

Test Booklet Code & Serial No.

प्रश्नपत्रिका कोड व क्रमांक

Paper-II

CHEMICAL SCIENCE

A

Signature and Name of Invigilator

Seat No.

1. (Signature)

(In figures as in Admit Card)

(Name)

Seat No.

(In words)

2. (Signature)

(Name)

OMR Sheet No.

JUN - 33220

(To be filled by the Candidate)

Time Allowed : 2 Hours]

[Maximum Marks : 200

Number of Pages in this Booklet : 36

Number of Questions in this Booklet : 100

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 100 objective type questions. Each question will carry *two* marks. All questions of Paper II will be compulsory.
- 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)
- 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.

विद्यार्थ्यासाठी महत्वाच्या सूचना

- परिक्षार्थीनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
- सदर प्रश्नपत्रिकेत 100 बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास दोन गुण आहेत. या प्रश्नपत्रिकेतील सर्व प्रश्न सोडविणे अनिवार्य आहे.
- परीक्षा सुरू झाल्यावर विद्यार्थ्याला 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 पाहिल्यानंतरच 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 काळा/निळा करावा.
उदा. : जर (C) हे योग्य उत्तर असेल तर.

(A)

(B)

(C)

(D)
- या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे ओ.एम.आर. उत्तरपत्रिकेत दर्शवावीत. इतर ठिकाणी लिहिलेली उत्तरे तपासली जाणार नाहीत.
- आत दिलेल्या सूचना काळजीपूर्वक वाचाव्यात.
- प्रश्नपत्रिकेच्या शेवटी जोडलेल्या कोन्या 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 गैरमार्गांचा अवलंब केल्यास विद्यार्थ्याला परीक्षेस अपात्र ठरविण्यात येईल.
- परीक्षा संपल्यानंतर विद्यार्थ्याने मूळ ओ.एम.आर. उत्तरपत्रिका पर्यवेक्षकांकडे परत करणे आवश्यक आहे. तथापि, 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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Your Personal Exam Guide

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Chemical Science

Paper II

Time Allowed : 120 Minutes]**[Maximum Marks : 200**

Note : This Paper contains **Hundred (100)** multiple choice questions. Each question carrying **Two (2)** marks. Attempt *All* questions.

- The bond length of the tetrachlorides for the following Group IV elements follows the order :
(A) $\text{SiCl}_4 > \text{CCl}_4 > \text{GeCl}_4$ (B) $\text{SiCl}_4 > \text{GeCl}_4 > \text{CCl}_4$
(C) $\text{GeCl}_4 > \text{SiCl}_4 > \text{CCl}_4$ (D) $\text{GeCl}_4 > \text{CCl}_4 > \text{SiCl}_4$
- In the reactions
(i) $n\text{H}_2\text{O} + \text{Cl}^- \rightarrow [\text{Cl}(\text{H}_2\text{O})_n]^-$
(ii) $6\text{H}_2\text{O} + \text{Mg}^{2+} \rightarrow [\text{Mg}(\text{H}_2\text{O})_6]^{2+}$
water acts as :
(A) an acid in both (i) and (ii) (B) an acid in (i) and base in (ii)
(C) base in (i) and acid in (ii) (D) base in both (i) and (ii)
- Carbon monoxide (CO) is isoelectronic with :
(A) N_2 (B) O_2
(C) NO (D) CN^-
- Which of the following statements regarding solubility of LiF and LiI in water at room temperature is correct ?
(A) Both are equally soluble (B) Both are insoluble
(C) LiF is more soluble than LiI (D) LiI is more soluble than LiF
- The hydrogen bond strength in
(i) $\text{O}-\text{H}\cdots\text{O}$
(ii) $\text{O}-\text{H}\cdots\text{Cl}$
(iii) $\text{O}-\text{H}\cdots\text{N}$
will follow the order :
(A) (i) > (iii) > (ii) (B) (ii) > (i) > (iii)
(C) (i) = (ii) > (iii) (D) (i) > (ii) > (iii)

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6. The type of hybridization in the diamagnetic $[\text{Ni}(\text{CN})_4]^{2-}$ and paramagnetic $[\text{NiCl}_4]^{2-}$ is :
- (A) sp^3d^2 and sp^3 (B) dsp^2 and sp^3
 (C) sp^3d and dsp^2 (D) dsp^2 and sp^2
7. The IUPAC nomenclature for the complex $[\text{PtBr}(\text{CH}_3\text{NH}_2)\text{Cl NH}_3]$ is :
- (A) methylamine ammine bromido chlorido platinum (II)
 (B) bromido methylamine chlorido ammine platinum (II)
 (C) chlorido ammine methylamine bromido platinum (II)
 (D) ammine bromido chlorido methylamine platinum (II)
8. The number of EPR lines observed in $[\text{Cu}(\text{pyridine})_2\text{Cl}_2]$ will be (Given : nuclear spin $^{63}\text{Cu} = 3/2$) :
- (A) 20 (B) 4
 (C) 5 (D) 9
9. A polycrystalline powder X-band EPR spectrum of a six coordinate Cu^{2+} complex exhibits $g_{11} = 2.35$ and $g_1 = 2.06$. The nature of this spectrum will be :
- (A) rhombic (B) isotropic
 (C) axial (D) diamagnetic
10. The stretching frequency for CO, CN^- and NO in IR spectrum will be of the order :
- (A) $\text{CN}^- > \text{CO} > \text{NO}$ (B) $\text{CO} > \text{CN}^- > \text{NO}$
 (C) $\text{NO} > \text{CO} > \text{CN}^-$ (D) $\text{CO} > \text{NO} > \text{CN}^-$
11. The only electronic transition that occurs in Cu^{2+} tetrahedral complexes is :
- (A) ${}^2\text{E}_g \leftarrow {}^2\text{T}_{2g}$ (B) ${}^2\text{E} \leftarrow {}^2\text{T}_2$
 (C) ${}^2\text{T}_{2g} \leftarrow {}^2\text{E}_g$ (D) ${}^2\text{T}_2 \leftarrow {}^2\text{E}$
12. The correct order of magnetic moment of Lanthanide ions La^{3+} , Gd^{3+} and Ce^{3+} is :
- (A) $\text{La}^{3+} > \text{Gd}^{3+} > \text{Ce}^{3+}$ (B) $\text{Gd}^{3+} > \text{Ce}^{3+} > \text{La}^{3+}$
 (C) $\text{Ce}^{3+} > \text{Gd}^{3+} > \text{La}^{3+}$ (D) $\text{La}^{3+} > \text{Ce}^{3+} > \text{Gd}^{3+}$

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13. The first absorption level of $[\text{VF}_6]^{3-}$ complex is observed at $14,800 \text{ cm}^{-1}$. The 10 Dq value for the complex is :
(A) $14,800 \text{ cm}^{-1}$ (B) $18,500 \text{ cm}^{-1}$
(C) $12,916 \text{ cm}^{-1}$ (D) $8,700 \text{ cm}^{-1}$
14. The geometry of $\text{N}(\text{SiH}_3)_3$ will be :
(A) tetrahedral (B) trigonal pyramidal
(C) trigonal planar (D) linear
15. The driving force for complexation of Mg^{2+} by EDTA in aqueous medium is :
(A) change in oxidation state of magnesium
(B) increase in entropy
(C) change in coordination geometry
(D) decrease in entropy
16. Which of the following can be classified as labile complexes ?
(i) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
(ii) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
(iii) $[\text{V}(\text{H}_2\text{O})_6]^{3+}$
(A) (i) and (ii) (B) (ii) and (iii)
(C) (iii) and (i) (D) Only (iii)
17. Which of the following represents the *correct* order of Lewis acidity ?
(A) $\text{AlCl}_3 > \text{BF}_3 > \text{BCl}_3$ (B) $\text{AlCl}_3 > \text{BCl}_3 > \text{BF}_3$
(C) $\text{BCl}_3 > \text{BF}_3 > \text{AlCl}_3$ (D) $\text{BF}_3 > \text{BCl}_3 > \text{AlCl}_3$
18. Which of the following statements about the reaction
$$\text{SbF}_5 + 2\text{HF} \rightarrow [\text{SbF}_6]^- + \text{H}_2\text{F}^+$$

is *correct* :
(A) H_2F^+ is a superacid
(B) SbF_5 is a Lewis base
(C) HF is a stronger acid than H_2F^+
(D) $[\text{SbF}_6]^-$ is a Lewis acid
19. The element which causes chemical interference in Atomic Absorption spectroscopy is :
(A) Al (B) Sr
(C) La (D) Mn
20. An analytical technique in which the temperature difference between the sample and a non-reactive reference material is monitored is :
(A) TGA (B) DTG
(C) DSC (D) DTA

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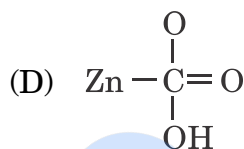
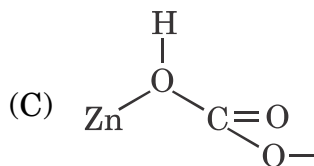
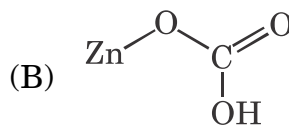
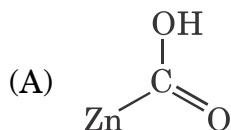
21. In ion-exchange chromatography the capacity of exchange of hydrated ions of Al^{3+} , Ca^{2+} and Na^{+} on the surface of cationic exchanger will follow the order :
- (A) $\text{Na}^{+} > \text{Ca}^{2+} > \text{Al}^{3+}$ (B) $\text{Al}^{3+} > \text{Ca}^{2+} > \text{Na}^{+}$
(C) $\text{Na}^{+} < \text{Ca}^{2+} > \text{Al}^{3+}$ (D) $\text{Al}^{3+} < \text{Ca}^{2+} > \text{Na}^{+}$
22. The percentage of bromide ion in a compound was found by three students as 10.20, 10.30 and 10.40. The mean deviation of the result is :
- (A) 0.66 (B) 6.60
(C) 0.0066 (D) 0.066
23. The reaction of NiBr_2 and Ph_2FtP results in two products with composition $[\text{Ni}(\text{P}(\text{Ph})_2\text{Et})_2 \text{Br}_2]$. The first product is green in colour with magnetic moment 3.20 B.M. The second product is red in colour and is diamagnetic. The geometry of the green and red product respectively is :
- (A) square planar and tetrahedral
(B) trigonal pyramidal and octahedral
(C) octahedral and trigonal bipyramidal
(D) tetrahedral and square planar
24. The total orbital angular momentum quantum number L and spin quantum S of the term symbol $4G$ is :
- (A) 2, $1/2$ (B) 3, $3/2$
(C) 4, $3/2$ (D) 5, $1/2$
25. The strength of hardness of the isoelectronic ions F^{-} , OH^{-} , NH_2^{-} and CH_3^{-} follows the order :
- (A) $\text{CH}_3^{-} > \text{OH}^{-} > \text{NH}_2^{-} > \text{F}^{-}$ (B) $\text{CH}_3^{-} > \text{F}^{-} > \text{OH}^{-} > \text{NH}_2^{-}$
(C) $\text{F}^{-} > \text{OH}^{-} > \text{NH}_2^{-} > \text{CH}_3^{-}$ (D) $\text{CH}_3^{-} > \text{NH}_2^{-} > \text{OH}^{-} > \text{F}^{-}$

