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FOR MAHA SET PREPARATION

# MAHA SET 2024 Paper II Chemical Sciences Set A Question Paper

| EXAM | YEAR | TYPE |
| --- | --- | --- |
| MAHA SET | 2024 | Question Paper |

Test Booklet Code & Serial No.
प्रश्नपत्रिका कोड व क्रमांक

**A**

# Paper-II
# CHEMICAL SCIENCE

**Signature and Name of Invigilator**

1. (Signature) .....

(Name) .....

2. (Signature) .....

(Name) .....

Seat No. | | | | | | | |

(In figures as in Admit Card)

Seat No. .....

(In words)

OMR Sheet No. | | | | | | | |

(To be filled by the Candidate)

## APR - 33224

**Time Allowed : 2 Hours]** **[Maximum Marks : 200**

Number of Pages in this Booklet : **44** Number of Questions in this Booklet : **100**

### Instructions for the Candidates

1. Write your Seat No. and OMR Sheet No. in the space provided on the top of this page.
2. This paper consists of **100** objective type questions. Each question will carry *two* marks. *All* questions of Paper II will be compulsory.
3. 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 :
   (*i*) 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.
   (*ii*) 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.
   (*iii*) After this verification is over, the OMR Sheet Number should be entered on this Test Booklet.
4. 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) ● (D)

5. 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.
6. Read instructions given inside carefully.
7. Rough Work is to be done at the end of this booklet.
8. 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.
9. 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.
10. Use only Blue/Black Ball point pen.
11. Use of any calculator or log table, etc., is prohibited.
12. There is no negative marking for incorrect answers.

### विद्यार्थ्यांसाठी महत्त्वाच्या सूचना

1. परीक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
2. सदर प्रश्नपत्रिकेत **100** बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास **दोन** गुण आहेत. या प्रश्नपत्रिकेतील **सर्व** प्रश्न सोडविणे अनिवार्य आहे.
3. परीक्षा सुरू झाल्यावर विद्यार्थ्याला प्रश्नपत्रिका दिली जाईल. सुरुवातीच्या 5 मिनिटांमध्ये आपण सदर प्रश्नपत्रिका उघडून खालील बाबी अवश्य तपासून पहाव्यात.
   (*i*) प्रश्नपत्रिका उघडण्यासाठी प्रश्नपत्रिकेवर लावलेले सील उघडावे. सील नसलेली किंवा सील उघडलेली प्रश्नपत्रिका स्वीकारू नये.
   (*ii*) पहिल्या पृष्ठावर नमूद केल्याप्रमाणे प्रश्नपत्रिकेची एकूण पृष्ठे तसेच प्रश्नपत्रिकेतील एकूण प्रश्नांची संख्या पडताळून पहावी. 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.
   (*iii*) वरीलप्रमाणे सर्व पडताळून पाहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा नंबर लिहावा.
4. 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) ● (D)

5. या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे **ओ.एम.आर. उत्तरपत्रिकेतच दर्शवावीत.** इतर ठिकाणी लिहिलेली उत्तरे तपासली जाणार नाहीत.
6. आत दिलेल्या सूचना काळजीपूर्वक वाचाव्यात.
7. प्रश्नपत्रिकेच्या शेवटी जोडलेल्या कोऱ्या पानावरच कच्चे काम करावे.
8. जर आपण ओ.एम.आर. वर नमूद केलेल्या ठिकाणाव्यतिरिक्त इतर कोठेही नाव, आसन क्रमांक, फोन नंबर किंवा ओळख पटेल अशी कोणतीही खूण केलेली आढळून आल्यास अथवा असभ्य भाषेचा वापर किंवा इतर गैरमार्गाचा अवलंब केल्यास विद्यार्थ्याला परीक्षेस अपात्र ठरविण्यात येईल.
9. 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.
10. फक्त निळ्या किंवा काळ्या बॉल पेनचाच वापर करावा.
11. कॅलक्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही.
12. चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही.

**APR- 33224/II—A**

**APR- 33224/II—A**

# 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.

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1. The recovery of *two* lanthanoids easier than the others due to their redox chemistry. These lanthanoids are :

   (A) $Pr^{4+}$, $Tb^{4+}$ (B) $Ce^{4+}$, $Eu^{2+}$

   (C) $Nd^{4+}$, $Ln^{2+}$ (D) $Dy^{4+}$, $Ln^{4+}$

2. Which one of the following is used for the formation of atomic vapours in Atomic Absorption Spectroscopy ?

   (A) Flame atomization (B) Electric arcs and sparks

   (C) Sputtering devices (D) Ovens

3. The highest 10 Dq value obtained among the ligands $Br^-$, $PR_3$, en and $H_2O$ in complexes will be for :

   (A) $PR_3$ (B) $H_2O$

   (C) $Br^-$ (D) en

4. The $\gamma$-ray source used in $^{57}Fe$ Mössbauer spectroscopy is :

   (A) $^{57}Co$ (B) $^{129}Tc$

   (C) $^{119m}Sn$ (D) $^{121m}Sn$

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5. The correct trend of $\Delta_0$ for chromium (III) complexes $[Cr(CN)_6]^{3-}$, $[Cr(en)_3]^{3+}$, $[Cr(H_2O)_6]^{3+}$ and $[Cr(NH_3)_6]^{3+}$ is :

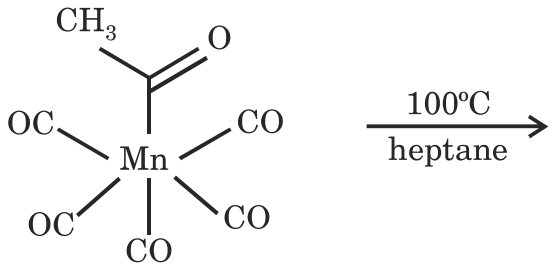
(A) $[Cr(CN)_6]^{3-} > [Cr(en)_3]^{3+} > [Cr(NH_3)_6]^{3+} > [Cr(H_2O)_6]^{3+}$

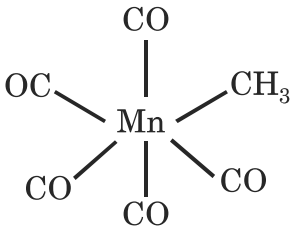
(B) $[Cr(H_2O)_6]^{3+} > [Cr(NH_3)_6]^{3+} > [Cr(en)_3]^{3+} > [Cr(CN)_6]^{3-}$

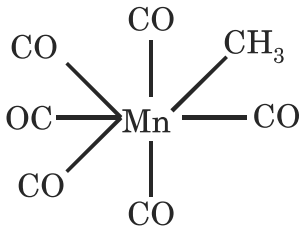
(C) $[Cr(H_2O)_6]^{3+} > [Cr(NH_3)_6]^{3+} \cong [Cr(en)_3]^{3+} > [Cr(CN)_6]^{3-}$

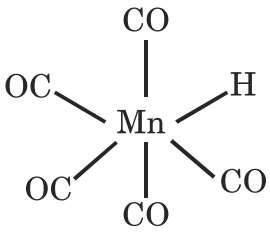
(D) $[Cr(en)_3]^{3+} > [Cr(CN)_6]^{3-} > [Cr(NH_3)_6]^{3+} > [Cr(H_2O)_6]^{3+}$

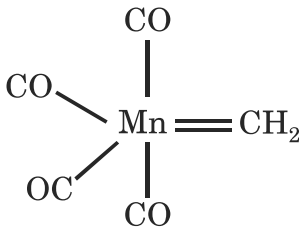
6. The product of the following reaction is :




(A)



(B)



(C)



(D)


7. The pair of compounds that are isoelectronic and isostructural is :

(*i*) $C_2B_{10}H_{12}$

(*ii*) $C_2B_9H_{12}^-$

(*iii*) $C_2B_8NH_{11}$

(*iv*) $C_3B_7SH_{11}^{2+}$

(A) (*i*), (*ii*) and (*iii*)

(B) (*ii*), (*iii*) and (*iv*)

(C) (*i*), (*iii*) and (*iv*)

(D) (*i*), (*ii*) and (*iv*)

8. The complex $[Co(NH_3)_6]^{3+}$ will show NQR resonance lines due to $\left(^{59}Co;\ I = \frac{7}{2}\right)$ and ($^{14}N;\ I = 1$) :

(A) $^{59}Co$ only

(B) $^{14}N$ only

(C) Both $^{59}Co$ and $^{14}N$

(D) No resonance will be observed

9. In the $^1H$ NMR spectrum of diborane number of resonance peaks obtained due to bridging hydrogens are :

($^{11}B;\ I = 3/2$)

(A) 21

(B) 7

(C) 3

(D) 35



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10. Which among the following hexa coordinated molecules will exhibit distorted Octahedral structure ?

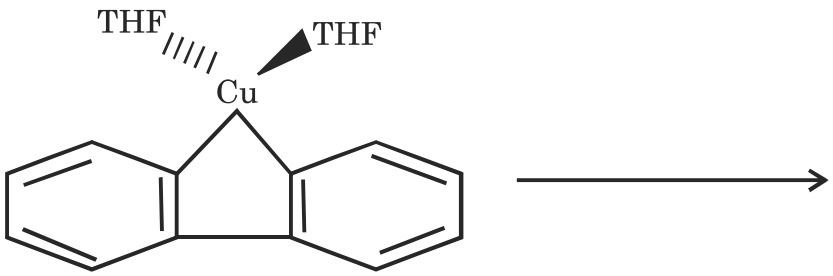
(A) $[IF_6]^-$

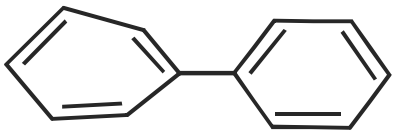
(B) $[SeBr_6]^{2-}$

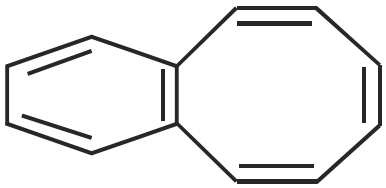
(C) $[TeCl_6]^{2-}$

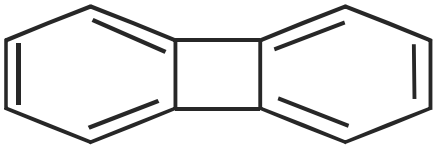
(D) $[BrF_6]^-$

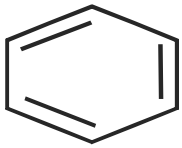
11. Intramolecular oxidative coupling of the following organometallic species would yield :




(A) 

(B) 

(C) 

(D) 

12. The reactivities of halogen oxyanions and oxyacids are well understood by studying Latimer diagram. The Latimer diagram for bromine species in acidic medium is given below :

$$BrO_4^- \xrightarrow{+1.82\ V} BrO_3^- \xrightarrow{+1.49\ V} HBrO \xrightarrow{+1.59\ V} Br_2 \xrightarrow{+1.07\ V} Br^-$$

Identify the *correct* statement(s) from the following :

(*i*) $BrO_3^-$ is unstable with respect to disproportionation.

