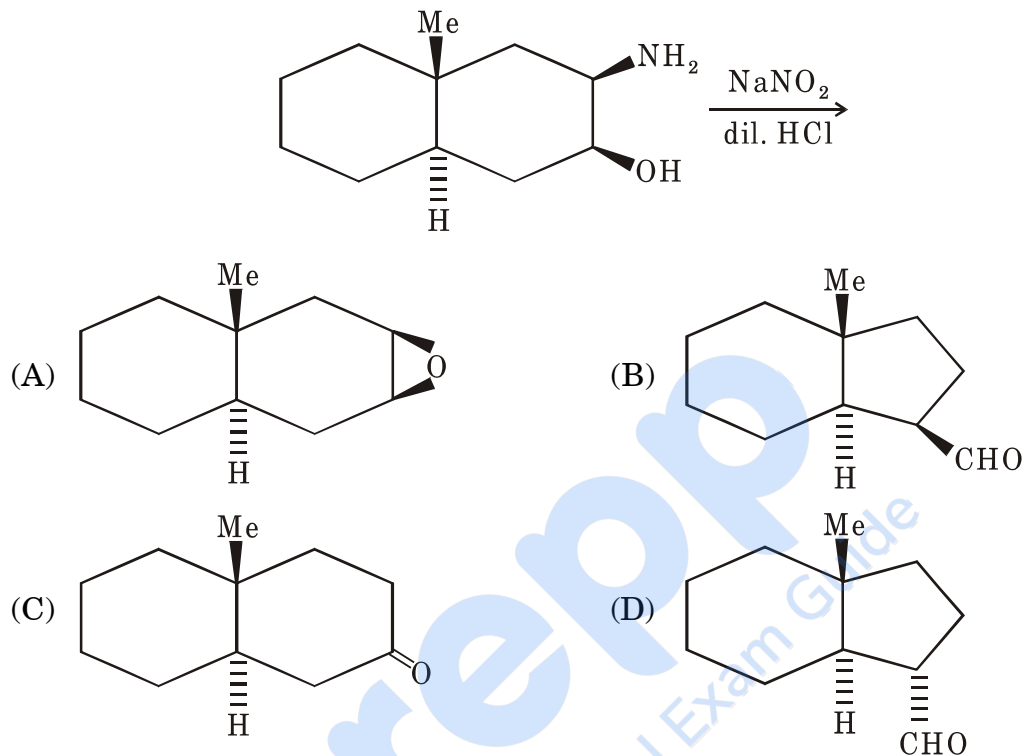
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43. Major product formed in the following reaction is :

