Paper-II
CHEMICAL SCIENCE

Signature and Name of Invigilator

Seat No. [ ][ ][ ][ ][ ]

1. (Signature) ....

(In figures as in Admit Card)

(Name) ....

2. (Signature) ....

Seat No. ....

(In words)

(Name) ....

OMR Sheet No. [ ][ ][ ][ ][ ][ ]

JAN - 33218

(To be filled by the Candidate)

Time Allowed : 1¼ Hours]

[Maximum Marks : 100

Number of Pages in this Booklet : **20**

Number of Questions in this Booklet : **50**

| Instructions for the Candidates	विद्यार्थ्यांसाठी महत्त्वाच्या सूचना
1. Write your Seat No. and OMR Sheet No. in the space provided on the top of this page.	1. परिक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोप-यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
2. This paper consists of **50** objective type questions. Each question will carry *two* marks. *All* questions of Paper-II will be compulsory, covering entire syllabus (including all electives, without options).	2. सदर प्रश्नपत्रिकेत **50** बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास **दोन** गुण आहेत. या प्रश्नपत्रिकेतील **सर्व** प्रश्न सोडविणे अनिवार्य आहे. सदरचे प्रश्न हे या विषयाच्या संपूर्ण अभ्यासक्रमावर आधारित आहेत.
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 :	3. परीक्षा सुरु झाल्यावर विद्यार्थ्याला प्रश्नपत्रिका दिली जाईल. सुरुवातीच्या 5 मिनिटांमध्ये आपण सदर प्रश्नपत्रिका उघडून खालील बाबी अवश्य तपासून पहाव्यात.
(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.	(i) प्रश्नपत्रिका उघडण्यासाठी प्रश्नपत्रिकेवर लावलेले सील उघडावे. सील नसलेली किंवा सील उघडलेली प्रश्नपत्रिका स्विकारू नये.
(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.**	(ii) **पहिल्या पृष्ठावर नमूद केल्याप्रमाणे प्रश्नपत्रिकेची एकूण पृष्ठे तसेच प्रश्नपत्रिकेतील एकूण प्रश्नांची संख्या पडताळून पहावी. पृष्ठे कमी असलेली/कमी प्रश्न असलेली/प्रश्नांचा चूकीचा 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) After this verification is over, the OMR Sheet Number should be entered on this Test Booklet.	(iii) वरीलप्रमाणे सर्व पडताळून पहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा नंबर लिहावा.
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)	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. 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.	5. या प्रश्नपत्रिकेतील प्रश्नांची उत्तरे **ओ.एम.आर. उत्तरपत्रिकेतच दर्शवावीत.** इतर ठिकाणी लिहीलेली उत्तरे तपासली जाणार नाहीत.
6. Read instructions given inside carefully.	6. आत दिलेल्या सूचना काळजीपूर्वक वाचाव्यात.
7. Rough Work is to be done at the end of this booklet.	7. प्रश्नपत्रिकेच्या शेवटी जोडलेल्या को-या पानावरच कच्चे काम करावे.
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.	8. 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.
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.	9. परीक्षा संपल्यानंतर विद्यार्थ्याने मूळ ओ.एम.आर. उत्तरपत्रिका पर्यवेक्षकांकडे परत करणे आवश्यक आहे. तथापी, प्रश्नपत्रिका व ओ.एम.आर. उत्तरपत्रिकेची द्वितीय प्रत आपल्याबरोबर नेण्यास विद्यार्थ्यांना परवानगी आहे.
10. **Use only Blue/Black Ball point pen.**	10. **फक्त निळ्या किंवा काळ्या बॉल पेनाचाच वापर करावा.**
11. **Use of any calculator or log table, etc., is prohibited.**	11. **कॅलक्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही.**
12. **There is no negative marking for incorrect answers.**	12. **चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही.**

Chemical Science
## Paper II

Time Allowed : 75 Minutes]   **[Maximum Marks : 100**

Note : This Paper contains **Fifty (50)** multiple choice questions. Each question carrying **Two (2)** marks. Attempt *All* questions.