(*ii*) HBrO is more electrophilic.

(*iii*) Reactions of $BrO_4^-$ are more rapid than $BrO_3^-$.

(A) Statements (*i*) and (*iii*) are correct

(B) Statements (*ii*) and (*iii*) are correct

(C) Statements (*i*) and (*ii*) are correct

(D) Only statement (*ii*) is correct

13. The point group of diborane is :

(A) $D_2h$ (B) $C_2h$

(C) $D_\infty h$ (D) $D_4h$

14. The Direct Synthesis method involving a reaction between a metal and an organic halide is exothermic for :

(A) Mg and Pb (B) Bi and Hg

(C) Li and Mg (D) Li and Tl



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15. In the hydrogenation of carbon monoxide to methanol, finely divided ZnO is used as a catalyst. The cleavage of $H_2$ on ZnO surface is of the type ..... and produce .....

(A) Heterolytic cleavage; hydrides and protons

(B) Homolytic cleavage; protons

(C) Homolytic cleavage; tiradicals

(D) Heterolytic cleavage; hydrides

16. In a non-aqueous medium, a weak acid gets dehydrated upon protonation. Identify A and B in the equation given below :

$$HNO_3 + 2H_2SO_4 \longrightarrow [A] + [B] + [H_3O]^+$$

(A) A = $[NO_2]^+$, B = $2[HSO_4]^-$

(B) A = $NO_2$, B = $2[HSO_4]^-$

(C) A = $[NO_3]^-$, B = ½ $SO_3$

(D) A = $\left[NO_3^-\right]$, B = $4SO_3$

17. Four different students reported % of bromine in an organic compound as 40.00, 40.10, 40.20 and 40.30. The mean deviation of their results is :

(A) 40.15

(B) 0.15

(C) 0.10

(D) –0.15

18. The *incorrect* statement about $XeF_6$ is :

(A) It has 14 electrons around central xenon atom

(B) In condensed phase, it exists as an equilibrium mixture of 4 $XeF_6 \rightleftharpoons \left[XeF_5^+F^-\right]_4$

(C) It can be synthesized by reacting $SbF_5$ with $XeF_5^+$ wherein $XeF_5^+$ acts as a fluoride ion acceptor

(D) It undergoes double-displacement reaction with $SiO_2$ to give xenon trioxide

19. The trans-$PtCl_2(NH_3)_2$ can be obtained from the transformation :

(A) $[PtCl(NH_3)_3]^+ + Cl^- \rightarrow$

(B) $[PtCl_3(NH_3)]^- + NH_3 \rightarrow$

(C) $[PtCl_4]^{2-} + 2NH_3 \rightarrow$

(D) Cis – $[PtCl_2(NH_3)_2] + Cl^- \rightarrow$

20. The allowed term symbol for microstate $(1^- \ 0^-)$ is :

(A) $^3F$

(B) $^3P$

(C) $^1P$

(D) $^1G$

21. In Frost diagram, $NE^o$ values for four different oxidation states of Thorium is found to be Th(II) > Th(I) > Th(III) > Th(IV), then :

(A) Th(II) is the most stable oxidation state

(B) Th(III) can disproportionate to Th(I) and Th(IV)

(C) Th(II) can disproportionate to Th(I) and Th(III)

(D) Th(II) and Th(IV) can consproportionate to Th(III)

22. Bailar twist and Ray-Dutt twist pathways are observed for :

(A) Octahedral complexes undergoing isomerization reaction

(B) Octahedral complexes undergoing electron-transfer reaction

(C) Square-planar complexes undergoing substitution reaction

(D) Octahedral complexes undergoing substitution reaction



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23. The magnetic moment of $Cu_2(CH_3COO)_4.2H_2O$ at 295 K is 1.41 B.M. This can be best explained by :

(A) Ferromagnetic coupling

(B) Spin-orbit coupling

(C) Temperature independent paramagnetism

(D) Antiferromagnetic coupling

24. Carbon monoxide poisoning happens due to :

(A) Binding of CO to deoxyhemoglobin leading to a paramagnetic complex

(B) Binding of CO to deoxyhemoglobin leading to a diamagnetic complex

(C) Binding of CO to oxidized cytochrome C oxidase

(D) Binding of two CO to heme leading to a diamagnetic complex

25. Which protein is NOT a part of $\bar{e}$-transfer chain in photosystem II ?

(A) Plastocyanin (B) Plastoquinone

(C) $Fe_8S_7$ cluster (D) Cytochrome

26. For a hydrate alkali metal ion, $[M(H_2O)_6]^+$, the rate of water exchange increases :

(A) As the size of a metal ion decreases

(B) As the coordination number increases

(C) As the surface charge density increases

(D) As the electronegativity of the metal ion increases

27. The g-value of a radical showing a four-line EPR signal centered at 3300 G in a spectrometer operating at 9.10 GHz is (Given Planck constant = $6.62608 \times 10^{-34}$ Js, Bohr magneton = $9.27402 \times 10^{-24}$ $JT^{-1}$).

(A) 1.97 (B) 2.1

(C) 2.2 (D) 2.4

28. The Jahn-Teller distortion in $[Ti(H_2O)_6]^{3+}$ species leads to :

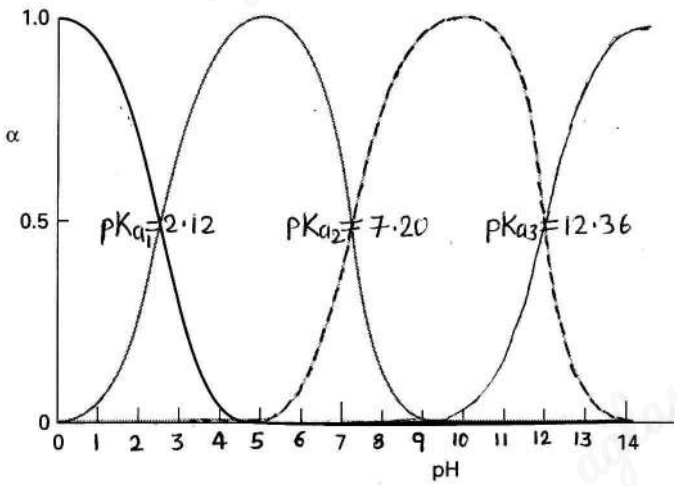
(A) No observed *d-d* transition

(B) Three Laporte-forbidden *d-d* transition

(C) Two spin forbidden *d-d* transition

(D) Only one Laporte-allowed *d-d* transition

29. The species distribution diagram for phosphate is given below where *y*-axis represents the fraction of the species ($\alpha$). The predominant species present at pH 3.0, 5.0, 10.0 and 13.0 are respectively :




(A) $H_3PO_4$, $H_2PO_4^-$, $HPO_4^{2-}$, $PO_4^{3-}$ (B) $H_2PO_4^-$, $H_2PO_4^-$, $HPO_4^{2-}$, $PO_4^{3-}$

(C) $H_3PO_4$, $H_2PO_4^{2-}$, $HPO_4^{2-}$, $PO_4^{3-}$ (D) $H_3PO_4$, $HPO_4^{2-}$, $HPO_4^{2-}$, $PO_4^{3-}$



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30. The relation between the lattice constant and radius of an atom for fcc lattice is :

(A) $r = \frac{\sqrt{3}a}{4}$ (B) $r = \frac{\sqrt{2}a}{4}$

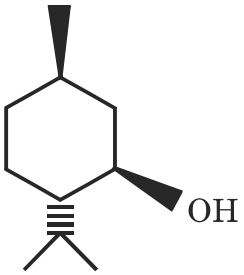
(C) $r = \frac{a}{2\sqrt{2}}$ (D) $r = \frac{a}{\sqrt{2}}$

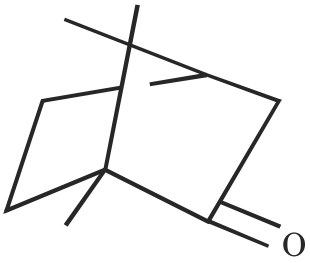
31. The line positions of a quartet signal of compound in $^{1}$H–NMR spectrum taken on 200 MHz instrument are 791, 797, 803, 809 Hz respectively. The chemical shift in ppm and coupling constant of same signal is :

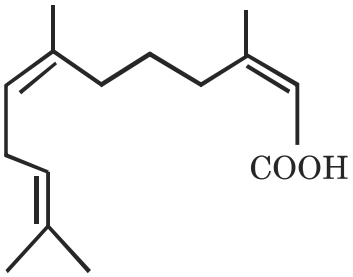
(A) 4.0 δ, J = 6Hz (B) 4.3 δ, J = 9Hz

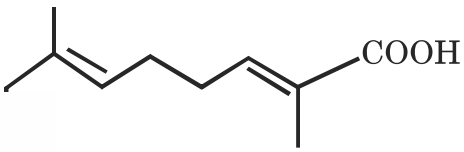
(C) 3.8 δ, J = 3Hz (D) 4.0 δ, J = 3Hz

32. Which of the structures given below do NOT follow isoprene rule ?

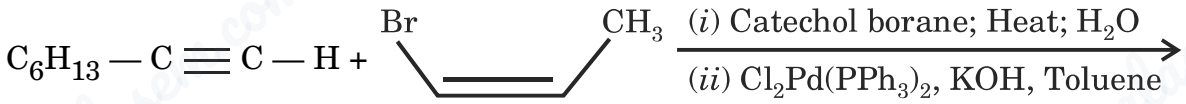
(A) 

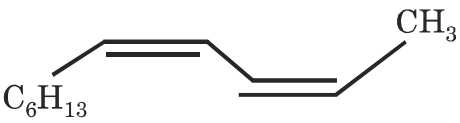

(B) 

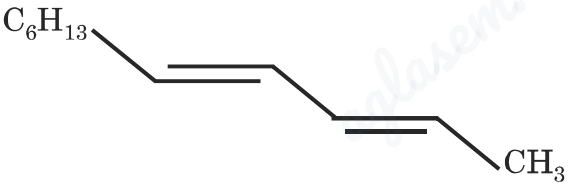

(C) 