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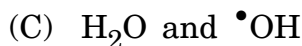
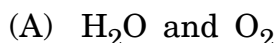
26. Which of the following Ln^{3+} aqua ions are colourless and coloured respectively ?
(A) Pr^{3+} and Gd^{3+} (B) Gd^{3+} and Pr^{3+}
(C) Gd^{3+} and Yb^{3+} (D) Yb^{3+} and Gd^{3+}
27. The total number of M-M bonds in the stable complex $[\mu\text{—CO—}\mu\text{—CH}_2\text{—}(\eta^5\text{ Cp Rh})_2]$ is :
(Cp = cyclopentadienyl anion)
(A) 0 (B) 1
(C) 2 (D) 3
28. The complex $[\text{M}(\eta^3\text{—C}_5\text{H}_5)(\text{CO})_2]$ is stable when M is :
(A) CO (B) Fe
(C) Ni (D) V
29. Which statement of a Fischer-type carbene is *incorrect* ?
(A) it contains a $\text{M} = \text{C}$ bond
(B) it contains a nucleophilic carbene centre
(C) it contains a metal in low oxidation state
(D) it contains a heteroatom attached to a metal bound carbon atom
30. The quadrupole splitting (ΔE_Q) value in Mössbauer spectroscopy gives information about which of the following :
(i) molecular symmetry
(ii) oxidation state
(iii) spin state
(iv) 's' electron density
(A) (i), (ii), (iii) (B) (i) only
(C) (ii) and (iii) only (D) (iv) only
31. The $^{11}\text{B}\{\text{Me}\}$ NMR spectrum of $\text{Me}_4(\mu\text{—H})_2\text{B}_2$ (nuclear spin $^{11}\text{B} = 3/2$) will exhibit :
(A) a quartet (B) a doublet
(C) a triplet (D) a quintet

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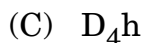
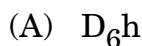
32. Which of the following is the structure of the intermediate during the reduction of CO_2 to carbonic acid by the enzyme zinc carbonic anhydrase ?



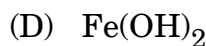
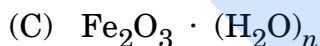
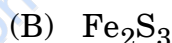
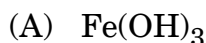
33. Zn-Cu superoxide dismutase is an enzyme that disproportionate :



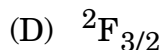
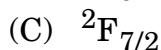
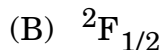
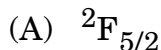
34. Trans-tetraamminedichloridocobalt (III) cation belongs to point group.



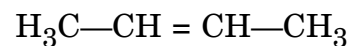
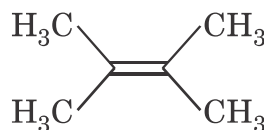
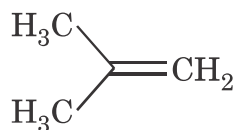
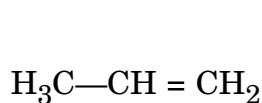
35. Iron is stored in the protein ferritin in the form :



36. The ground state term symbol of Yb^{3+} is (At. No. Yb = 70) :



37. The correct order of stability of the following alkenes is :



I

II

III

IV

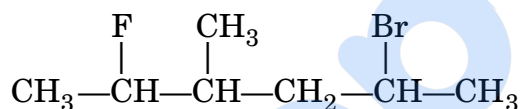


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38. The correct order of basicity of the following compounds is :

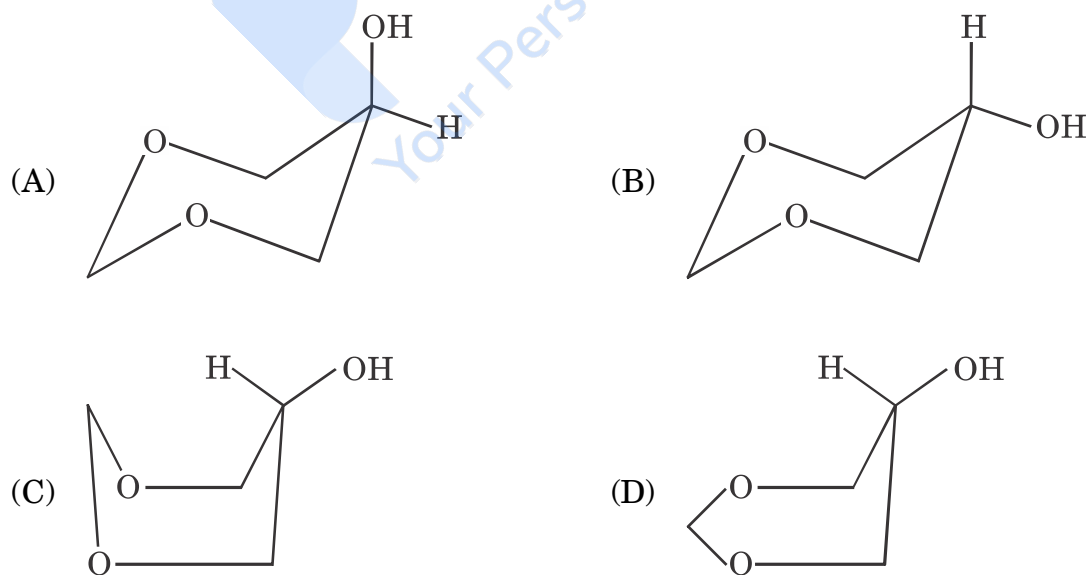
- | | | | |
|---------------|---------------------------|------------------------------|--|
| NH_3 | $\text{CH}_3\text{—NH}_2$ | $\text{H}_3\text{C—NH—CH}_3$ | $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C—N—CH}_3 \end{array}$ |
| I | II | III | IV |
- (A) III < II < IV < I (B) IV < III < II < I
(C) I < IV < II < III (D) II < IV < III < I

39. The correct IUPAC name of the following compound is :



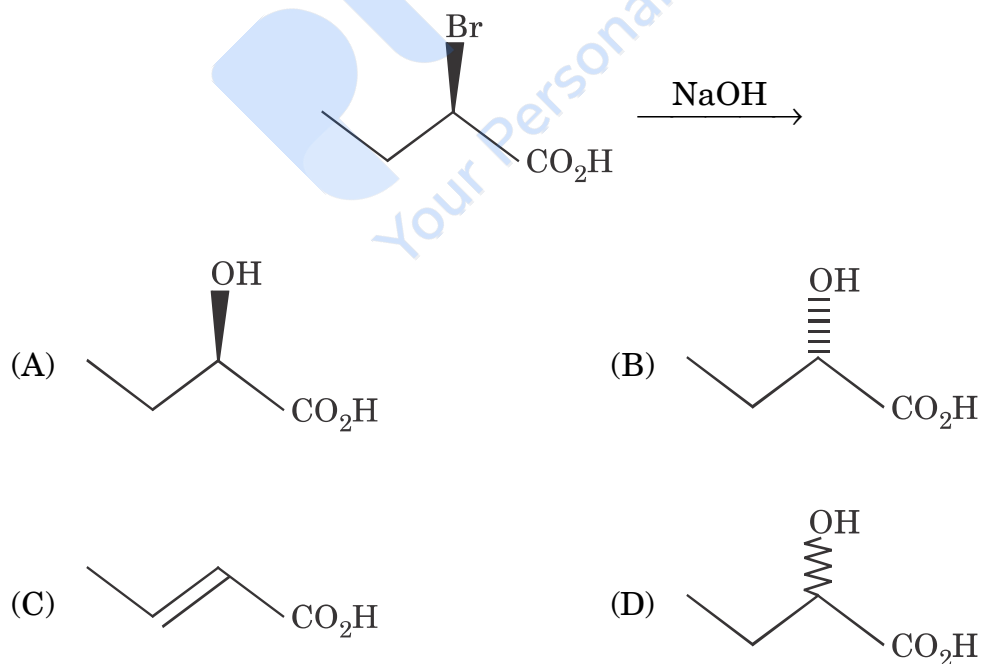
- (A) 2-fluoro-5-bromo-3-methylhexane
(B) 5-bromo-2-fluoro-3-methylhexane
(C) 2-bromo-5-fluoro-4-methylhexane
(D) 5-fluoro-2-bromo-5-methylhexane