1. Number of signals observed in the ^{1}H NMR and proton decoupled ^{13}C NMR spectrum of the following compound, respectively, are :
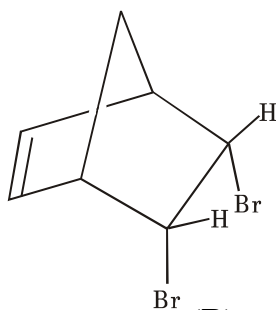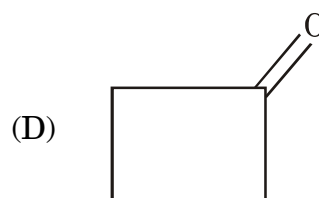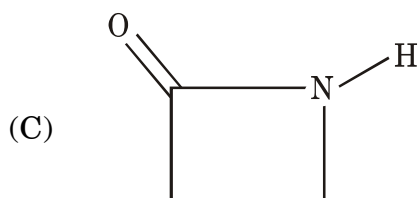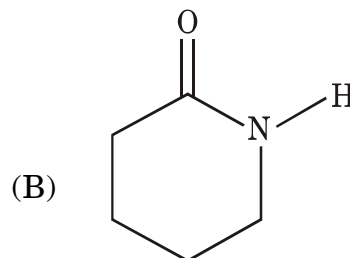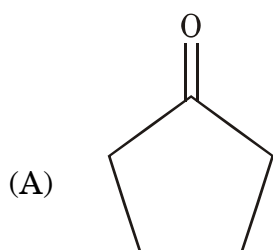

  (A)   4, 4   (B)   5, 4
  (C)   8, 7   (D)   8, 4

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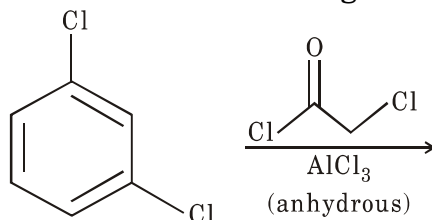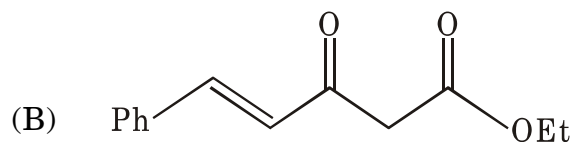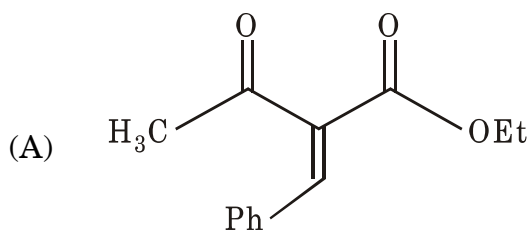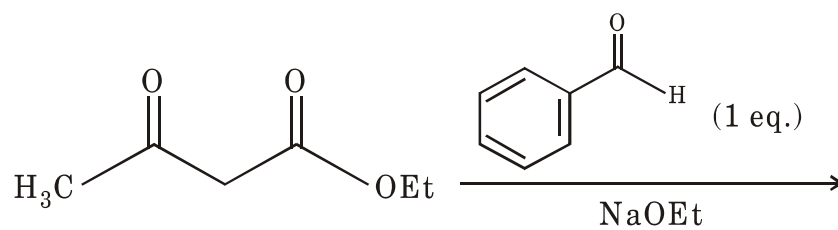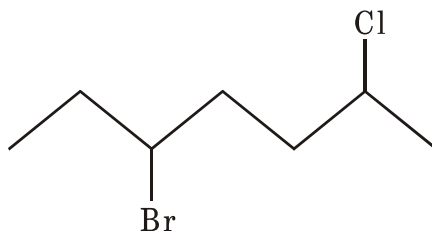

(A)

(B)

(C)

(D)

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3. Amongst the following, the compound that will show IR absorption band at 1780 cm^{-1} is :

(A)

(B)

(C)

(D)

4. Major product of the following reaction is :

(A)

(B)

(C)

(D)
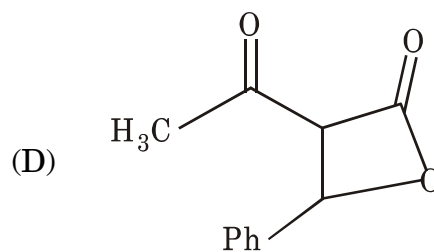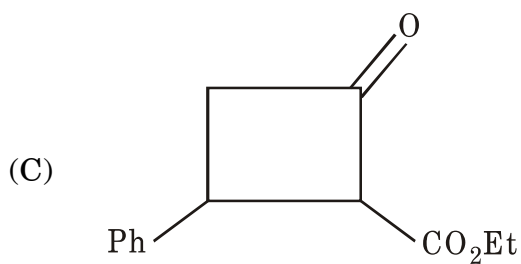
5. The *correct* IUPAC nomenclature of the following compound is :
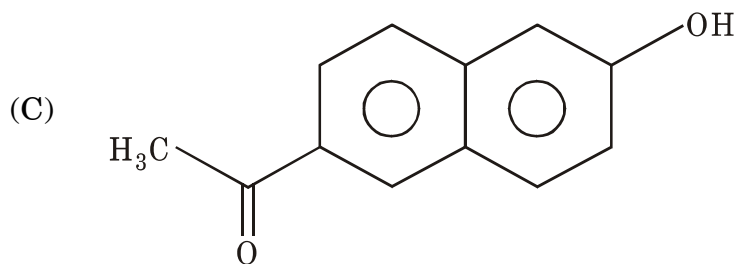