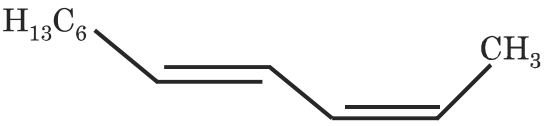

(D) 

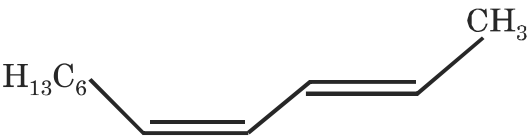
33. The major product formed in the following reaction is :




(A) 


(B) 

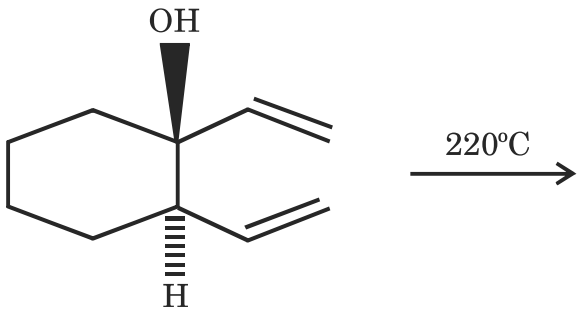

(C) 

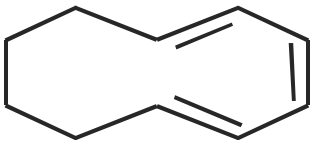

(D) 

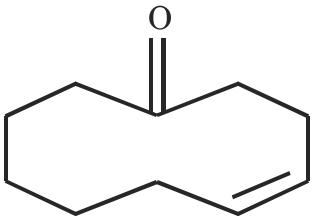


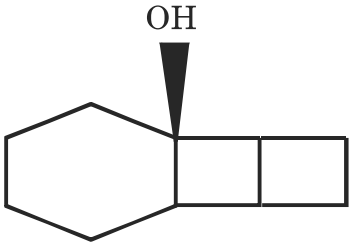

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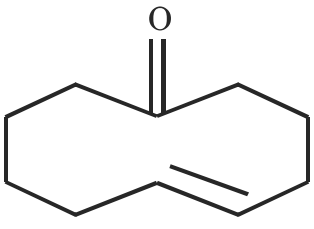
34. Predict the major product of the following reaction :



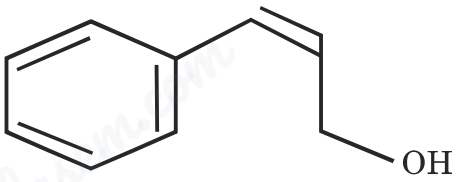

(A) 

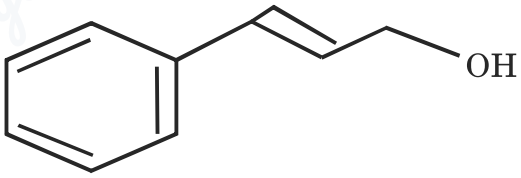
(B) 

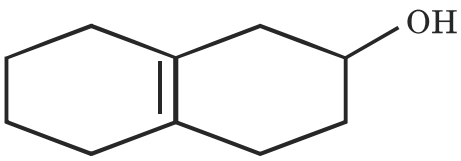

(C) 

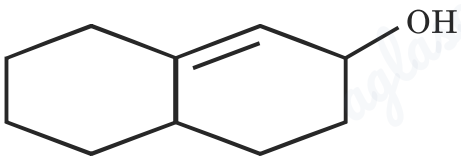

(D) 

35. Which of the following alcohols is NOT suitable substrate for sharpless asymmetric epoxidation reaction ?

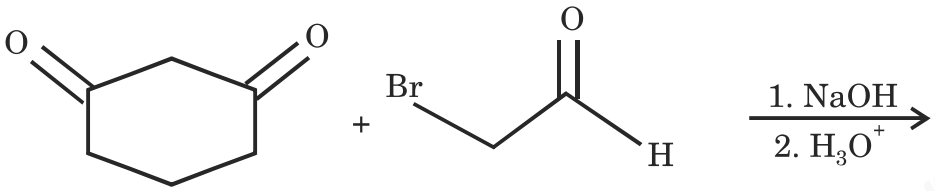
(A) 

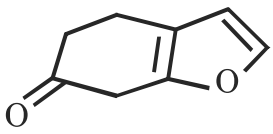

(B) 

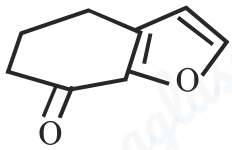

(C) 

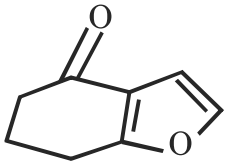

(D) 

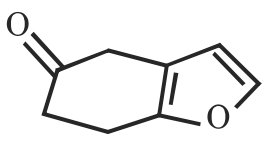

36. Predict the major product of the following reaction :




(A) 


(B) 


(C) 


(D) 

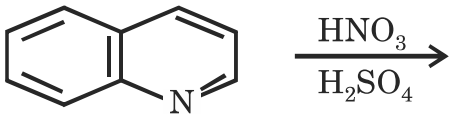
**APR- 33224/II—A**

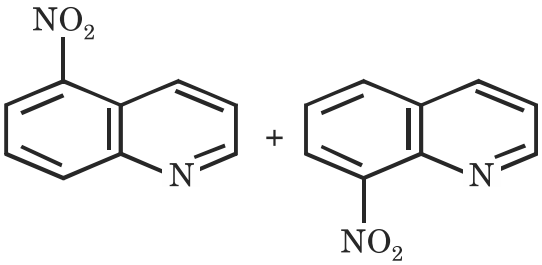
37. 2-Butanamine on reaction with excess $CH_3I$ and $Ag_2O$, $H_2O$ followed by heating at 150°C, gives the following major product :

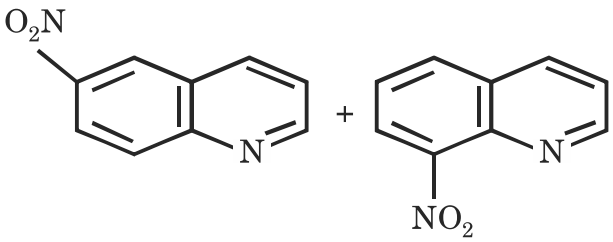
(A) 1-butene (B) 2-butene

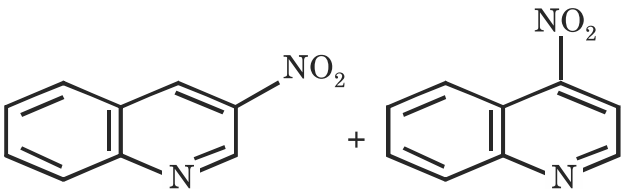
(C) butane (D) 2-butanol

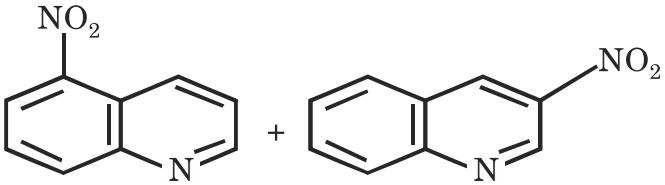
38. The major products of the following reaction is :



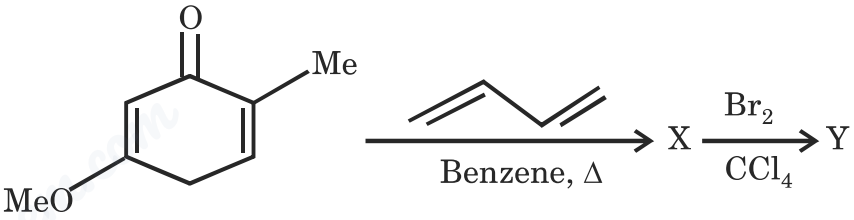

(A) 

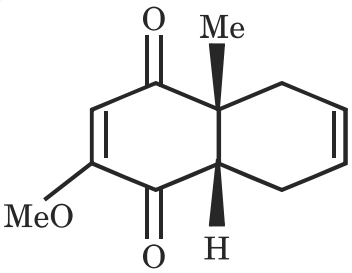

(B) 

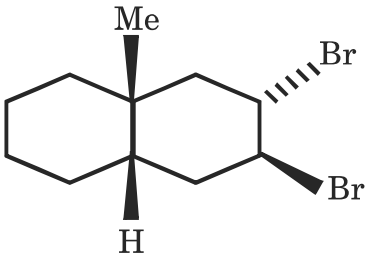

(C) 

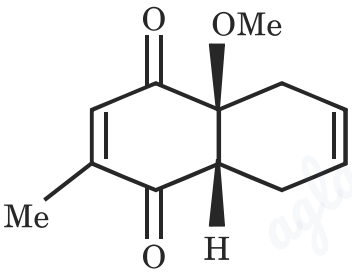

(D) 

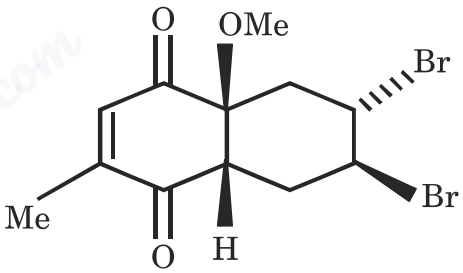
39. The major products formed in the following reaction is :