40. Most stable conformation of 5-hydroxy-1, 3-dioxane is :



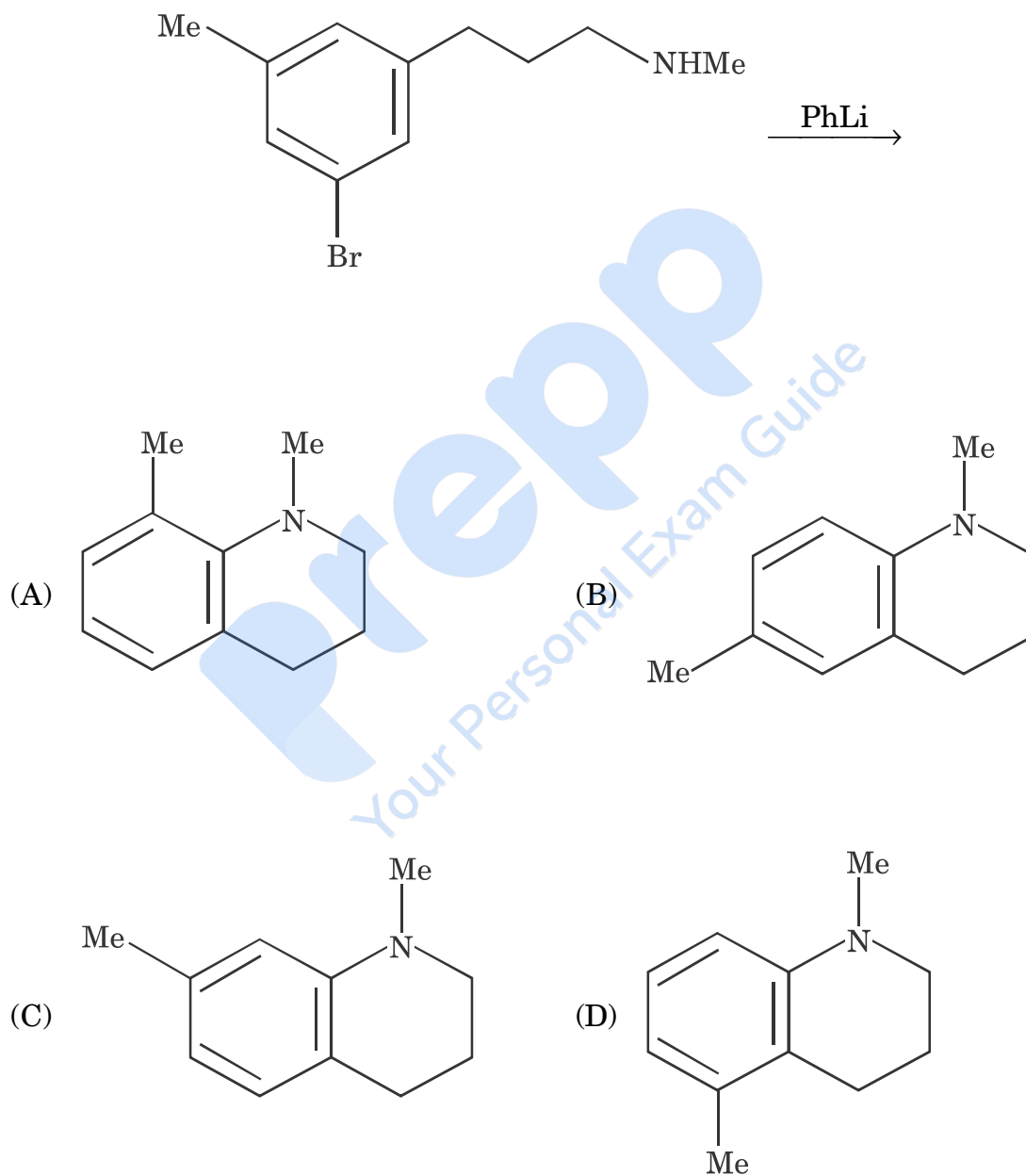
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41. In the Fischer projection, the absolute configuration of a chiral centre will not change from R to S when,
- (A) the priority numbers 1 and 2 are interchanged
- (B) the priority numbers 2 and 3 are interchanged
- (C) the priority numbers 1 and 2 are interchanged and then 3 and 4 are interchanged
- (D) the priority numbers 3 and 4 are interchanged
42. The major product in the following reaction is :



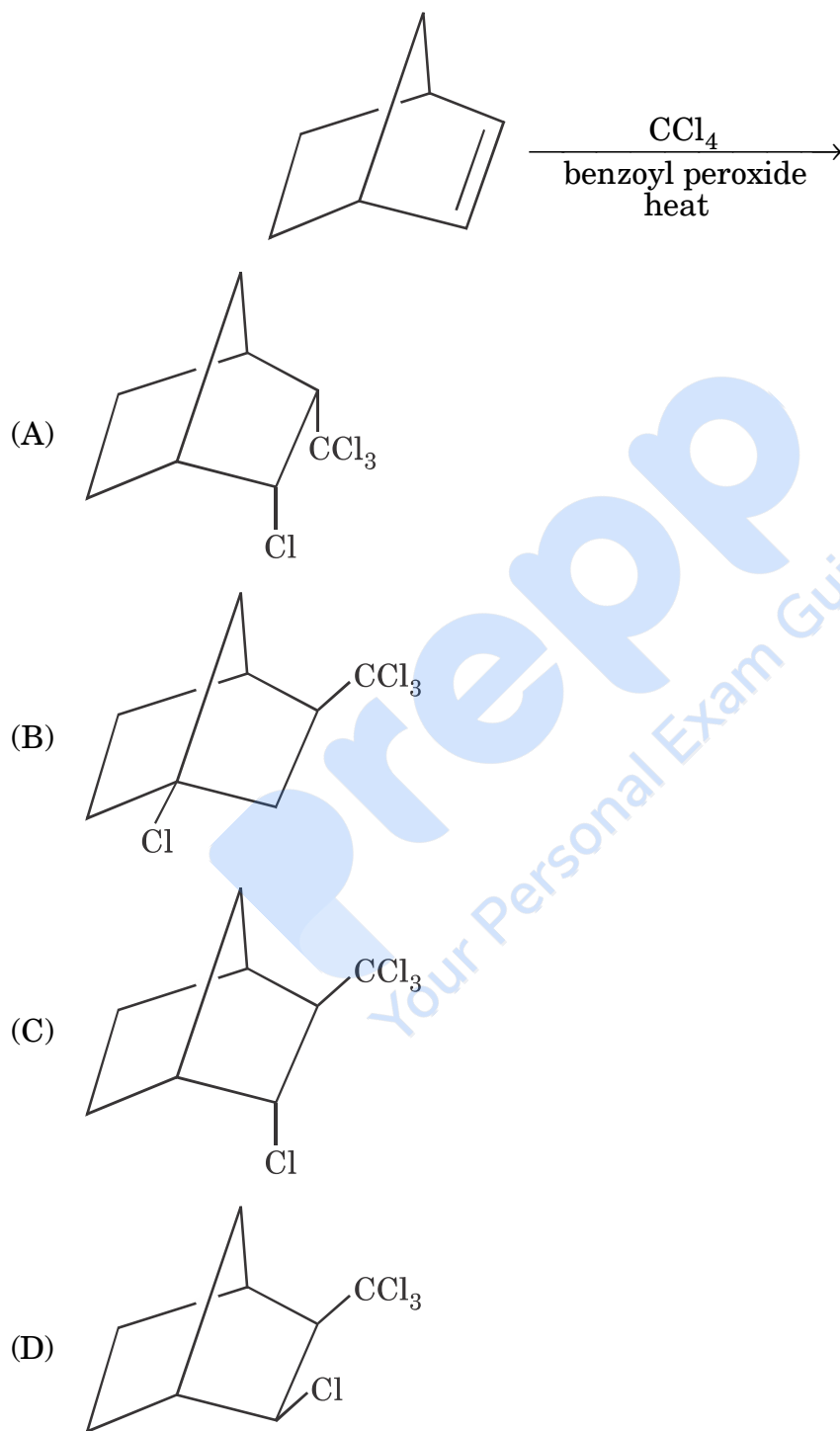
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43. The major product of the following reaction is :



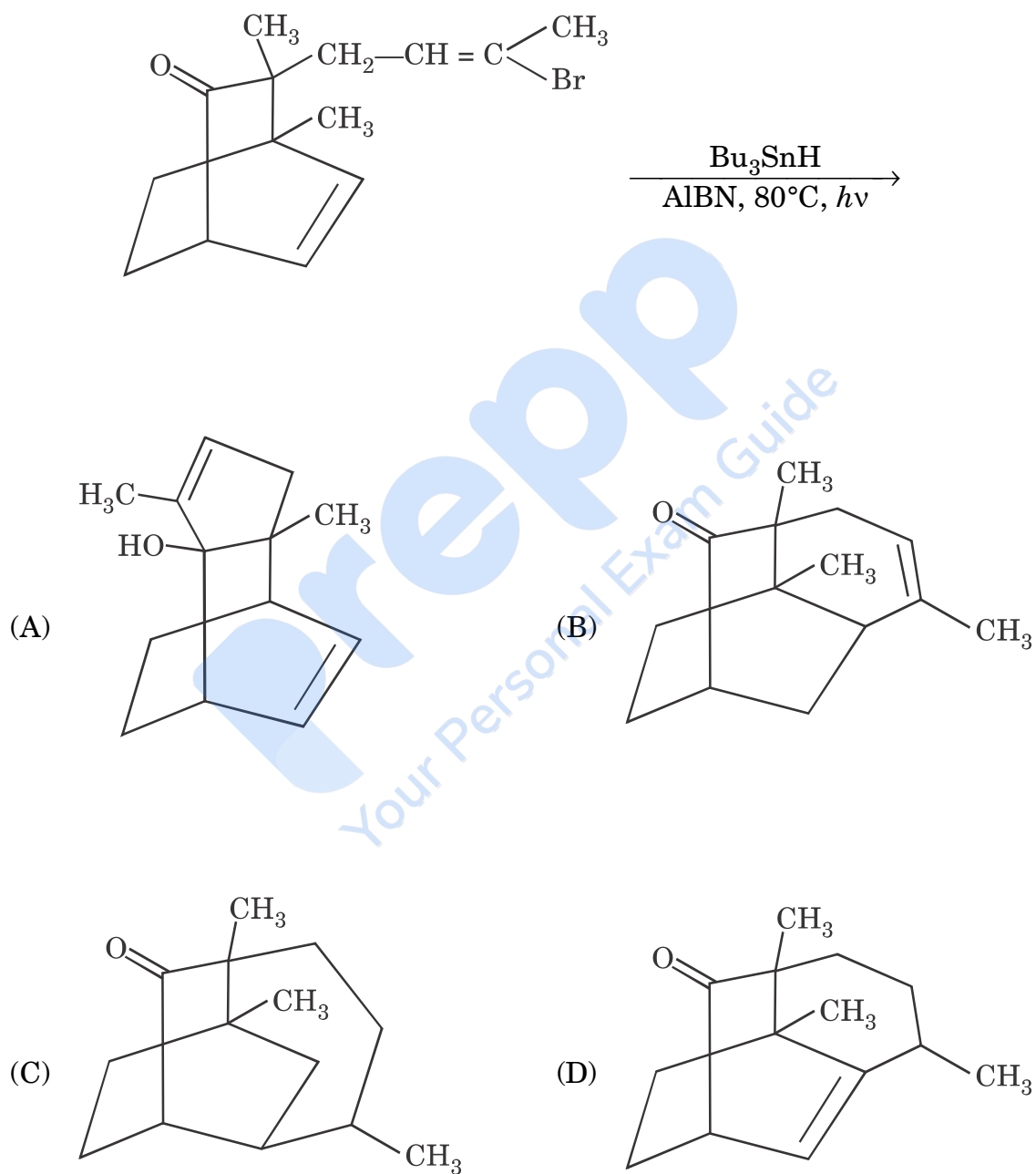
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44. The major product in the following reaction is :