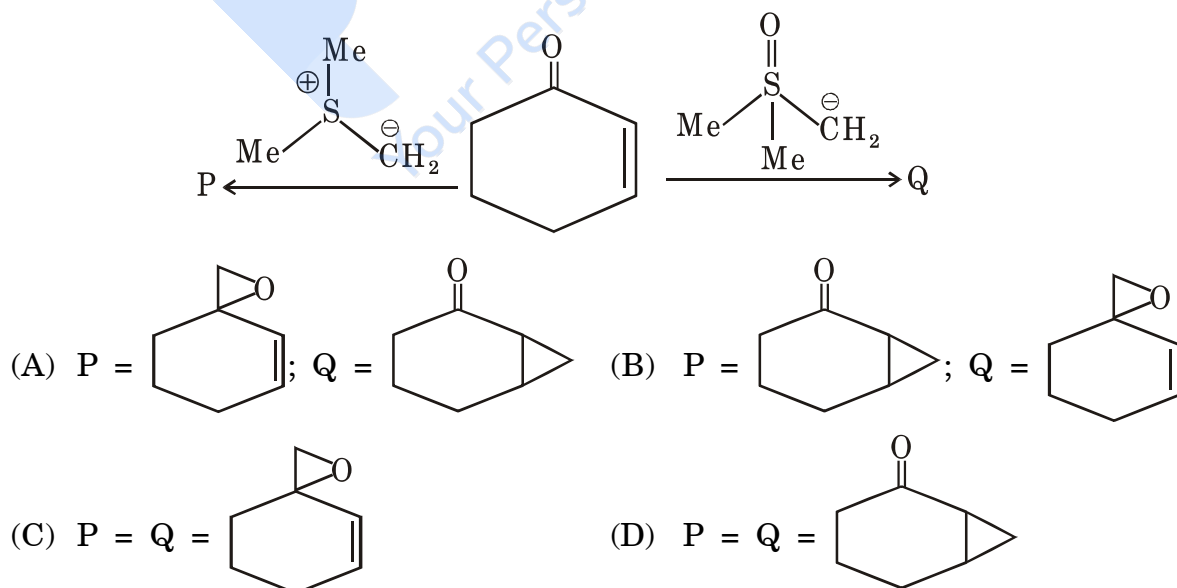


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44. Major product formed in the following reaction is :