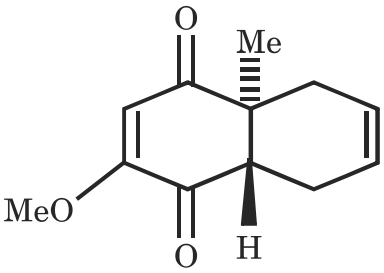


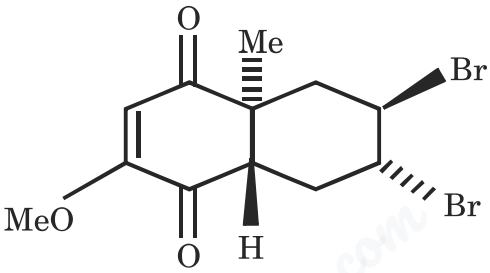

(A) X = 

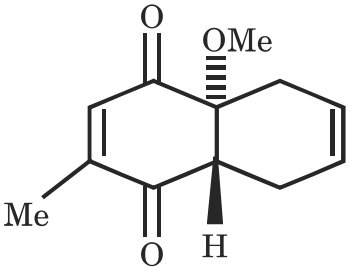
Y = 

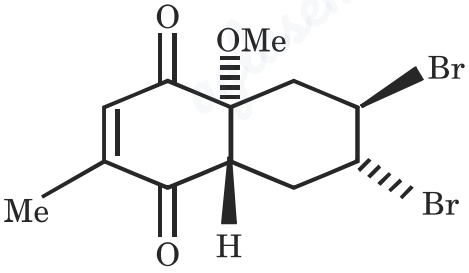

(B) X = 

Y = 


(C) X = 

Y = 


(D) X = 

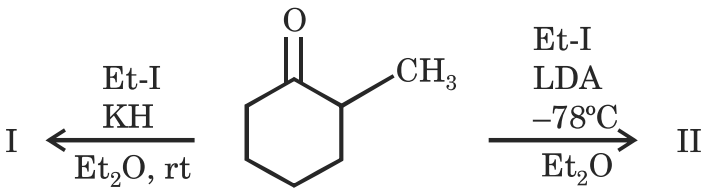
Y = 



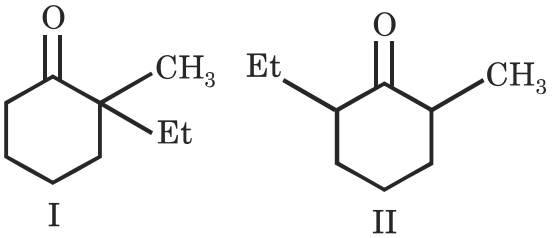

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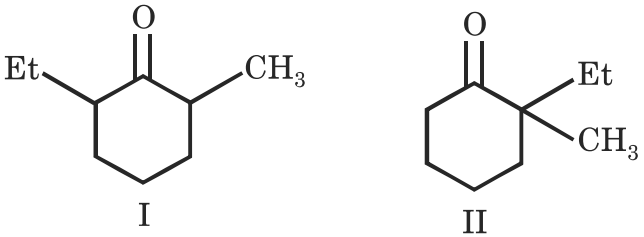
40. Predict the major product of the following reactions :



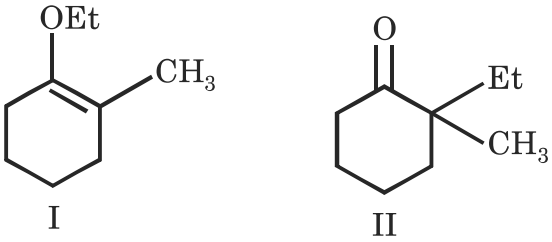

(A)



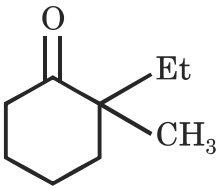

(B)



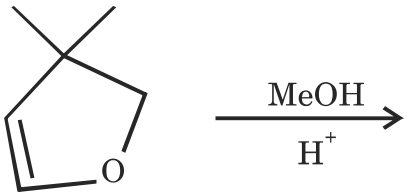

(C)

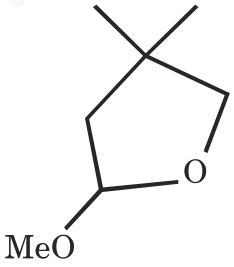


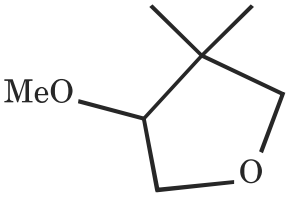

(D) I & II =

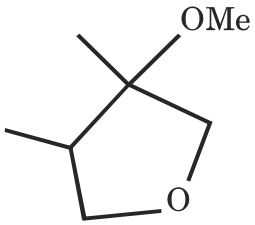


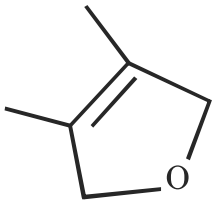
41. The major product of the following reaction is :




(A) 


(B) 


(C) 

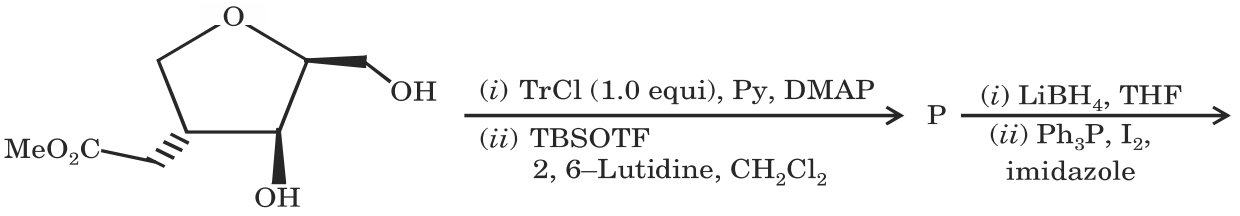

(D) 

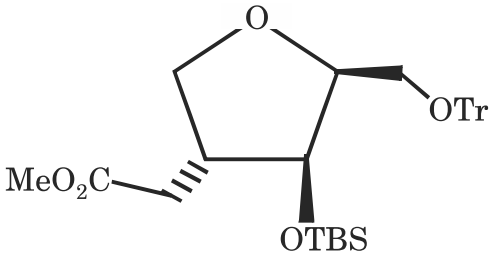


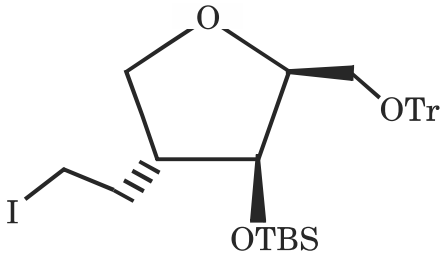

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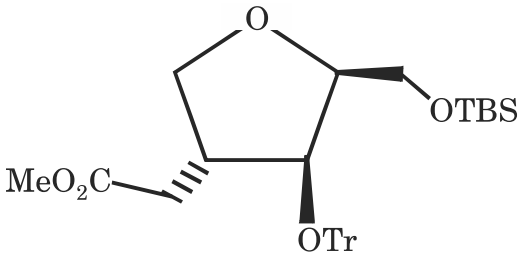
**APR- 33224/II—A**

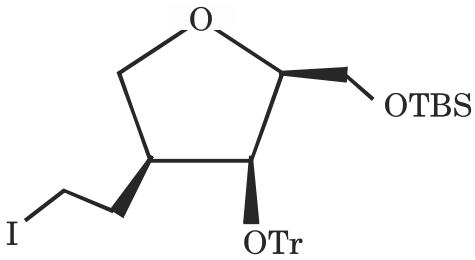
42. The major products of the following reaction is :

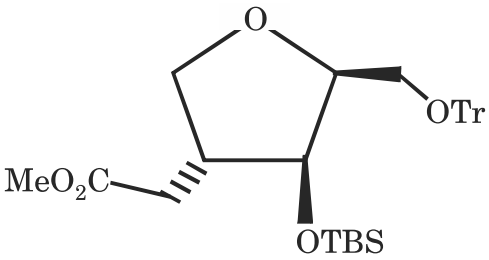


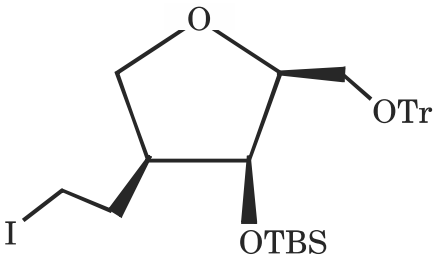

(A) P = 

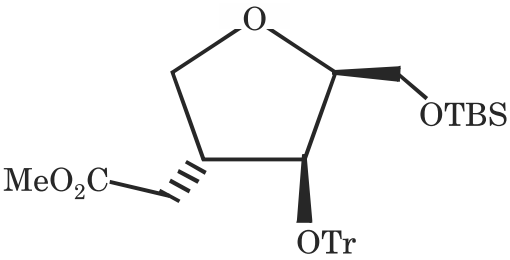
Q = 

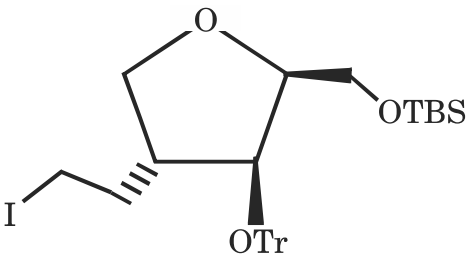

(B) P = 

Q = 


(C) P= 

Q = 


(D) P = 

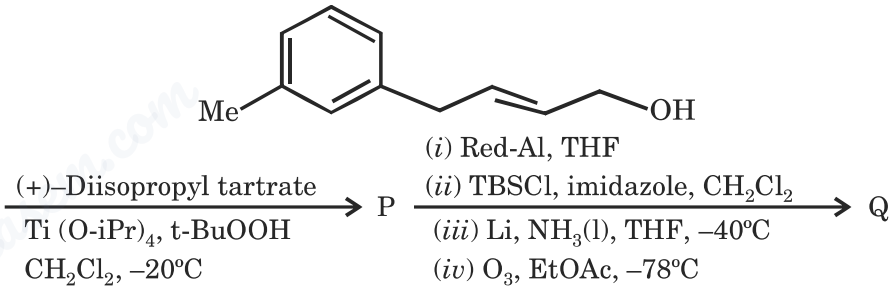
Q = 



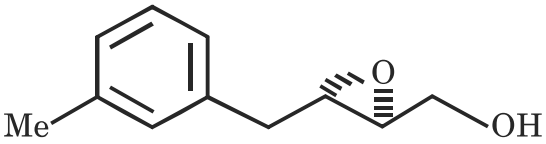

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**APR- 33224/II—A**

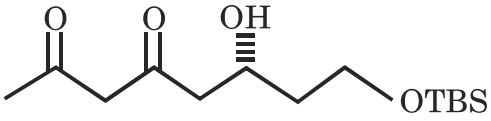
43. The major products formed in the following reaction is :