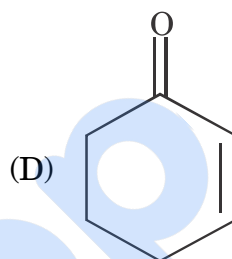
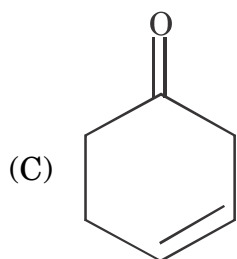
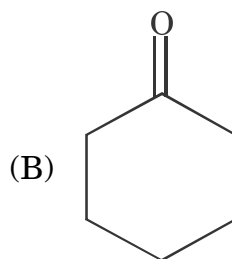
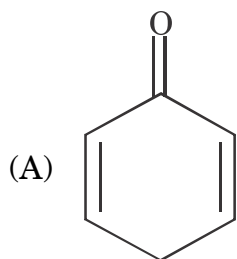
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45. The major product formed in the following reaction is :

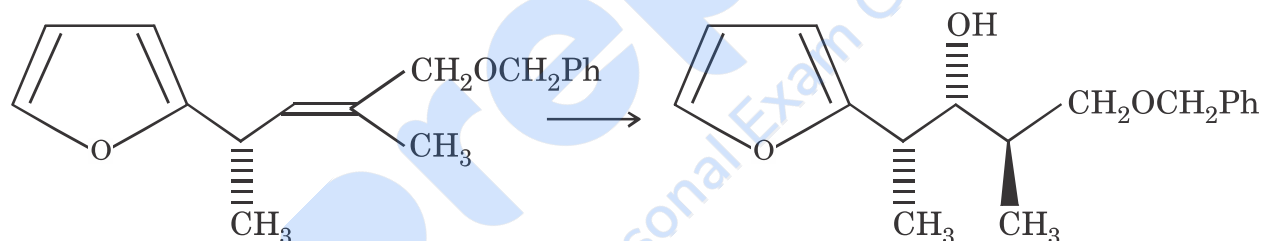


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46. Which of the following compounds undergo fastest tautomerization ?



47. The suitable reagents for the following reaction are :



(A) KMnO_4 , NaOH

(B) B_2H_6 , THF, H_2O_2 , ^-OH

(C) H_2O_2 , H_3O^+

(D) B_2H_6 , THF

48. The correct match between Column I and Column II is :

Column I

Column II

(i) *p*-xylene

(a) one signal in $^1\text{H-NMR}$ and two signals in $^{13}\text{C-NMR}$

(ii) 4-methyl cyclohexanone

(b) 2210 cm^{-1} in IR

(iii) 1-Butyne

(c) Two singlets in $^1\text{H-NMR}$

(iv) 2, 2-dimethyl propane

(d) λ_{max} 280 (ϵ 30) in UV

(A) (i—a) (ii—b) (iii—c) (iv—d)

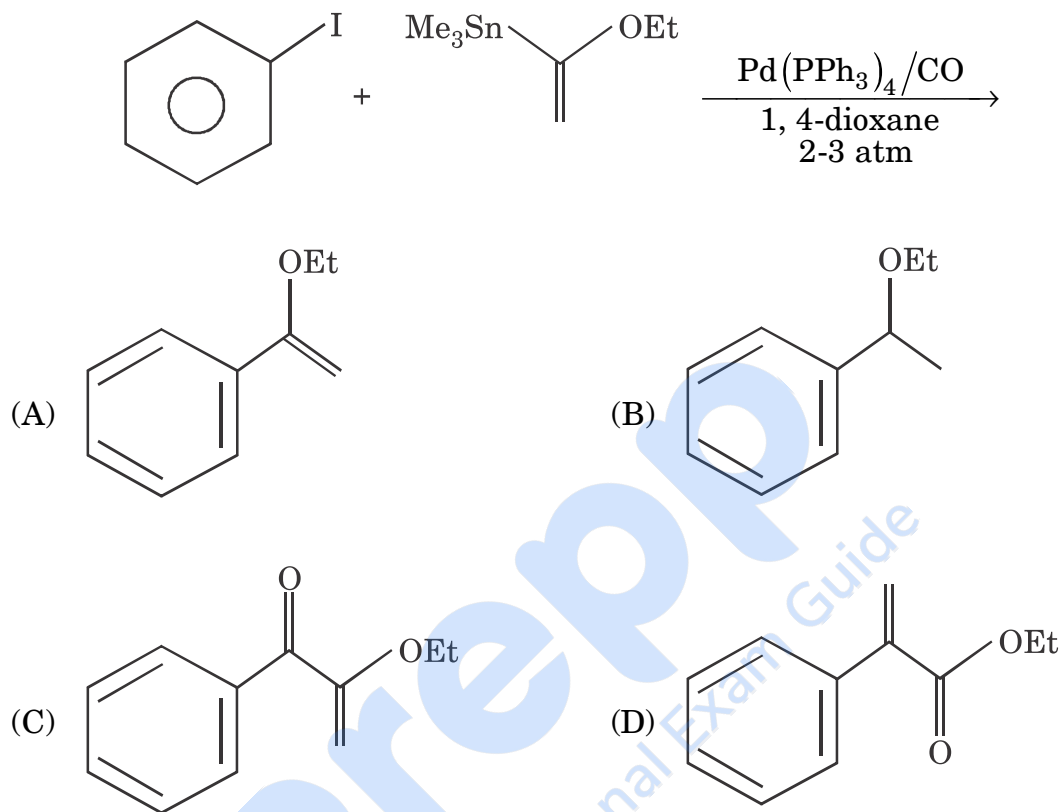
(B) (i—c) (ii—d) (iii—b) (iv—a)

(C) (i—a) (ii—b) (iii—d) (iv—c)

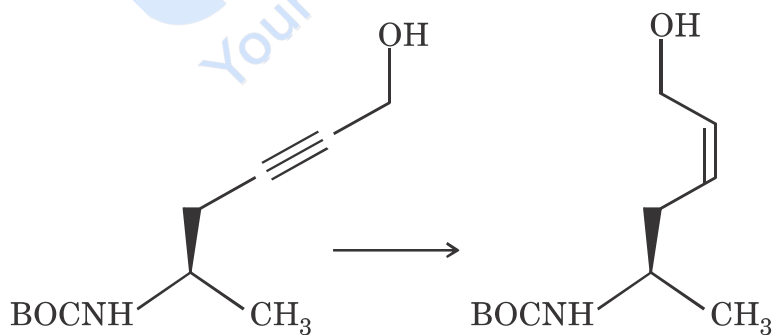
(D) (i—c) (ii—b) (iii—d) (iv—a)

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49. The major product of the following reaction is :



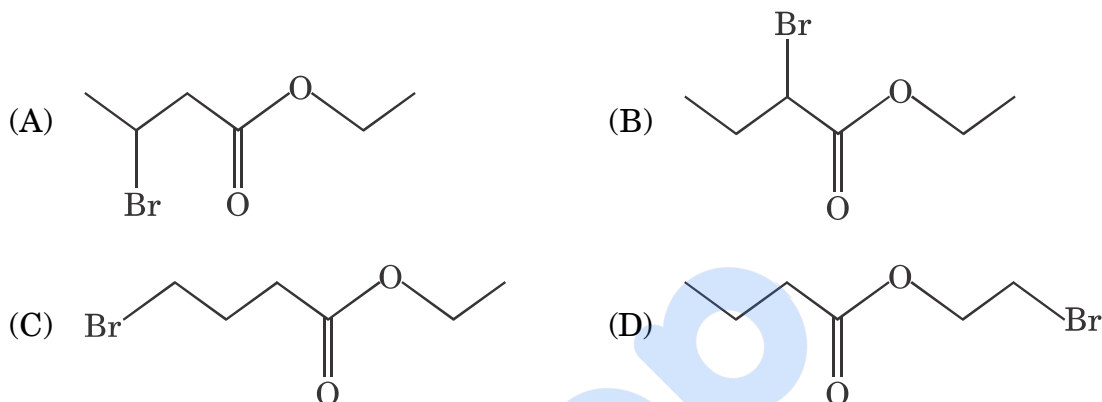
50. The suitable catalyst system for the following reaction is :



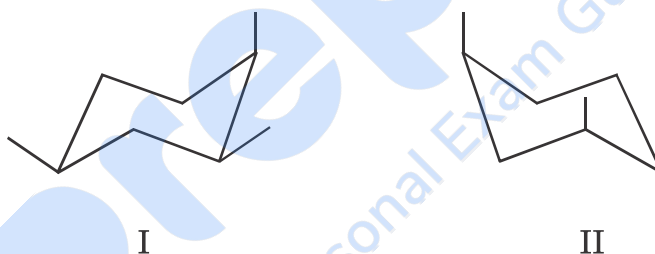
- (A) Pd/BaSO₄, quinoline, H₂ (1 bar) (B) LiAlH₄
 (C) Raney Ni, H₂ (D) Pd, BaSO₄, quinoline

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51. An organic compound having molecular formula $C_6H_{11}BrO_2$ exhibits the following peaks in 1H -NMR spectrum : δ 4.1(2H, *q*, $J = 7.5$ Hz), 4.0(2H, *t*, $J = 7.5$ Hz), 1.5-2.2(4H, *m*), 1.25(3H, *t*, $J = 7.5$ Hz). The structure of the compound is :