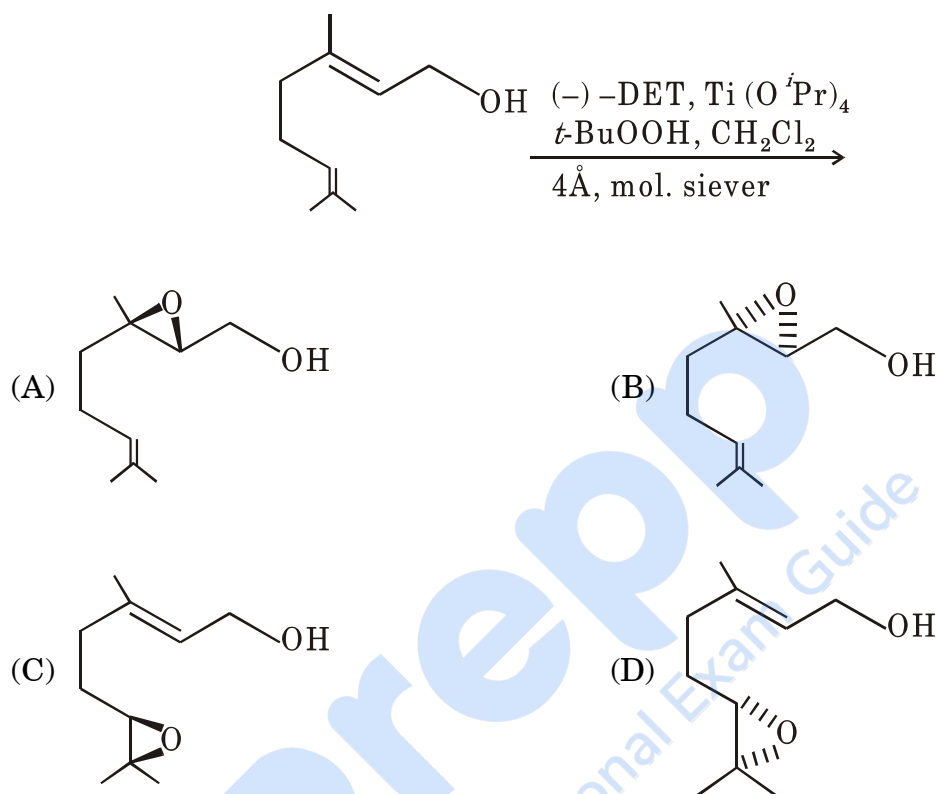


45. Major product formed in the following reaction is :

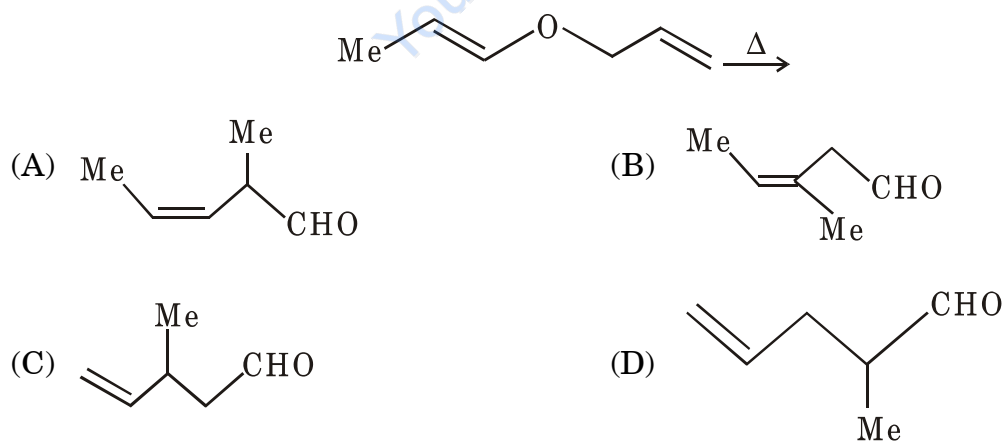


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46. The major product formed in the following reaction is :

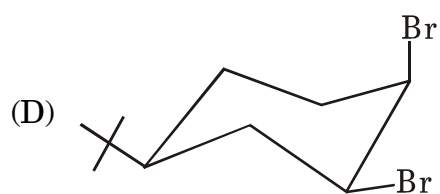
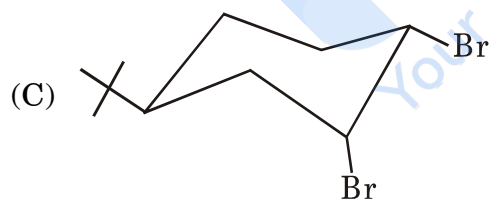
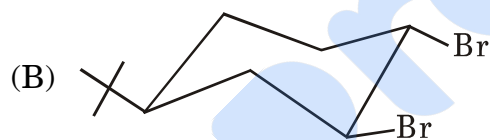
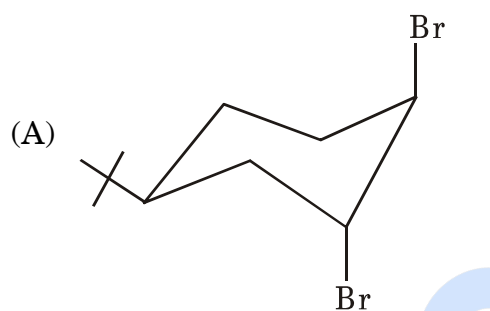
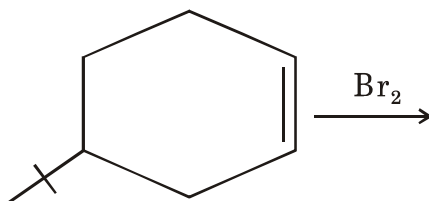