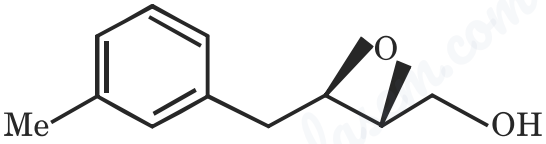

(A) P =



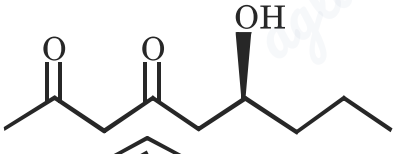

Q =



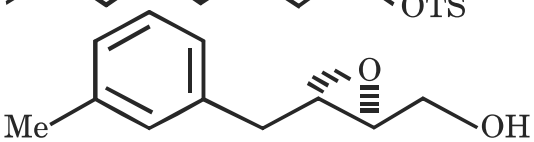

(B) P =



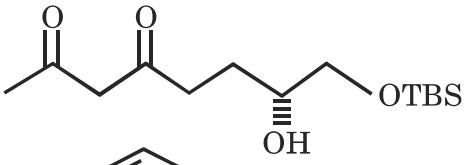

Q =



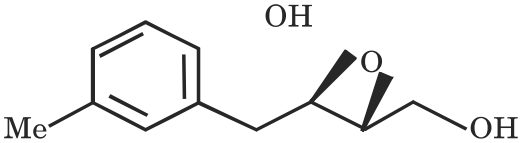

(C) P =



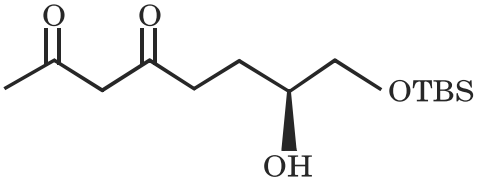

Q =




(D) P =



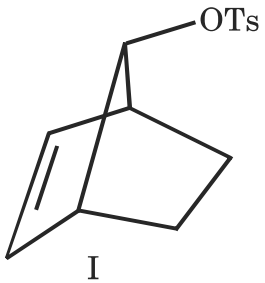

Q =



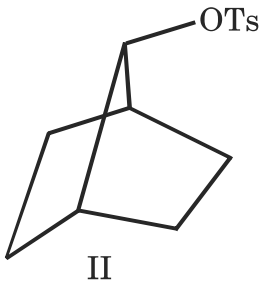



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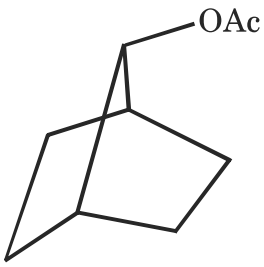
44. Which one of the following compounds undergoes solvolysis faster in HOAc and predict the major product ?

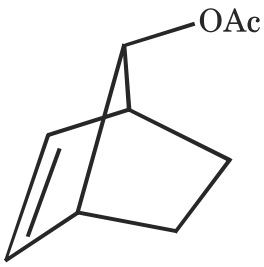


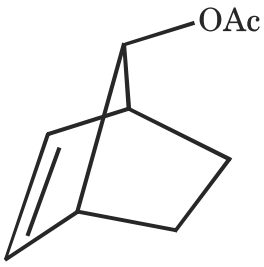

I

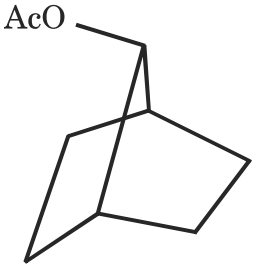



II

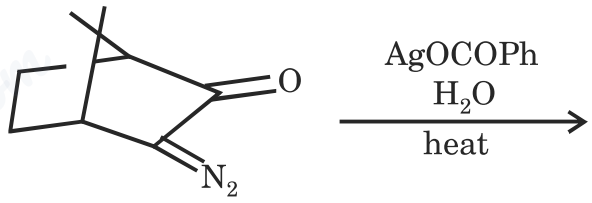
(A) II, 

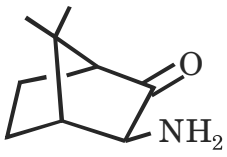

(B) I, 

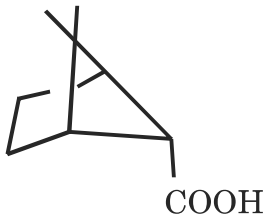

(C) II, 

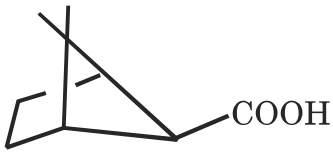

(D) I, 

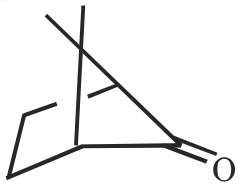
45. The major product of the following reaction is :




(A) 


(B) 

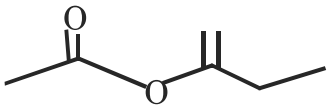

(C) 

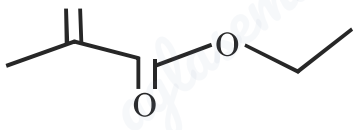

(D) 

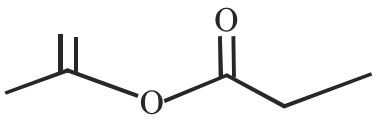

46. The compound that shows the following spectral data is,

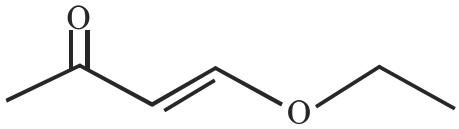
IR : 1720 $cm^{-1}$

$^1$H-NMR (ppm) : 1.30 (t, J = 7Hz, 3H), 1.93(s, 3H), 4.19(q, J = 7Hz, 2H), 5.58 (d, J = 3Hz, 1H), 6.15(d, J = 3Hz, $^1$H)

(A) 


(B) 

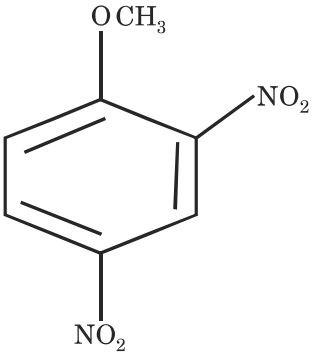

(C) 

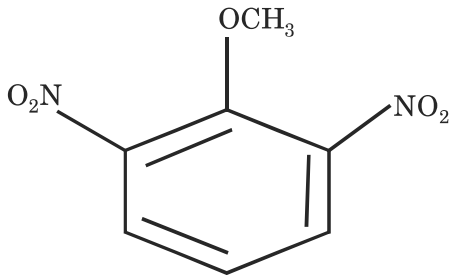

(D) 

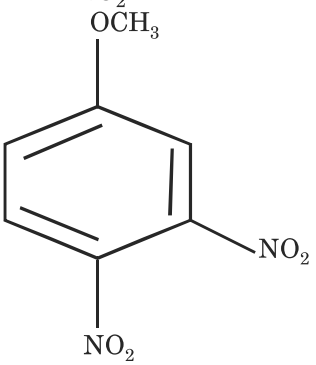


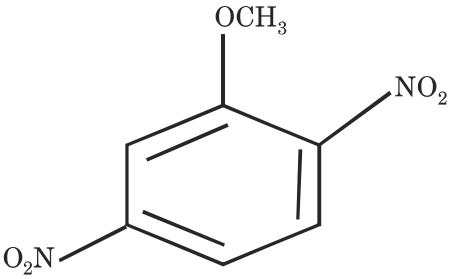

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47. The compound that shows the following spectral data is :
$^1$H-NMR (ppm) : 3.79 (s, 3H), 7.29 (d, J = 8Hz, 1H), 8.47 (dd, J = 8 and 2Hz, 1H), 9.11 (d, J = 2Hz, 1H).

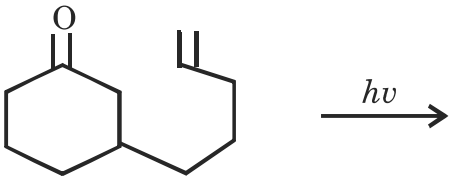
(A) 

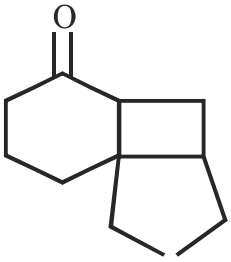
(B) 

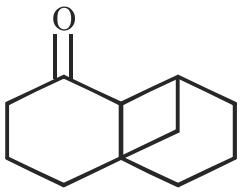
(C) 

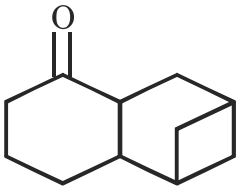
(D) 

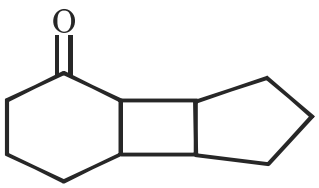
48. The major product of the following reaction is :



(A) 

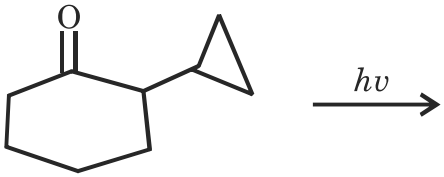
(B) 

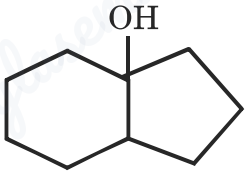
(C) 

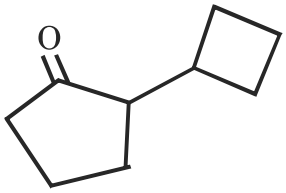
(D) 

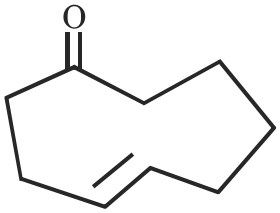
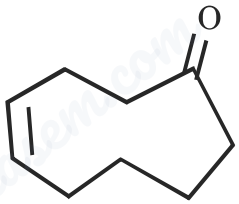
**APR- 33224/II—A**

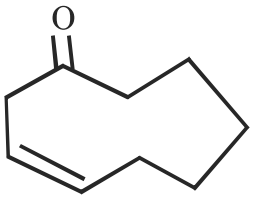
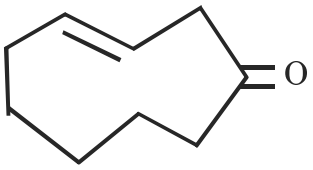
49. The major product(s) of the following reaction is/are :



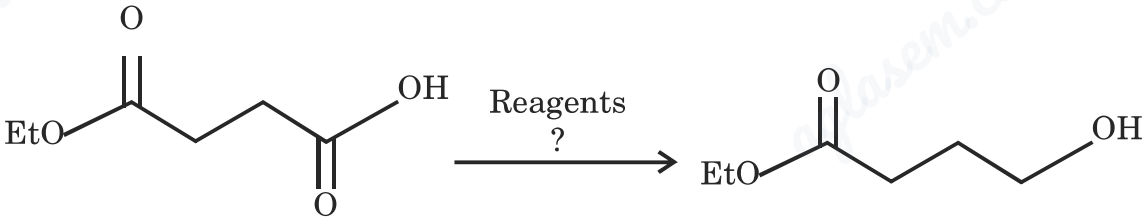

(A) 


(B) 