52. Relationship between compound I and II is :



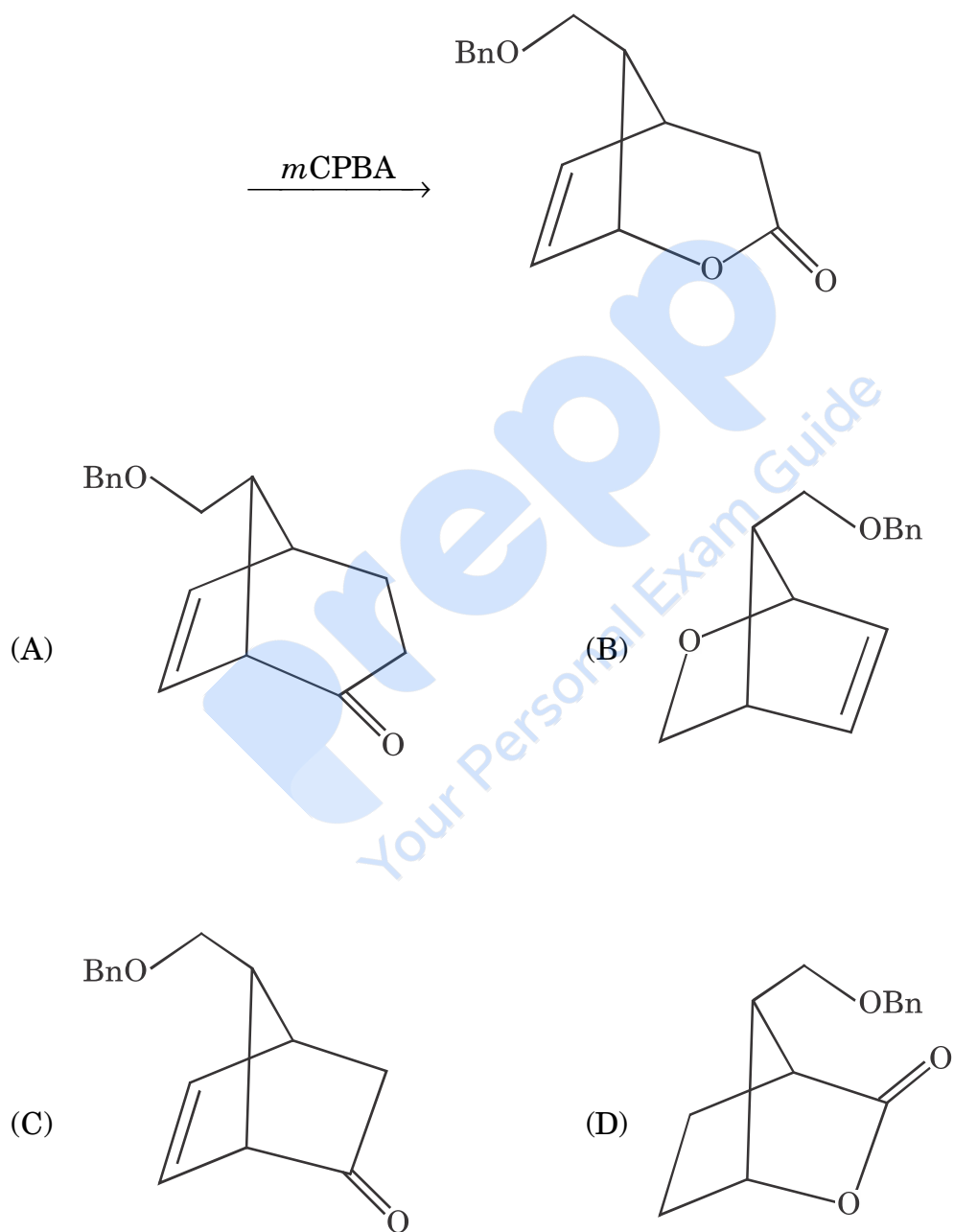
- (A) Diastereomers (B) Enantiomers
(C) Conformational isomers (D) Constitutional isomers
53. The energy difference between the two conformations of 1, 2-dimethylcyclohexane is :



- (A) 0.9 kcal/mol (B) 1.8 kcal/mol
(C) 2.7 kcal/mol (D) 3.6 kcal/mol

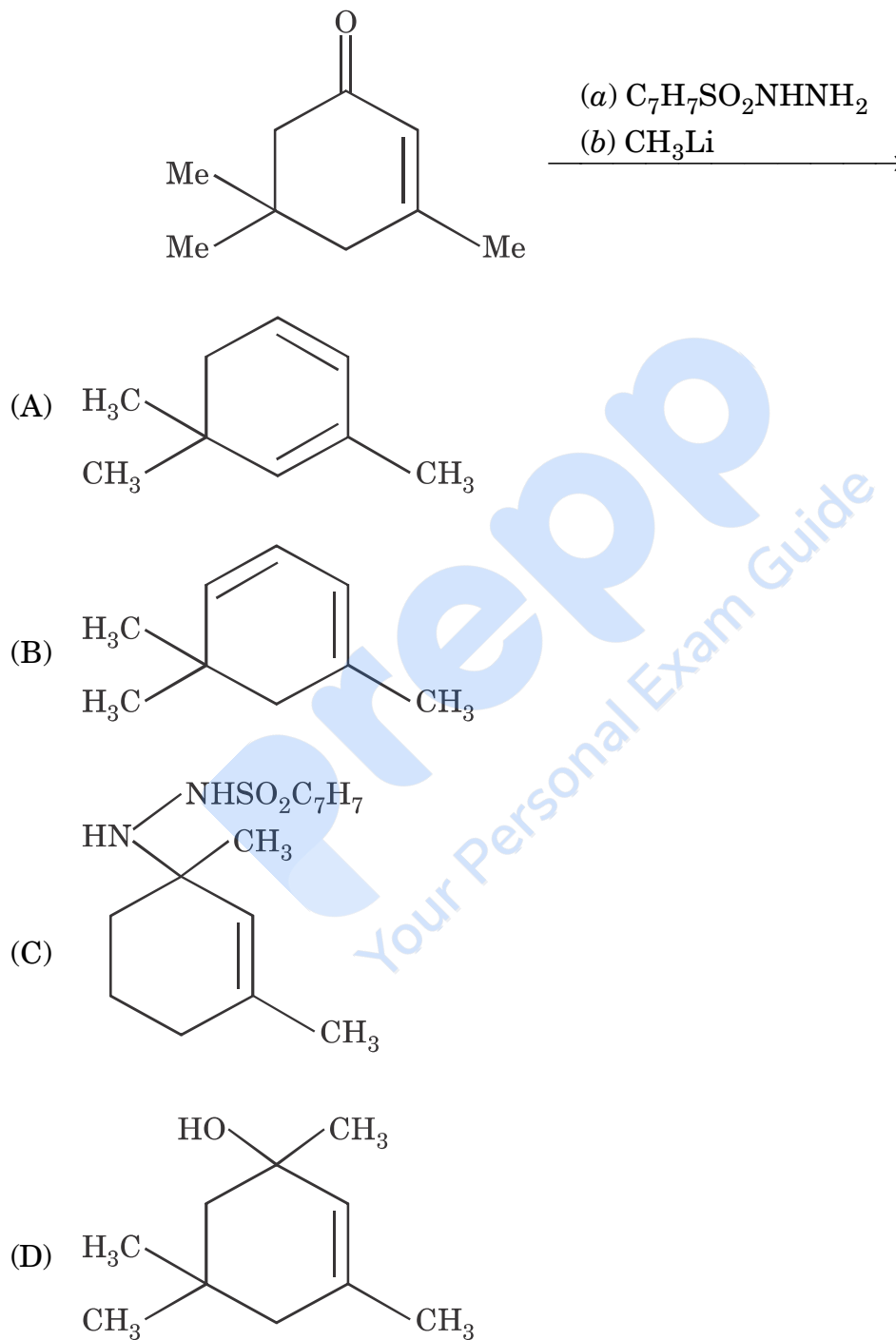
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54. The suitable starting material for the desired reaction is :



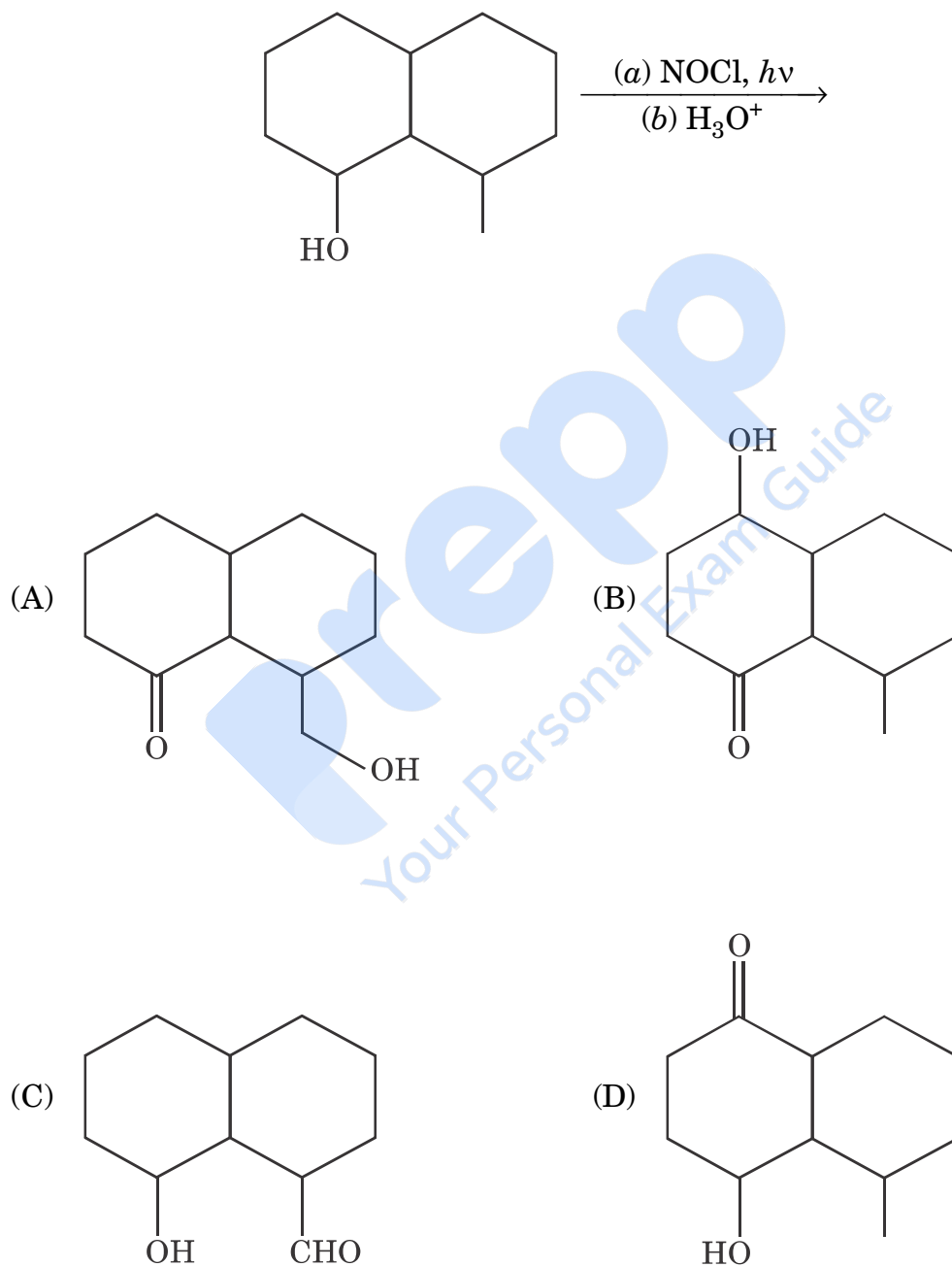
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55. The major product of the following reaction is :



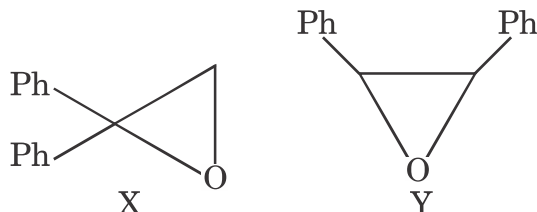
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56. The major product in the following reaction is :