47. Major product formed in the following reaction is :



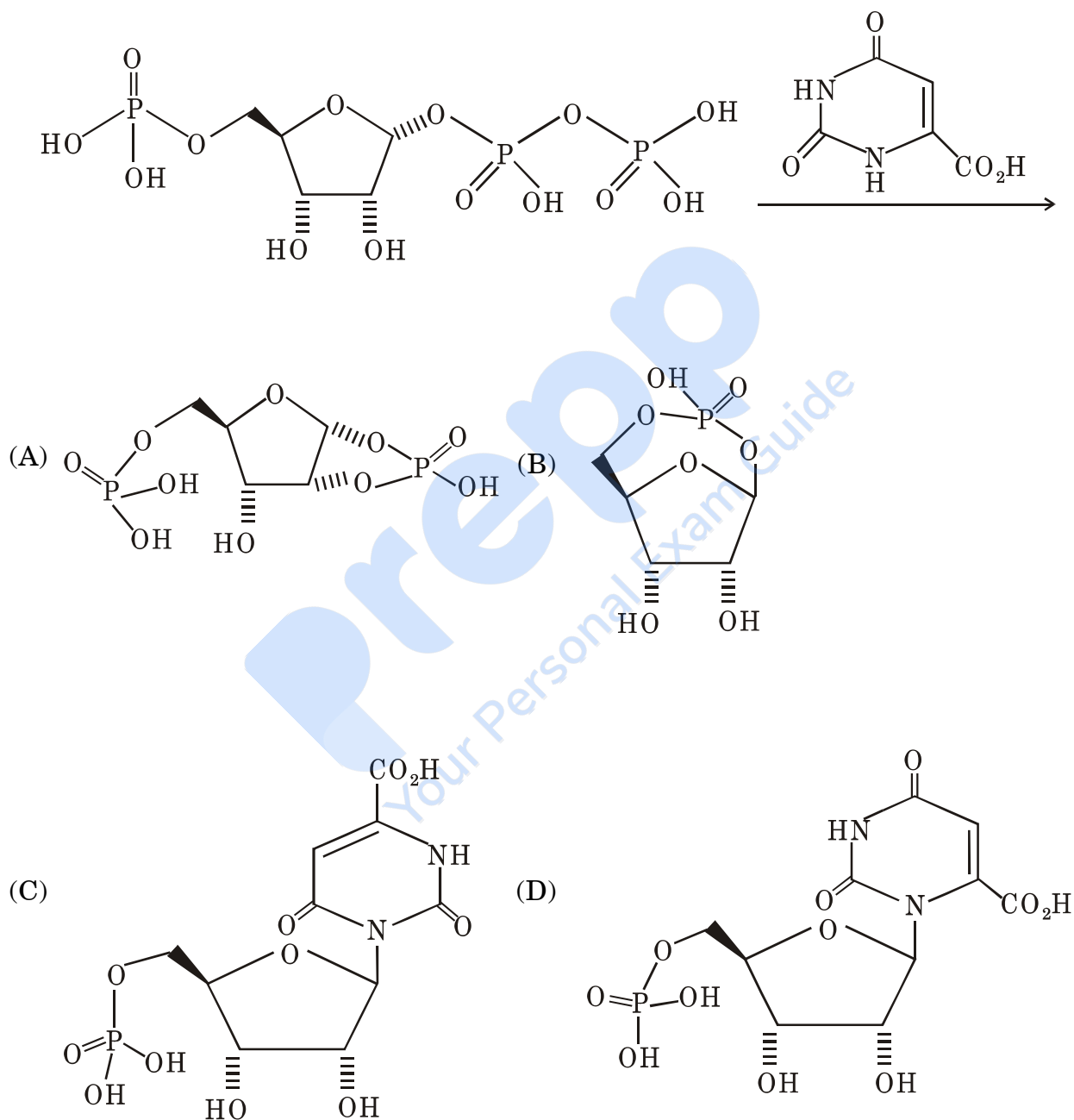
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48. Major product formed in the following reaction is :



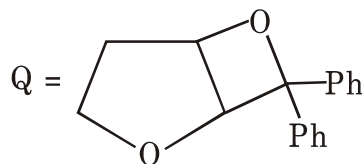
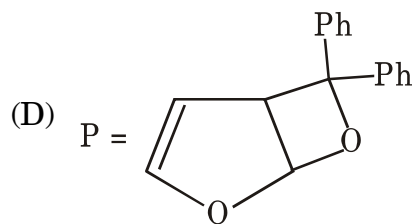
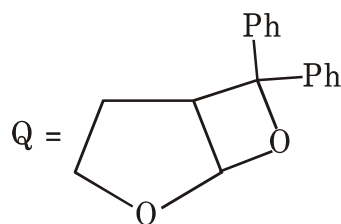
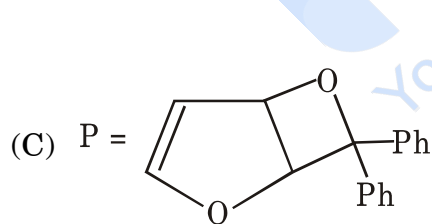
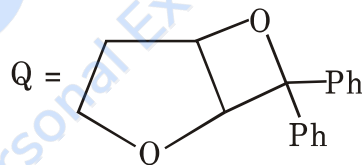
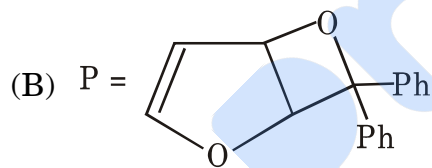
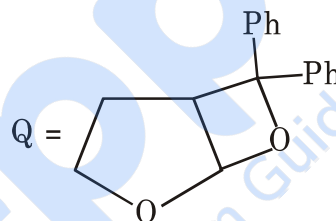
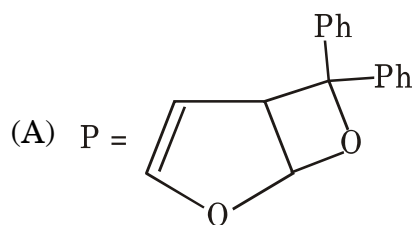
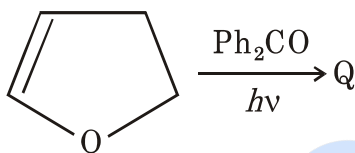
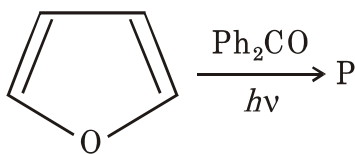
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49. Major product formed in the following reaction is :