(C)  and 


(D)  and 


50. Predict the appropriate reagent for the following transformation :




(A) $LiBH_4$, MeOH

(B) LAH, THF

(C) $BH_3$ . THF

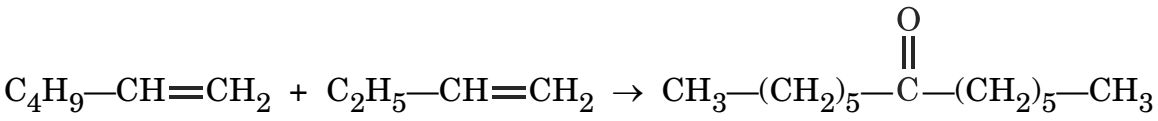
(D) $NaCNBH_3$, THF



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**APR- 33224/II—A**

51. The correct reagent for the following reaction is :



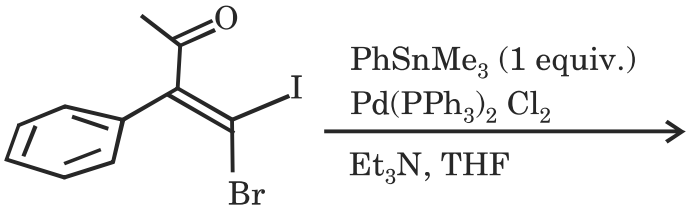
(A) Thexylborane; CO; $H_2O_2$/NaOH

(B) Thexylborane; $H_2O_2$/NaOH

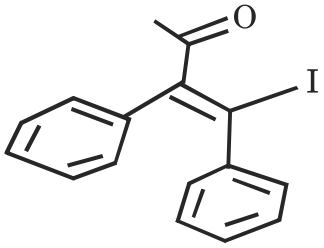
(C) 9-BBN; CO; $H_2O_2$/NaOH

(D) Triphenylborane; CO; $H_2O_2$/NaOH

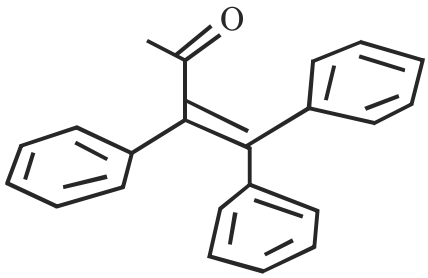
52. Predict the major product of the following reaction :



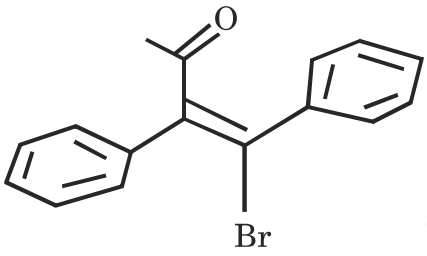

(A)



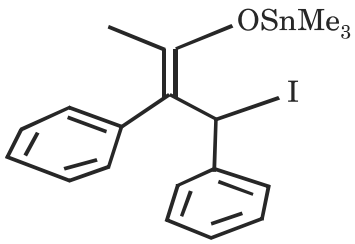

(B)




(C)

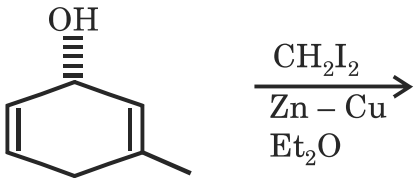


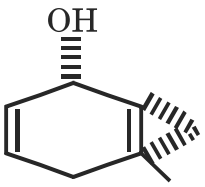

(D)

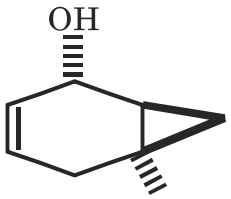


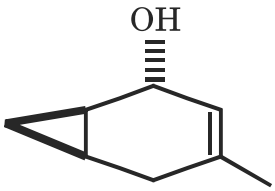
**APR- 33224/II—A**

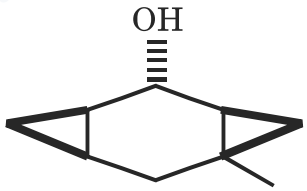
53. Predict the major product of the following reaction :



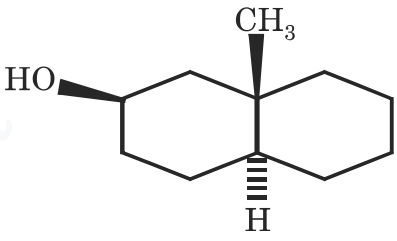

(A) 


(B) 

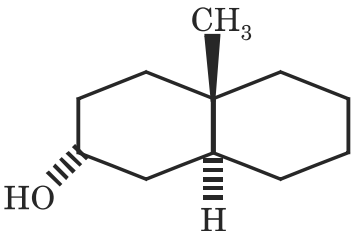

(C) 


(D) 

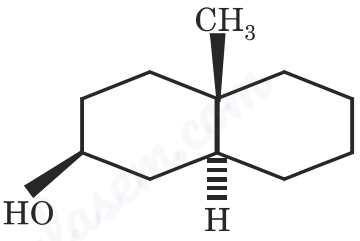

54. The *correct* order of reactivity of the following alcohols with *p*-nitrobenzoyl chloride in a esterification reaction is :




I




II




III

(A) III > II > I

(B) I > III > II

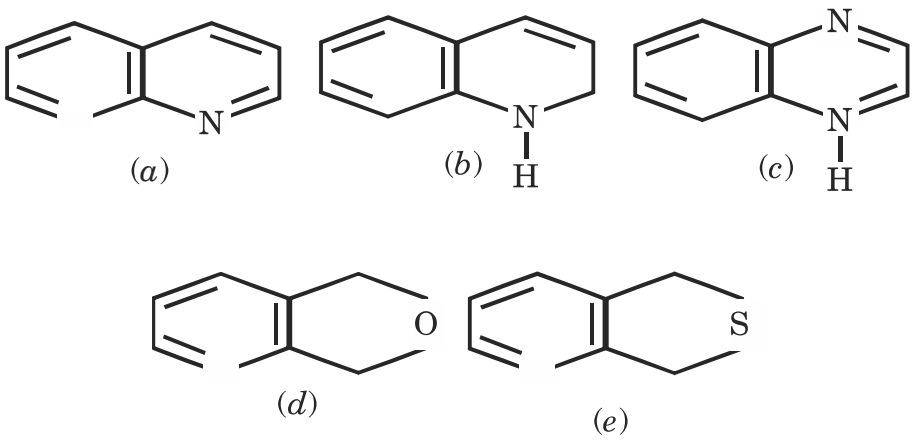
(C) II > III > I

(D) II > I > III



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55. List of isoelectronic compound is :



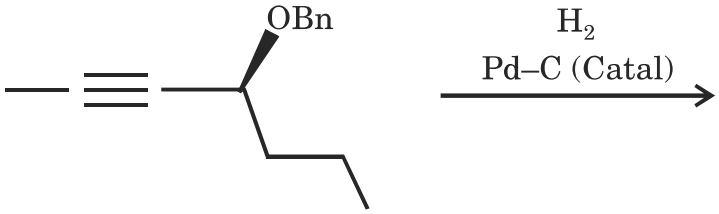

(A) (*a*), (*b*), (*d*)

(B) (*a*), (*b*), (*c*)

(C) (*a*), (*d*), (*e*)

(D) (*a*), (*b*), (*e*)

56. What will be the stereochemical outcome of the following reaction ?



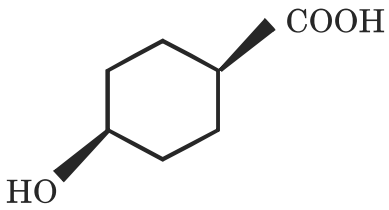

(A) Starting material is 'R', while the product has 'S' configuration

(B) Starting material is 'S', while the product has 'R' configuration

(C) Starting material and product both have 'S' configuration

(D) Starting material and product both have 'R' configuration

57. What position hydroxyl group of the alcohol will occupy in the most stable conformation of the following molecule ?



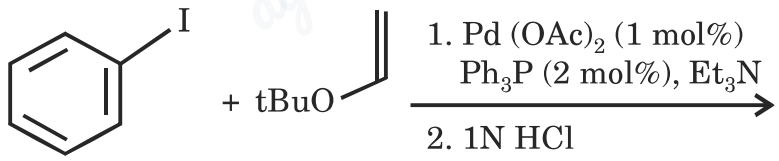

(A) Flagpole

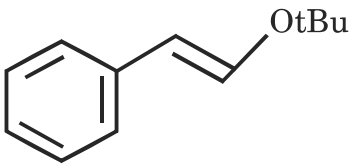
(B) Bowsprit

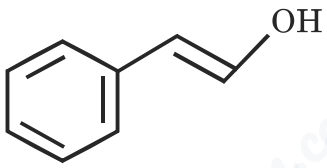
(C) Equatorial

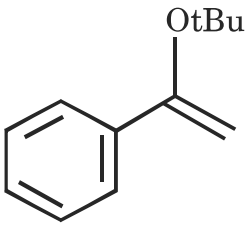
(D) Axial

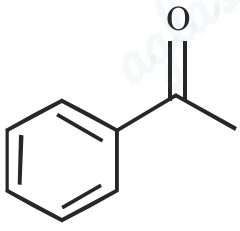
58. Predict the major product of the following reaction :




(A) 


(B) 

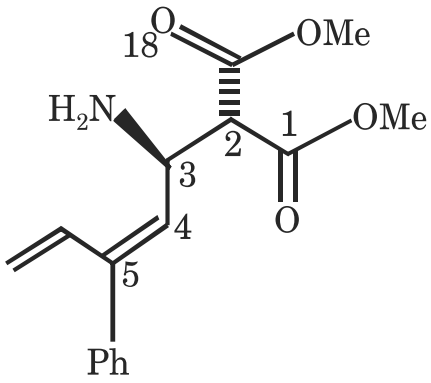

(C) 


(D) 




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59. Assign the chiral descriptors for the following molecule :



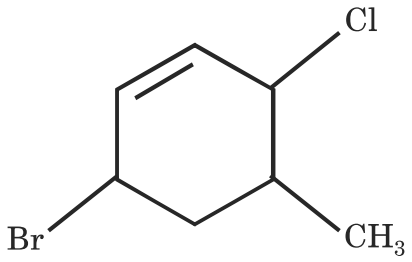

(A) 2S, 3S, E

(B) 2R, 3S, Z

(C) 2S, 3R, E

(D) 2S, 3R, Z

60. The IUPAC name of the following compound is :




(A) 6–Bromo – 3-chloro – 4-methyl cyclohexene

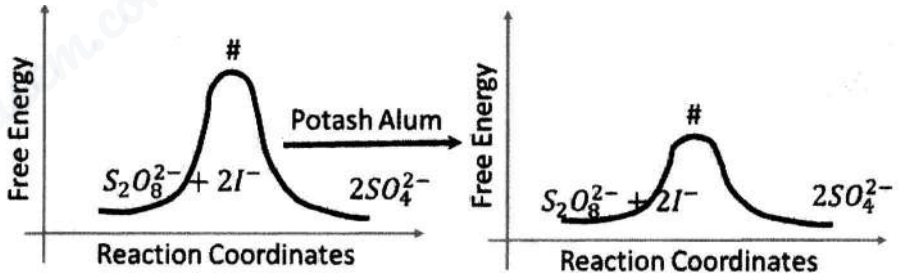
(B) 3–Bromo – 6-chloro – 5-methyl cyclohexene