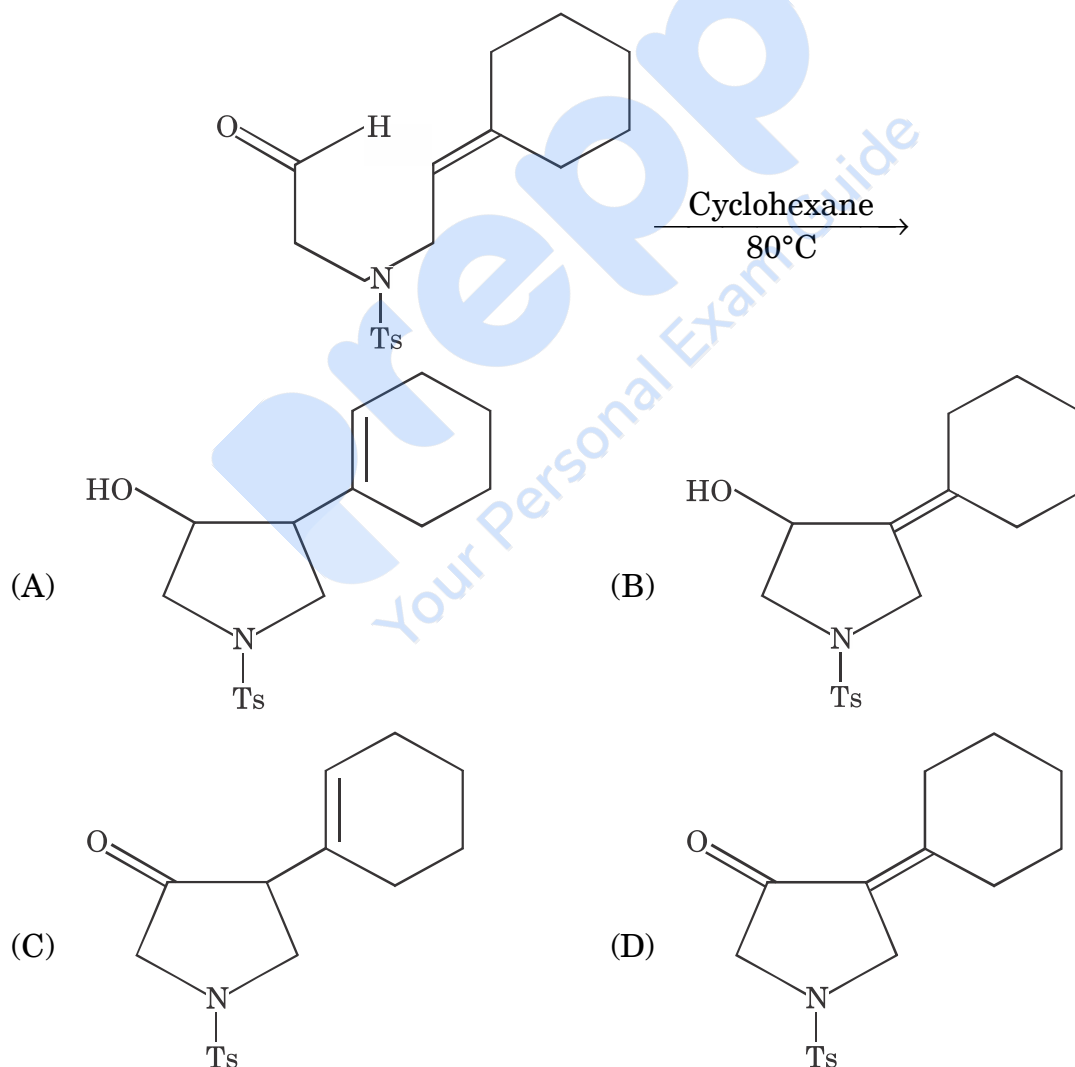


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57. Epoxides X and Y give the same aldehyde on BF_3 -etherate catalyzed rearrangement. The *correct* statement is :

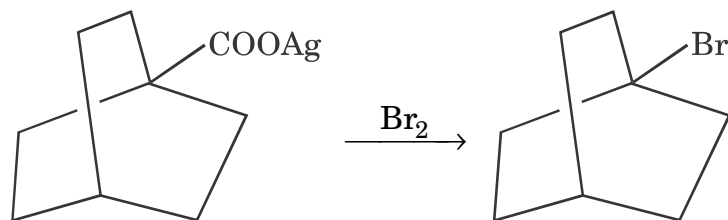


- (A) H migrates in both X and Y
(B) Ph migrates in both X and Y
(C) H migrates in X; Ph migrates in Y
(D) Ph migrates in X; H migrates in Y
58. The major product in the following reaction is :



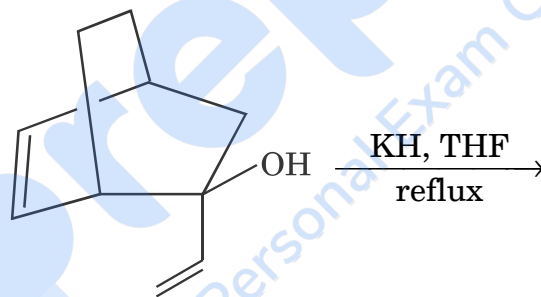
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59. The following reaction goes through :



- (A) Free radical intermediate (B) Carbanion intermediate
(C) Carbocation intermediate (D) Carbene intermediate

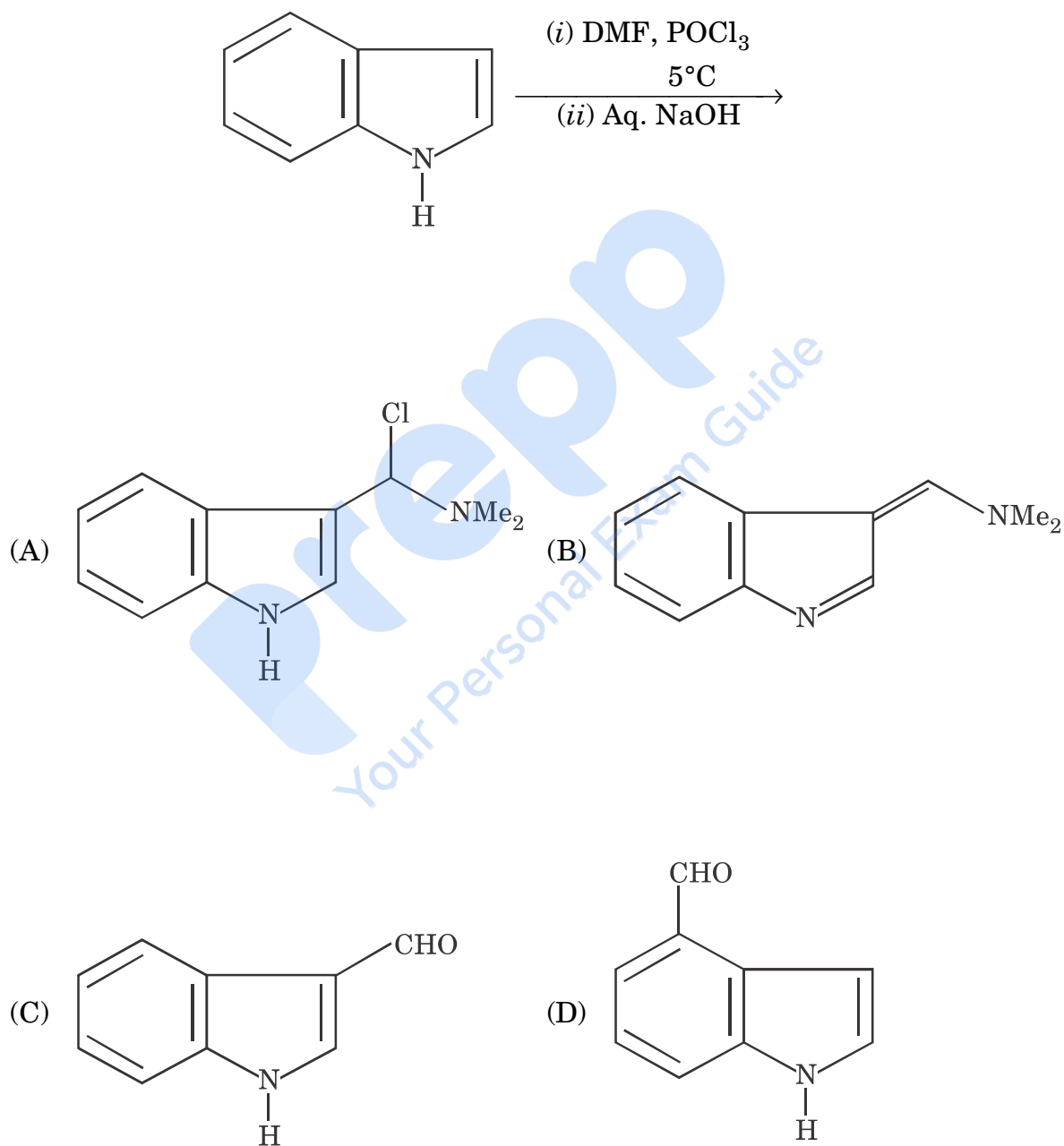
60. The major product of the following reaction is :



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

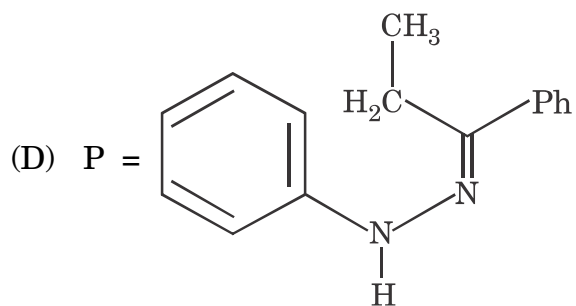
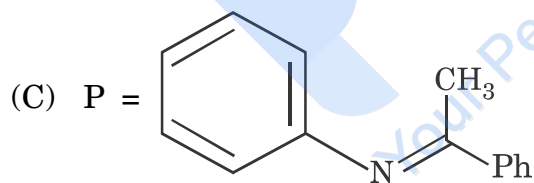
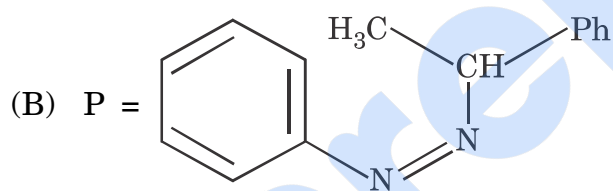
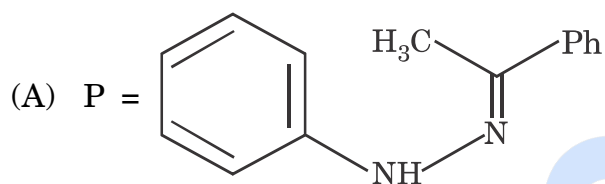
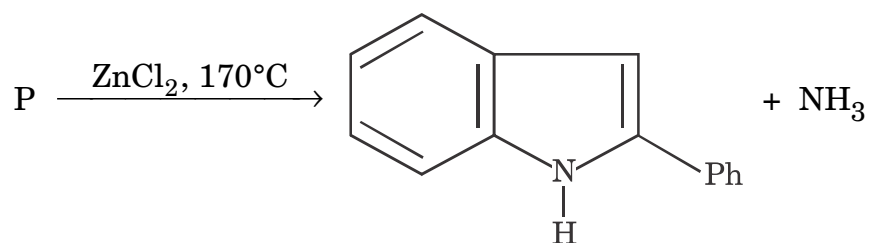
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61. The major product of the following reaction is :