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50. The major product P and Q formed in the following reactions are :



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51. One of the most widely used functions for the van der Waals potential is the Lennard-Jones expressed as :

$$(A) \quad E_{LJ} = \sum_{\text{nonbonded pairs}} \left(\frac{A_{ik}}{r_{ik}^6} - \frac{C_{ik}}{r_{ik}^{12}} \right)$$

$$(B) \quad E_{LJ} = \sum_{\text{nonbonded pairs}} \left(\frac{A_{ik}}{r_{ik}^{12}} - \frac{C_{ik}}{r_{ik}^6} \right)$$

$$(C) \quad E_{LJ} = \sum_{\text{nonbonded pairs}} \left(\frac{A_{ik}}{r_{ik}^{12}} + \frac{C_{ik}}{r_{ik}^6} \right)$$

$$(D) \quad E_{LJ} = \sum_{\text{nonbonded pairs}} \left(\frac{A_{ik}}{r_{ik}^6} + \frac{C_{ik}}{r_{ik}^{12}} \right)$$

52. Coefficient of thermal expansion (α) is given by :

$$(A) \quad \frac{1}{V} \left(\frac{\partial V}{\partial T} \right)_P$$

$$(B) \quad - \frac{1}{V} \left(\frac{\partial V}{\partial T} \right)_P$$

$$(C) \quad \frac{1}{V^2} \left(\frac{\partial V}{\partial T} \right)_P$$

$$(D) \quad - \frac{1}{V^2} \left(\frac{\partial V}{\partial T} \right)_P$$

53. The distribution function for identical indistinguishable particles can be

represented by the equation $N_j = \frac{g_j}{e^{(\epsilon_j - \mu)/kT} + a}$, which of the following statements

is *correct* ?