(C) 1–Bromo – 4-chloro – 5-methyl cyclohex – 2-ene

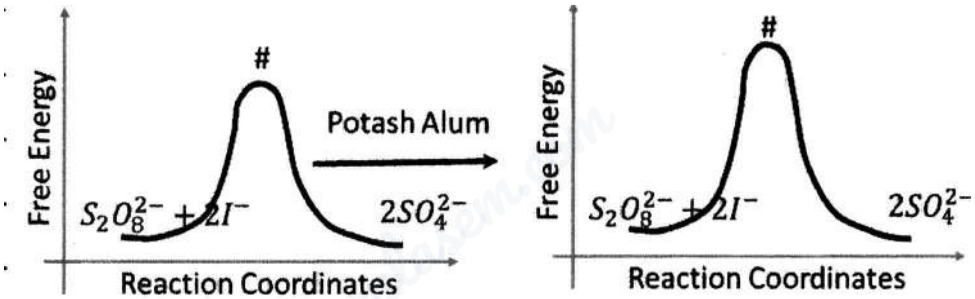
(D) 4–Bromo – 1-chloro – 6-methyl cyclohex – 2-ene

61. The following diagrams represent the effect of ionic strength on relative free energy of reactants and activated complex (≠). Which sketch, most appropriately represents the gist of primary salt effect ?

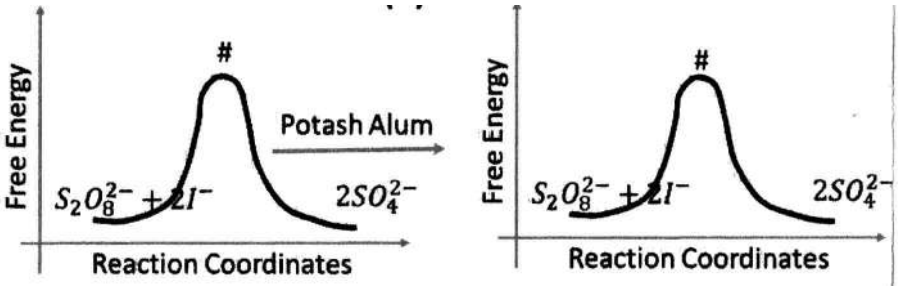
(A)



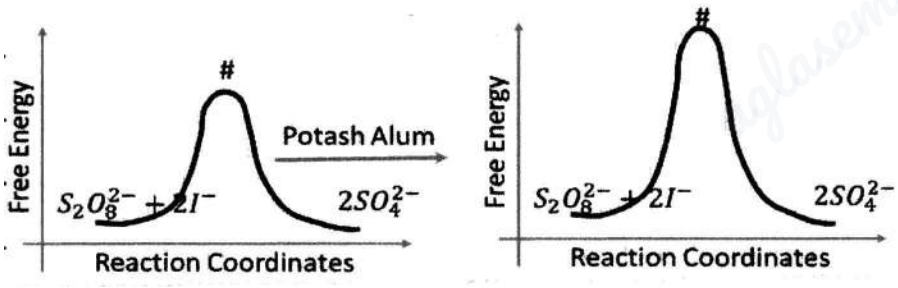

(B)




(C)




(D)






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62. Through activated complex theory, the mechanism of diffusion controlled reactions is expressed as :

$$A + B \underset{k_{esc}}{\overset{k_{enc}}{\rightleftharpoons}} (AB) \xrightarrow{k_r} P$$

$\because$ $k_{enc}$ $\equiv$ rate constant associated to encounter of reactant pair.

$k_{esc}$ $\equiv$ rate constant associated to escaping or separating pair.

The rate law is given as

$$\frac{d[P]}{dt} = \frac{k_r\, k_{enc}}{k_{esc} + k_r}[A][B]$$

The reaction would become diffusion controlled when :

(A) $k_r << k_{esc}$ (B) $k_r >> k_{esc}$

(C) $k_r << k_{esc} + k_{enc}$ (D) $k_{esc} = k_{enc}$

63. In the following reaction mechanism

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} X^*$$

$$X^* \xrightarrow{k_2} P$$

The rate constants have the relation

$$k_2 << k_1,\ k_{-1}$$

The mechanism can be qualified as :

(A) steady state approximation (B) Pre-equilibrium approximation

(C) principle of mass balance (D) ACT approximation

64. For the first order consecutive mechanism of the type

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C,$$

the concentration [B] is expressed as

$$[B] = \frac{k_1[A]_0}{k_2 - k_1}\left(e^{-k_1 t} - e^{-k_2 t}\right).$$

If $k_1 >> k_2$, then :

(A) $[B] = [A]_0\ e^{-k_1 t}$

(B) $[B] = [A]_0\ e^{-k_2 t}$

(C) $[B] = [A]_0\left(e^{-k_1 t} - e^{-k_2 t}\right)$

(D) $[B] = [A]_0\left(e^{-k_1 t} - e^{k_2 t}\right)$

65. In 1.0 M $H_2SO_4$ solution, the mean activity coefficient of $SO_4^{2-}$ ions can more accurately estimated by :

(A) Debye-Huckel theory of acid and base

(B) Debye-Huckel limiting law

(C) Debye-Huckel extended law

(D) Debye-Huckel theory for strong acids

66. Practically it is impossible to construct the standard hydrogen electrode (SHE) because :

(A) It is difficult to get high purity $H_2$ gas

(B) Due to vapour pressure of water, it is difficult to maintain exact 1 atm pressure of $H_2$ gas

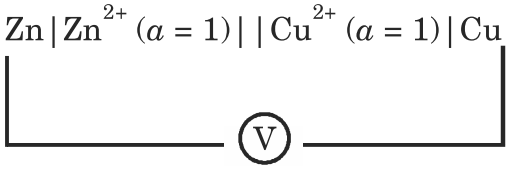
(C) Being inflammable, it is challenging to handle hydrogen gas in normal laboratory condition

(D) It is impossible to measure the exact activity of $H^+$ ions



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67. Daniell cell was shunted through very high impedance voltmeter :




The voltage was noted to be 1.10 V.

Based on this data, the equilibrium constant for the equilibrium (pK).

$$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$$

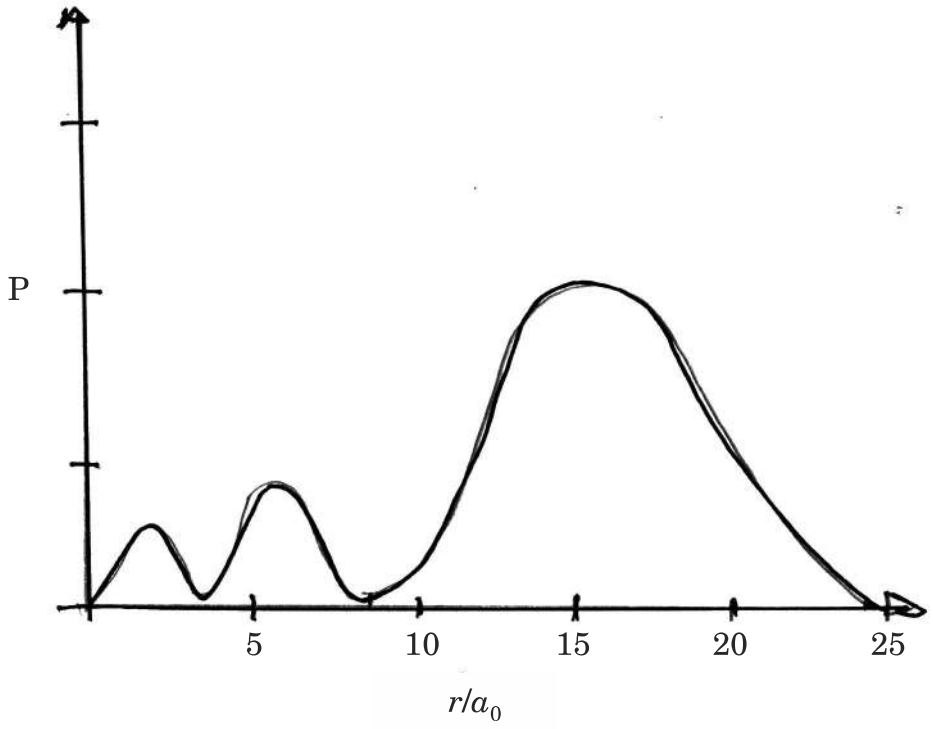
will be,

(Given : RT (at room temp) = 2500 $J.mol^{-1}$)

(A) pK = –80 (B) pK = –40

(C) pK = –30 (D) pK = –120

68. The following sketch represents the probability density distribution for :




(A) 3*s* orbital (B) 3*d* orbital

(C) 2*p* orbital (D) 1*p* orbital

69. Born interpretation of wave function is based on :

(A) Probability of finding the particle (electron) in the region $r$ and $r + dr$ is proportional to $|\psi|^2\ dr$.