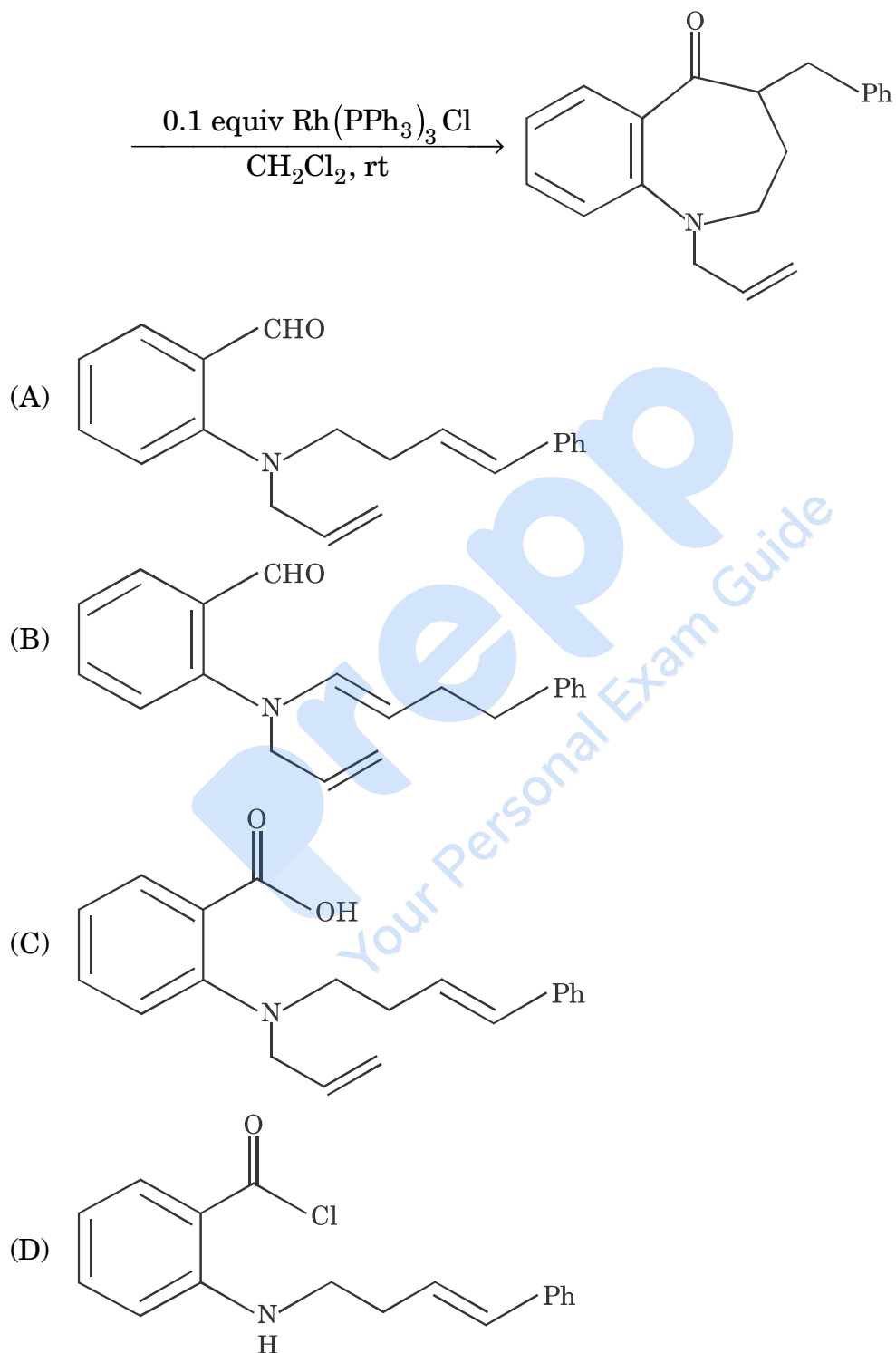
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62. The suitable starting material for the following reaction is :



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63. The starting material in the following reaction is :



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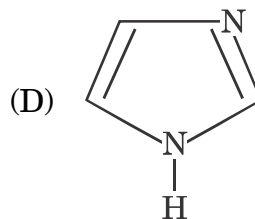
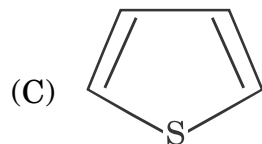
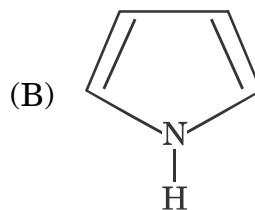
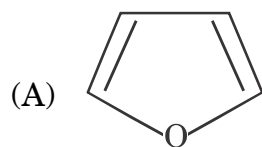
64. The *correct* match of natural product in Column II with class in Column I is :

Column I	Column II
(a) Terpene	(i) Strychnine
(b) Alkaloid	(ii) Cortisone
(c) Steroids	(iii) Chitin
(d) Polysaccharide	(iv) Camphor
(A) (a—iv) (b—i) (c—ii) (d—iii)	
(B) (a—i) (b—ii) (c—iv) (d—iii)	
(C) (a—iv) (b—i) (c—iii) (d—ii)	
(D) (a—iii) (b—iv) (c—ii) (d—i)	

65. Which of the following is *not* reducing sugar ?

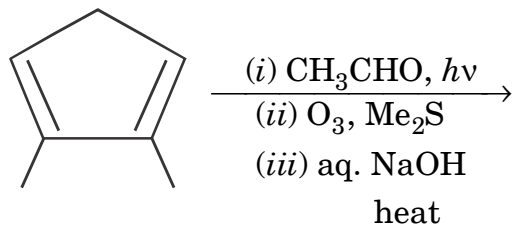
- | | |
|----------------|--------------|
| (A) D-Fructose | (B) D-Ribose |
| (C) Cellobiose | (D) Sucrose |

66. Which of the following compounds will react fastest with diene (A) under thermal condition ?



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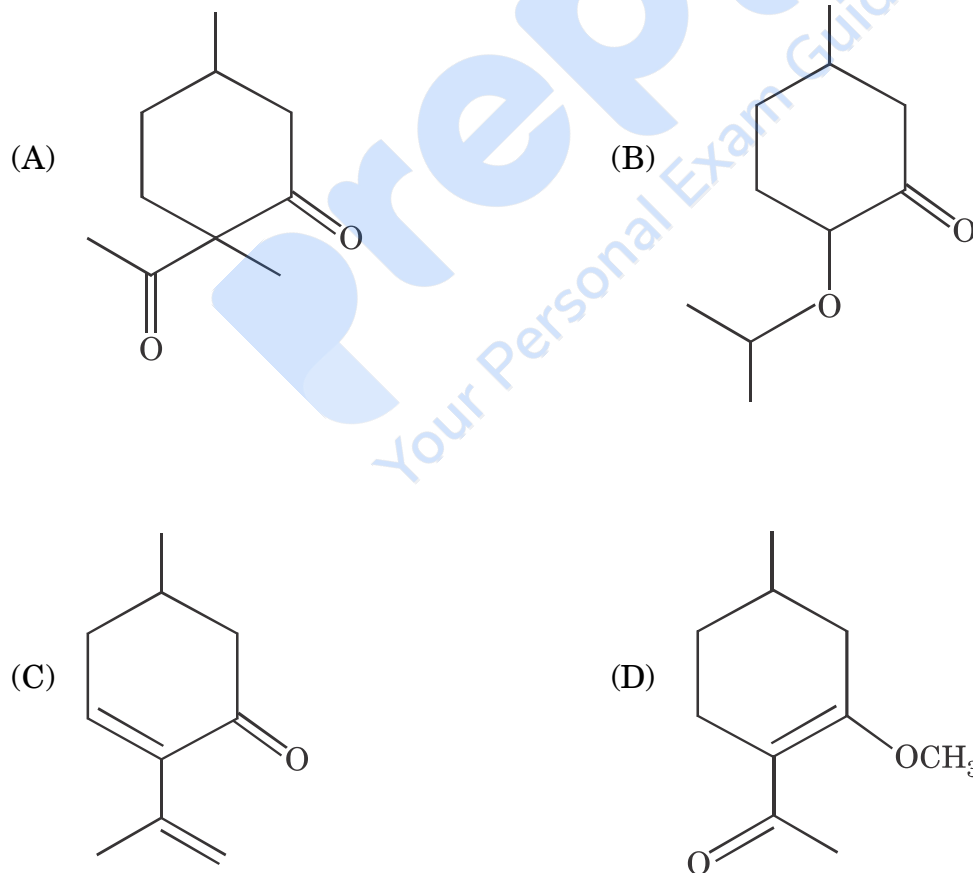
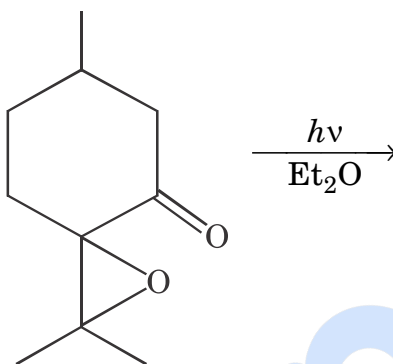
67. The major product in the following sequence of reactions is :



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

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68. The major product in the following reaction is :