(A) $a = +1$ for Bose-Einstein statistics

(B) $a = -1$ for Fermi-Dirac statistics

(C) $a = +1$ for Fermi-Dirac statistics

(D) $a = 1/2$ for Bose-Einstein statistics

54. For an isolated system :

$$(A) \quad dS = d_e S$$

$$(B) \quad dS = d_f S$$

$$(C) \quad d_e S > 0$$

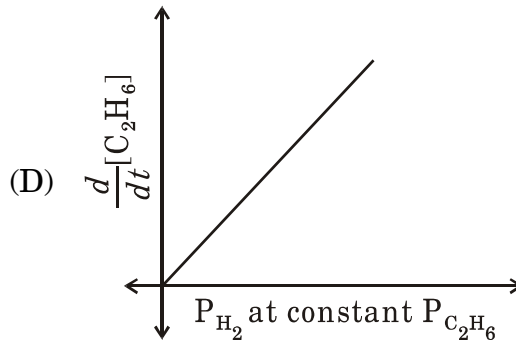
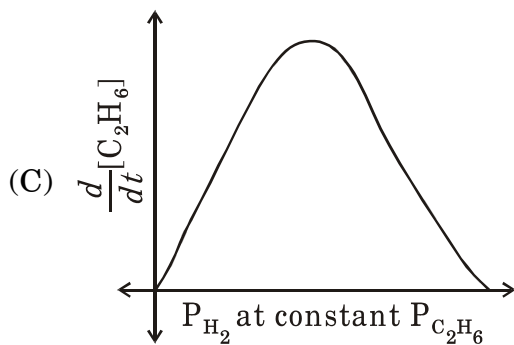
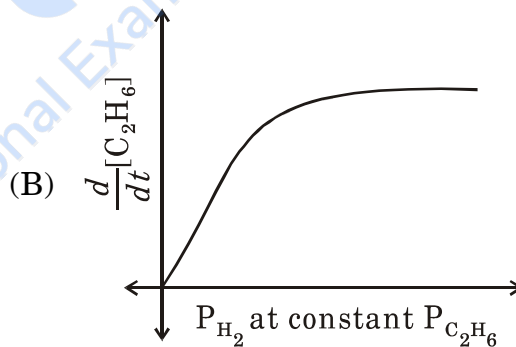
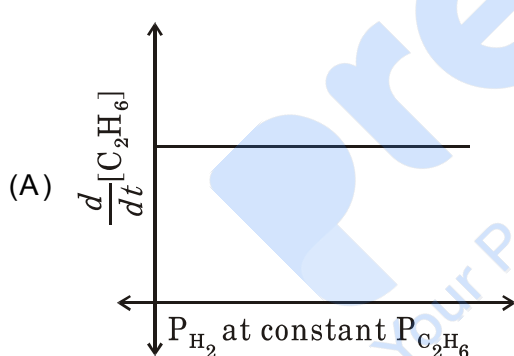
$$(D) \quad d_e S < 0$$

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55. If there is no net flow of electrical current, then generation of potential difference per unit change of pressure and generation of potential difference per unit change of temperature is termed as respectively.
- (A) Thermoelectric power and osmotic pressure
(B) Osmotic pressure and thermoelectric power
(C) Streaming potential and thermoelectric power
(D) Thermoelectric power and streaming potential
56. For any polydispersed system, which of the following statements is *true* ?
- (A) Number average relative molar mass is greater than mass average relative molar mass
(B) Number average relative molar mass is less than mass average relative molar mass
(C) Number average relative molar mass coincide with mass average relative molar mass
(D) None of the above
57. A particle in a one-dimensional box of length L can be excited from $n = 1$ to $n = 2$ state with frequency ν . If the box length is doubled, the frequency needed to achieve this transition is :
- (A) $\nu/4$ (B) $\nu/2$
(C) 2ν (D) 4ν
58. If operator $\hat{D}^n$ (n times differentiate with respect to x) operates on eigenfunction e^{ax} , the eigenvalue would be :
- (A) $n\alpha$ (B) n^α
(C) α^n (D) $n! \alpha$
59. The eigenfunctions of a rigid rotator are :
- (A) Spherical harmonics (B) Laguerre polynomials
(C) Hermite polynomials (D) Legendre transformers

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60. According to Hund's rule, most stable state for np^2 configuration is
- (A) 1S_0 (B) 3P_0
(C) 3P_1 (D) 3P_2
61. According to simple HMO theory, which one of the following statements about butadiene is *true* ?
- (A) It has a non-bonding MO
(B) Exciting an electron from the HOMO to the LUMO will not change the π bond orders
(C) Exciting an electron from the HOMO to the LUMO will not change the π charge densities
(D) It is most likely to undergo electrophilic substitution at one of the two inner carbons
62. In the hydrogenation of C_2H_4 on a Ni surface both the alkene and H_2 are adsorbed on similar active sites of the catalyst surface. Which of the following figures depict the reaction ?