(B) Continuous property of the chosen function throughout the limits

(C) Mathematical representation of observable of the particle

(D) Normalization property of certain mathematical function

70. Degeneracy in rotational levels for H-atom along $z$-axis for $l$ = 0, 1, 2, 3 are :

(Given : $\frac{\hbar^2}{2I} = 1.2 \times 10^{-21}$ J)

(A) 1, 2, 3, 4 (B) 1, 3, 5, 7

(C) 2, 4, 6, 8 (D) 1, 4, 9, 16

71. In X-ray diffraction, the rays are scattered from :

(A) atomic/ionic nuclei periodically arranged in crystal

(B) Lattice vibration (phonon) in the crystal

(C) Electrons cloud present in the crystal

(D) Electrostatic potential among ions in the crystal

72. Due to symmetry consideration associated to crystals, some of the reflections in X-ray diffraction are absent, systematically when symmetry increases from triclinic to cubic, the number of systematic absence :

(A) increases (B) decreases

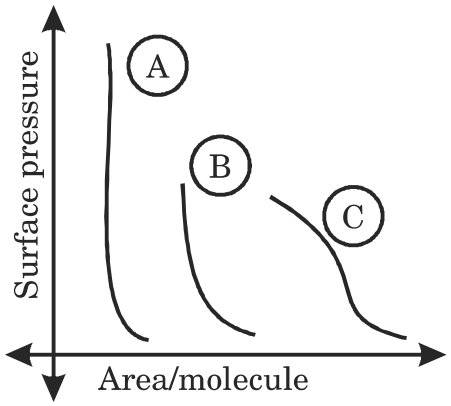
(C) no change (D) difficult to predict

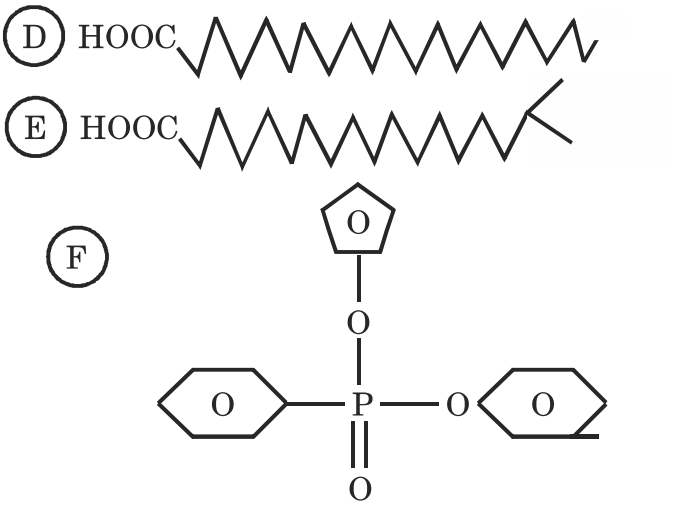


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**APR- 33224/II—A**

73. The following plots indicate, the surface pressure ($\pi$, $m$ N $m^{-1}$) *vs* area per surface active molecules viz. stearic acid, isostearic acid and tri-*p* cresyl phosphate :




Match the following :

(A) A ≡ D, B ≡ E, C ≡ F (B) A ≡ F, B ≡ E, C ≡ D

(C) A ≡ E, B ≡ F, C ≡ D (D) A ≡ E, B ≡ D, C ≡ F

74. The result of the following operation

$$\hat{A}\,(e^{ikx}) = \because \hat{A} = -i\hbar\frac{d}{dx}$$

is :

(A) $e^{ikx}$ (B) $ke^{ikx}$

(C) $k\hbar e^{ikx}$ (D) $k\hbar e^{ikx^2}$



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75. The change in the function ($f$) of two variables $x$ and $y$ will be exact if :

(A) $\left(\frac{\partial f}{\partial x}\right)_y = \left(\frac{\partial f}{\partial y}\right)_x$

(B) $\left(\frac{\partial^2 f}{\partial x^2}\right)_y = \left(\frac{\partial^2 f}{\partial y^2}\right)_x$

(C) $\left(\frac{\partial^2 f}{\partial x . \partial y}\right) = \left(\frac{\partial^2 f}{\partial y . \partial x}\right)$

(D) $(\partial f)_x = (\partial f)_y$

76. The partial pressure of $NO_2(g)$ at 1 atm. of total pressure in the reaction given below is :

($\alpha$ = degree of dissociation)

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$$

(A) $\frac{2\alpha}{(1+\alpha)}$

(B) $\frac{(1-\alpha)}{(1+\alpha)}$

(C) $\frac{2(1+\alpha)}{(1-\alpha)}$

(D) $\frac{(1-\alpha)}{2\alpha}$

77. The normal boiling point of a liquid is 200 K. If the liquid behaves as ideal liquid at 76 mm, then its boiling point will be close to : (Given : $\frac{\Delta H}{R} \approx 2303\,K$)

(A) 167 K

(B) 20 K

(C) 200 K

(D) 440 K

78. For Maxwell-Boltzmann statistics which of the following statements is *incorrect* ?

(A) System has constant volume and constant total energy

(B) The energy levels are eigen values of Schrodinger equation

(C) All possible distributions are equally probable

(D) Total energy depend upon the number of energy levels available



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79. When in an ensemble the condition of constant temperature is replaced by the constant energy condition, each system behaves as :

(A) Closed
(B) Open
(C) Isolated
(D) Condensed

80. At what temperature, the population in $v$ = 1 level of $I_2$ would become half the population in ground energy level ? (Given : $\frac{hc\bar{v}}{k}$ = 346.5 K)

(A) 773 K
(B) 500 K
(C) 227 K
(D) 300 K

81. The transmittance of a solution is 0.900 in 10 mm cell at certain wavelength. What will be the transmittance of this solution in 5 cm cell at the same wavelength ?

(A) 1.000
(B) 0.450
(C) 0.180
(D) 0.100

82. Every alternate line in Raman spectra of a symmetric top molecule has increased intensity because of :

(A) Existence of nuclear spin
(B) Overlapping of S-branch lines with every alternate R-branch line
(C) Selection rule $\Delta K = 0$
(D) Combined rotational Raman spectra

83. Assign the spectral lines given in the table to different vibrational modes of $A_2B$ type molecule :

| | $\bar{\upsilon}(cm^{-1})$ | Description |
|---|---|---|
| (1) | 590 | IR-active (PQR branches) |
| (2) | 1290 | Raman active, polarized |
| | | IR-active (PR branches) |
| (3) | 2220 | Raman active, depolarized |
| | | IR-active (PR branches) |

(A) 1→ bending, 2→ symmetric stretching, 3→ asymmetric stretching

(B) 1→ bending, 2→ asymmetric stretching, 3→ symmetric stretching

(C) 1→ symmetric stretching, 2→ asymmetric stretching, 3→ bending

(D) 1→ asymmetric stretching, 2→ bending, 3→ symmetric stretching

84. For a free electron placed in magnetic field strength of 1.6 T, the value of magneton will be :

(A) $9.273 \times 10^{-28}\ JT^{-1}$ (B) $9.273 \times 10^{-28}\ JG^{-1}$

(C) $9.273 \times 10^{-24}\ JG^{-1}$ (D) $0.9273 \times 10^{-28}\ JT^{-1}$

85. The molecular population is :

(A) Proportional to $(2J + 1)^{-1}$ (B) Proportional to $\frac{(2J + 1)}{e^{-E/kT}}$

(C) Proportional to $(2J + 1)e^{-E/kT}$ (D) Proportional to $(2J + 1)^{-1}\ e^{E/kT}$



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86. For a stone weighing 100 g located within 0.1 Å, which of the following statements is *incorrect* ?

(Given : $\frac{h}{4\pi} = 5.27 \times 10^{-35}$ kg. $m^2.s^{-1}$).

(A) Uncertainty in velocity is negligible

(B) Both position and velocity can be determined with reasonable precision

(C) Position of stone is precisely known

(D) Velocity cannot be measured accurately

87. The most probable distance of 1*s* electron in hydrogen like atom with atomic number '*z*' is given by :

(A) $\frac{z^3}{a_0}$ (B) $z.a_0$

(C) $\frac{a_0}{z}$ (D) $z^3.a_0$

88. By applying variation method, the ground state energy of the electron in hydrogen atom is (in a.u.) :

(A) –2.75 (B) –0.5

(C) –2 (D) 0

89. In stepwise polymerization, the addition of a small amount of catalyst results into :

(A) Increase in time required to reach high degree of polymerization

(B) No effect on molecular weight distribution

(C) Reduction in time required for reaching high degree of polymerization

(D) Lowering of esterification

90. The adsorption of solution on a solid surface follows the equation $\frac{x}{m} = k.c^{1/n}$.

The plot of log $\left(\frac{x}{m}\right)$ versus log $(c)$ gives a horizontal line. It means :

(A) C = 0 (B) C = constant

(C) $\frac{1}{n} = 0$ (D) C = $\frac{1}{n}$

91. The strongest acid among the following is :

(A) $H_2SO_4$ (B) $HNO_3$

(C) $[SbF_6]^-H_2F^+$ (D) HI

92. The following is the application of nanotechnology in recent years :

(A) Corona vaccines (B) Pregnancy test kit

(C) Steel industry (D) Paper industry

93. The ground state energy of hydrogen like species is proportional to :

(A) $\frac{-R}{n^2}$ (B) $\frac{-Rz^2}{n^2}$

(C) $\frac{Rz^2}{n^2}$ (D) $\frac{Rz}{n}$

94. The point group of $CO_3^{2-}$ is :

(A) $C_3h$ (B) $D_3h$

(C) $C_3v$ (D) None of these

95. According to molecular orbital theory, the correct order of energy for $\sigma_{2p}$ orbital is :

(A) $C_2 < N_2 < O_2$ (B) $N_2 < C_2 < O_2$

(C) $N_2 < O_2 > C_2$ (D) $C_2 < N_2 > O_2$



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96. The answer of multiplication (4.26 × 8.003 × 2.09) can be expressed as :

(A) 71.2539102 (B) 71.2539

(C) 71.25 (D) 71.2

97. The increasing order of acidity of pentafluorides ($SbF_5$, $NbF_5$, $PF_5$, $AsF_5$ and $TaF_5$) in fluorosulphonic acid is :

(A) $SbF_5 > AsF_5 > PF_5 > TaF_5 \cong NbF_5$

(B) $SbF_5 > AsF_5 > TaF_5 \cong NbF_5 > PF_5$

(C) $PF_5 > NBF_5 > TaF_5 > AsF_5 > SBF_5$

(D) $SbF_5 > AsF_5 > TaF_5 > NbF_5 > PF_5$

98. Acetylene can be converted to 1-Bromo pentane via coupling of 1-Bromopropane. The set of reagents required are :

(A) $NaNH_2$, $CH_3CH_2CH_2Br$; $H_2$/Lindlar cut; HBr, $H_2O_2$

(B) $NaNH_2$, $CH_3CH_2CH_2Br$; $H_2$, Pd/C; HBr

(C) $NaNH_2$, $CH_3CH_2CH_2Br$; $LiAlH_4$; HBr, $H_2O_2$

(D) $NaNH_2$, $CH_3CH_2CH_2Br$; $H_2$/Lindlar; HBr

99. A prodrug is :

(A) A protype member of a class of drugs

(B) The oldest member of a class of drugs

(C) An inactive drug that is transformed in the body to an active metabolite

(D) A drug that is stored in the body tissues and is gradually released in the circulation

100. Which of the following compounds is an alkaloid ?

(A) Morphine (B) Tocopherol

(C) Carvone (D) Camphor

**ROUGH WORK**

## ROUGH WORK