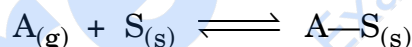


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69. The equilibrium constant (K_C) for the reaction $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$ at a particular temperature is 4.0×10^{-4} . The value of K_C for the reaction $\text{NO}(\text{g}) \rightleftharpoons \frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$ at the same temperature is :
- (A) 2.0×10^2 (B) 50
(C) 2×10^{-2} (D) 500
70. Maximum number of molecules are present in :
- (A) 15L of H_2 at STP (B) 10L of O_2 at STP
(C) 0.5 g of H_2 (D) 1.0 mol of O_2 gas
71. A thermoflask used to carry hot drinks is an example of an/a :
- (A) Open system (B) Closed system
(C) Isolated system (D) Adiabatic system
72. A dislocation with Burgers vector that equals one lattice spacing is called dislocation.
- (A) Unit (B) Partial
(C) Imperfect (D) Frank
73. The expression for the rate of chain initiation in addition polymerization is :
- (A) $f k_d [\text{I}]$ (B) $k_d [\text{I}]/2$
(C) $2f k_d [\text{I}]$ (D) $k_d [\text{I}]$
74. In condensation polymerization the reactivity of a specific functional group :
- (A) Increases with increase in molecular size
(B) Decreases with increase in molecular size
(C) Is independent of molecular size
(D) Increases with increasing polarity of group and molecular size

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75. The weight average molar mass ($\bar{M}_w$) of a polymer having 50 and 75 molecules with corresponding molecular mass of 5000 and 6000 g/mol respectively is :
- (A) 5,800 (B) 5,642
(C) 6,800 (D) 10,000
76. According to Langmuir theory of adsorption which of the following is *correct* ?
- (A) Heat of adsorption changes with coverage.
(B) Heat of adsorption is independent of coverage.
(C) The adsorbed species interact with each other.
(D) Adsorption is always non-dissociative.
77. According to Debye theory, specific heat at high temperature is proportional to :
- (A) T (B) T^2
(C) T^3 (D) Independent of T
78. According to Langmuir model of adsorption, there is an equilibrium between adsorption and desorption as given below :



where A & S represent the adsorbate and the solid surface sites and A—S is the adsorbed species.

The adsorption coefficient K is defined as k_a/k_d where k_a and k_d are the rate constants for adsorption and desorption respectively.

Which of the following is *correct* ?

(I) $K = \frac{[A-S]}{[A][S]}$

(II) $K = \frac{[A][S]}{[A-S]}$

(III) A large value of K indicates strong adsorption

(IV) A large value of K indicates strong desorption

- (A) (I) and (III) (B) (II) and (III)
(C) (I) and (IV) (D) (I) and (II)

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79. Which of the following is *correct* ?
- (A) In X-ray photoelectron spectroscopy valence electrons are ejected.
 - (B) K. E of photoelectrons increase when the intensity of the incident X-rays is increased.
 - (C) K. E of photoelectrons decrease when the oxidation state of the surface is increased.
 - (D) Number of photoelectrons emitted increases with frequency of the incident X-rays.

80. For a solid/liquid interface the following equation is applicable :

$$\frac{\gamma_{SV} - \gamma_{SL}}{\gamma_{LV}} = \cos \theta$$

where θ is the contact angle, γ_{SV} , γ_{SL} and γ_{LV} are the surface tension of solid, interfacial tension of S/L and surface tension of liquid.

If a metal pan has to be made non-sticking for cooking appliance :

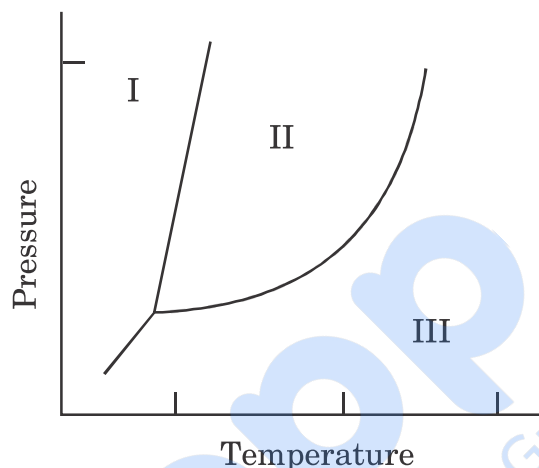
- (A) Edible surfactants are to be added to the cooking water.
 - (B) The metal has to be coated with high energy substance.
 - (C) The metal has to be coated with a low energy substance.
 - (D) Edible surfactants that can adsorb at S/L interface can be added.
81. A particle can occupy either the ground state at $E = 0$ or an excited state at $E > 0$. At a temperature T , the probability of the particle being in the excited state is :
- (A) 0
 - (B) $1 + \exp - E/K_B T$
 - (C) $\exp - E/K_B T / (1 + \exp - E/K_B T)$
 - (D) $1 / (1 + \exp - E/K_B T)$

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82. According to Einstein's photoelectric equation, the slope of the plot of kinetic energy of the photoelectrons Vs. the frequency of the incident radiation :
- (A) will depend upon the nature of the metal that emits the photoelectrons
 - (B) will depend on the intensity of the incident radiation
 - (C) will depend on both the intensity of the radiation and the nature of the metal
 - (D) will be the same for all metals and independent of intensity of radiation
83. For a simple harmonic oscillator :
- (A) potential energy varies linearly with displacement from equilibrium
 - (B) spacing between energy levels increases with increasing energy
 - (C) spacing between energy levels decreases with increasing energy
 - (D) number of nodes of the wave function increases with increase in energy
84. Which of the following is *correct* for H_2^+ ion ?
- (A) A possible trial wave function for the ion is $\psi = C_1 1S_A \pm C_2 1S_B$
 - (B) The coefficients of the trial wave function are not equal
 - (C) A possible trial wave function is $\psi = C_1 1S_A / C_2 1S_B$
 - (D) The 1S orbitals are not normalised
85. Which of the following is *true* according to variational theorem ?
- (I) The ground state energy of a quantum mechanical system is zero.
 - (II) $\frac{\langle \psi | H | \psi \rangle}{\langle \psi | \psi \rangle} \geq E_0$
 - (III) $\frac{\langle \psi | H | \psi \rangle}{\langle \psi | \psi \rangle} = E_0$
 - (IV) The ground state energy of a quantum mechanical system is infinite.
- (A) (I) and (II) (B) (II) only
(C) (III) only (D) (I) and (IV)

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86. How many normal modes of vibrations are possible for nitrobenzene molecule ?
(A) 36 (B) 31
(C) 09 (D) 14
87. In the following phase diagram, the process corresponding to sublimation is :



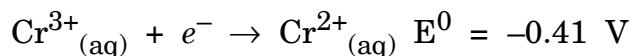
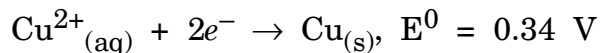
- (A) I $\rightarrow$ II (B) I $\rightarrow$ III
(C) II $\rightarrow$ III (D) III $\rightarrow$ II
88. 100 ml of a NaOH solution of pH 12 is mixed with 900 ml of water. What is the pH of the resulting solution ?
(A) 10 (B) 09
(C) 11 (D) 13
89. In August 1986, a cloud of CO_2 gas suddenly erupted from a lake in Cameroon killing several people. Which of the following could have caused this accident ?
(I) Over the years CO_2 (g) would have got saturated in the upper layers of the lake water.
(II) Heavy winds could have overturned the water in the lake.
(III) Over the years CO_2 (g) would have got saturated in the bottom layers of the lake water.
(IV) This incident could be related to Raoult's law.
(A) (I), (II), (IV) (B) (II), (III)
(C) (II), (III), (IV) (D) (I), (IV)

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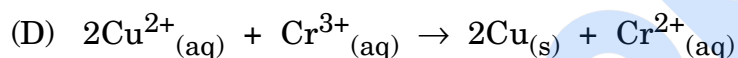
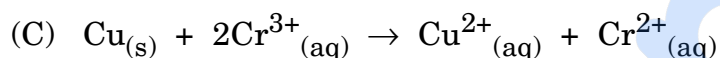
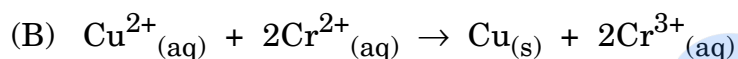
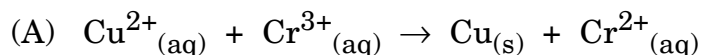
90. For a reversible process in a state of equilibrium :
- (A) $\Delta G^\circ = 0$ (B) $\Delta G = -RT \ln K$
(C) $\Delta G^\circ = -RT \ln K$ (D) $\ln K = 1$
91. The SI unit of measuring radioactivity is :
- (A) Curie (B) Becquerel
(C) Rads (D) Gray
92. In case of radioisotopes the activity reduces to of initial value after 2 half lives.
- (A) $\frac{1}{3}$ rd of the initial activity (B) $\frac{1}{2}$ of the initial activity
(C) $\frac{1}{4}$ of the initial activity (D) $\frac{1}{6}$ of the initial activity
93. Single crystal of which salt is used as a scintillator in scintillation counter ?
- (A) Sodium nitrate (B) Sodium iodide
(C) Sodium sulphate (D) Sodium carbonate
94. When radioactive equilibrium is attained, the relative amounts of parent to daughter :
- (A) Increase with time
(B) Decrease with time
(C) Is constant irrespective of time
(D) May increase or decrease with time depending on the parent isotope

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95. According to the following half cell reactions :



The reaction that would occur in aqueous solutions under standard condition is :



96. The formation of rust on iron can be inhibited by the coating because tin :

(A) is a sacrificial anode

(B) is a weaker reducing agent than iron

(C) cathodically protects the iron

(D) keeps the oxygen away from iron

97. Which of the following is *correct* for a spontaneous process in a closed system at constant temperature and pressure ?

(I) $\Delta S_{\text{sys}} + \Delta S_{\text{surr}} > 0$

(II) $\Delta G_{\text{sys}} = 0$

(III) $\Delta S_{\text{sys}} = \Delta S_{\text{surr}}$

(IV) $\Delta G_{\text{sys}} < 0$

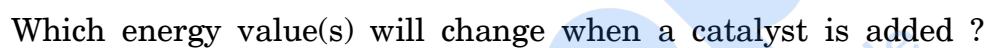
(A) (I) and (II)

(B) (I) only

(C) (II) and (III)

(D) (IV) only

98.



99. For the reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$, the rate expression is :

$$\frac{-d[\text{NH}_3]}{dt} = k[\text{H}_2][\text{N}_2]$$

Which of the following is/are *correct*?

- $$\text{(III)} \quad \frac{-d[\text{H}_2]}{dt} = \frac{-d[\text{NH}_3]}{dt}$$

- (A) (II) only
- (B) (I) and (II)
- (C) (II) and (III)
- (D) (I), (II) and (III)

(A) C_3V and 4
 (B) d_{2h} and 5
 (C) T_d and 5
 (D) T_d and 4

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ROUGH WORK

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