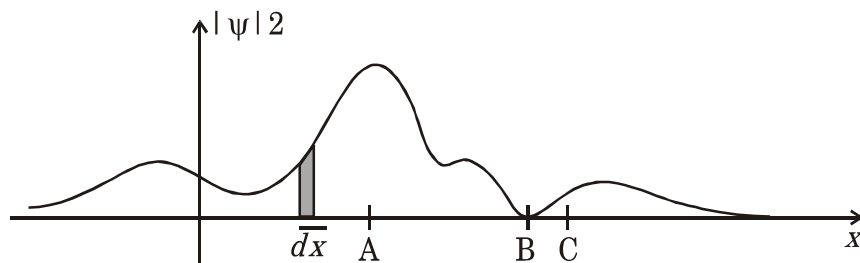


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63. In case of heterogeneous catalysis which of the following is *correct* ?
- (A) At least one reactant must be physisorbed on the catalyst
 - (B) At least one reactant must be chemisorbed on the catalyst
 - (C) The number of active sites decrease with increase in surface area
 - (D) Surface area can be determined by spectroscopic studies
64. A surface of Li metal (sample X) was suspected to be completely coated with a thin layer of Li_2O (sample Y). When X and Y are analysed by X-ray photoelectron spectroscopy :
- (A) Kinetic energy of the photoelectrons from X will be higher than that from Y
 - (B) Kinetic energy of the photoelectrons from Y will be higher than that from Y
 - (C) Binding energy of the photoelectrons from Y will be lower than that from X
 - (D) Kinetic energy of the photoelectrons from both X and Y will be the same
65. A reactor vessel at 1000 K contains CO_2 at a pressure of 0.5 atm. Part of the CO_2 is converted into CO by the addition of graphite. If the total pressure in the reactor vessel at equilibrium is 0.8 atm, the value of K_P for the reaction of CO_2 with graphite is :
- (A) 1.8
 - (B) 3.24
 - (C) 0.324
 - (D) 09
66. For the equilibrium $\text{Fe(s)} + \text{H}_2\text{O(g)} \rightleftharpoons \text{FeO(s)} + \text{H}_2\text{(g)}$, the number of components, phases and degrees of freedom are respectively :
- (A) 3, 3, 2
 - (B) 3, 4, 2
 - (C) 3, 3, 3
 - (D) 3, 2, 1

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67. Given below is the wave function of a particle :



Which of the following is *correct* ?

- (A) The particle is more likely to be found near B
 - (B) The particle is more likely to be found near A
 - (C) The shaded area represents the energy of the particle when it travels through a distance dx
 - (D) The shaded area represents the amplitude of the particle in an area dx
68. The de Broglie wavelength of an electron travelling with 1% speed of light is about :
- (mass of electron and speed of light are 9.109×10^{-31} kg and 2.998×10^8 ms⁻¹ respectively) :
- (A) 243 m
 - (B) 243 cm
 - (C) 243 Å
 - (D) 243 pm
69. Surface tension of Br₂(l) water and mercury are 41.0 mNm⁻¹, 72.0 mN/m and 486.2 mNm⁻¹ respectively at 25°C. These values imply that :
- (i) Metallic bonding is weaker than covalent bonding
 - (ii) Hydrogen bonding is stronger than van der Waals bonding
 - (iii) Metallic bonding is stronger than hydrogen bonding
 - (iv) All types of intermolecular forces are of similar strength
- (A) (iii) and (iv)
 - (B) (ii) and (iii)
 - (C) (i), (ii) and (iii)
 - (D) (iv), (ii) only

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70. In case of radical polymerization, the kinetic chain length is given by expression :

$$v = \frac{k_p[M][I]^{-1/2}}{2k_t f^{1/2} \left(\frac{k_d}{k_t} \right)^{1/2}}$$

increase in the initiator concentration eventually leads to :

- (A) Higher molecular weight polymer
 (B) Low molecular weight polymer
 (C) Rate of reaction and thus the extent polymerization does not depend on the concentration of initiator
 (D) Fast polymerization reaction
71. Consider the following reaction in an aqueous solution :



and the following initial concentration and initial rate data for this reaction :

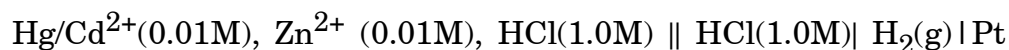
$[\text{I}^-], \text{M}$	$[\text{OCl}^-], \text{M}$	Initial Rate, Ms^{-1}
0.1	0.05	3.05×10^{-4}
0.2	0.05	6.10×10^{-4}
0.3	0.01	1.83×10^{-4}
0.4	0.02	6.12×10^{-4}

Which of the following is the *correct* rate law for this reaction ?

- (A) Rate = $k[\text{I}^-]^2[\text{OCl}^-]$ (B) Rate = $k[\text{OCl}^-]$
 (C) Rate = $k[\text{I}^-]^2$ (D) Rate = $k[\text{I}^-][\text{OCl}^-]$

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72. Consider the following electrochemical cell, connected to the potential source (Potentiostat) with Hg as a working electrode :



when the potential is change towards (i) more negative direction and (ii) change towards the more positive direction from the equilibrium potential value, the following observations are expected :

Given :

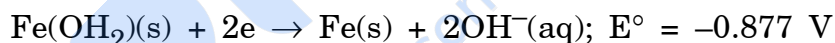
$$E^\circ(\text{Cd}^{2+}/\text{Cd}^\circ) = - 0.351 \text{ V},$$

$$E^\circ(\text{Zn}^{2+}/\text{Zn}^\circ) = - 0.762 \text{ V}, E^\circ(\text{Hg}^{2+}/\text{Hg}^\circ) = + 0.855 \text{ V}$$

- (A) (i) H_2 evolution will start.
(ii) O_2 evolution will start.
- (B) (i) Cd will deposit first followed by Zn.
(ii) Hg will start oxidizing.
- (C) (i) Zn will deposit.
(ii) O_2 evolution will be observed.
- (D) (i) Cd will deposit.
(ii) Hg will start oxidizing.

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73. The ideal solution made up of 5.00 mol (mole fraction = 0.606) benzene and 3.25 mol (mole fraction = 0.394) toluene, the free energy of mixing (ΔG_{mix}) is equal to -13 kJ mol^{-1} . The corresponding values for the their equimolar solution will be ;
- (A) Unity
(B) (ΔG_{mix}) does not depend on mole fraction, thus equal to -13 kJ mol^{-1}
(C) Less negative than that of -13 kJ mol^{-1}
(D) More negative than that of -13 kJ mol^{-1}
74. The ideal solution made up of 5.00 mol (mole fraction = 0.606) benzene and 3.25 mol (mole fraction = 0.394) toluene, the change in enthalpy during mixing (ΔH_{mix}) would be :
- (A) zero (B) 1.0 kJ mol^{-1}
(C) positive (D) negative
75. An electrochemical cell is constructed using half cell for the reduction reaction is given by :



It is combined with another half cell for which the cell reaction is given by :



Activities of all the components are assumed to be unity.

The overall reaction for the cell in the direction of spontaneous change is :

- (A) $\text{Fe}(\text{OH})_2(\text{s}) + \text{Al}(\text{s}) \rightarrow \text{Fe}(\text{s}) + \text{OH}^-(\text{aq.}) + \text{Al}^{3+}(\text{aq.})$
(B) $2\text{Fe}(\text{OH})_2(\text{s}) + 3\text{Al}(\text{s}) \rightarrow 2\text{Fe}(\text{s}) + 6\text{OH}^-(\text{aq.}) + 3\text{Al}^{3+}(\text{aq.})$
(C) $3\text{Fe}(\text{OH})_2(\text{s}) + 2\text{Al}(\text{s}) \rightarrow 3\text{Fe}(\text{s}) + 6\text{OH}^-(\text{aq.}) + 2\text{Al}^{3+}(\text{aq.})$
(D) $\text{Fe}(\text{s}) + \text{OH}^-(\text{aq.}) + \text{Al}^{3+}(\text{aq.}) \rightarrow \text{Fe}(\text{OH})_2(\text{s}) + \text{Al}(\text{s})$

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ROUGH WORK