(A) 5-Bromo-2-chloroheptane
(B) 2-Chloro-5-bromoheptane

(C) 3-Bromo-6-chloroheptane
(D) 6-Chloro-3-bromoheptane

6. Number of signals observed in the ^{1}H NMR spectrum is *p*-tolualdehyde is :

(A) 3
(B) 4

(C) 5
(D) 6

7. The *correct* absolute configuration for the chiral centers in the following compound is :
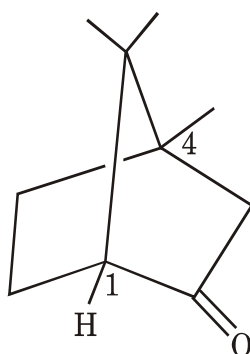
(A) 1S, 4S
(B) 1S, 4R

(C) 1R, 4R
(D) 1R, 4S

[P.T.O.

8. Major product formed in the following reaction is :

$$\xrightarrow[\text{2. HCl, H}_2\text{O work up}]{\text{1. AlCl}_3 \text{ (anhydrous)}}$$

(A)

(B)

(C)

(D)

9. Multiplicity of the signal expected in the ^1H NMR spectrum of the following compound is :

(A) singlet   (B) doublet

(C) triplet   (D) AB quartet

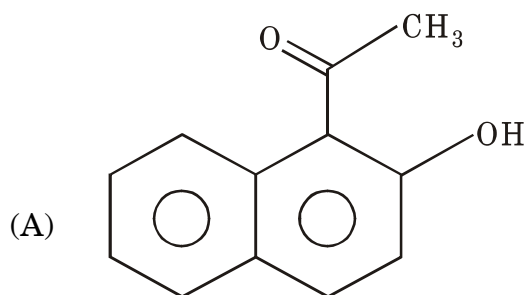10. The *correct* IUPAC nomenclature of the following compound is :

(A) 2-Nitro-5-carbaldehydo anisole

(B) 2-Methoxy-4-carbaldehydo nitrobenzene

(C) 4-Nitro-5-methoxy benzaldehyde

(D) 3-Methoxy-4-nitro benzaldehyde

[P.T.O.
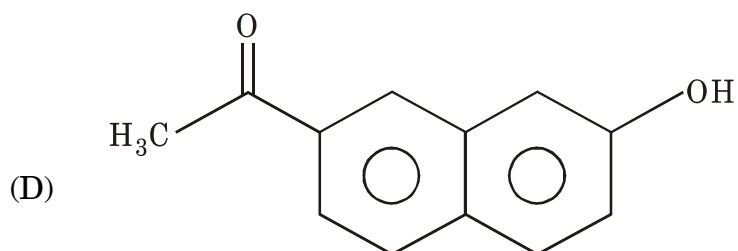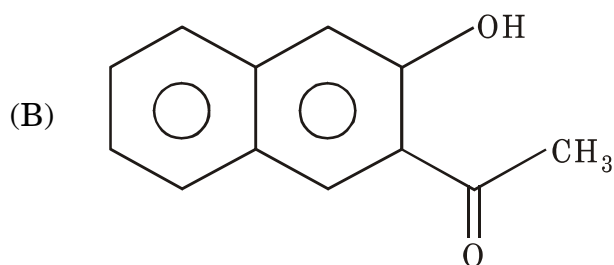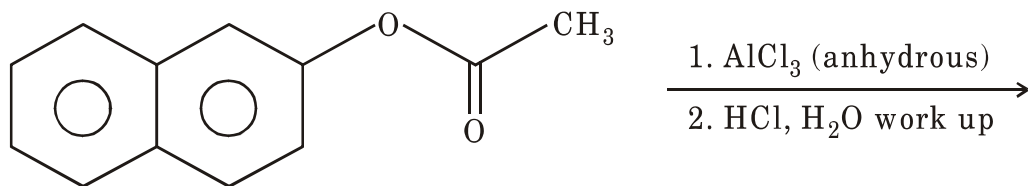
11.   The least stable conformation of 2-methylbutane is :

(A)

(B)

(C)

(D)

12. The major product formed in the following reactions is :

$\xrightarrow{\text{Li/liq. NH}_3}$

(A)

(B)

(C)

(D)
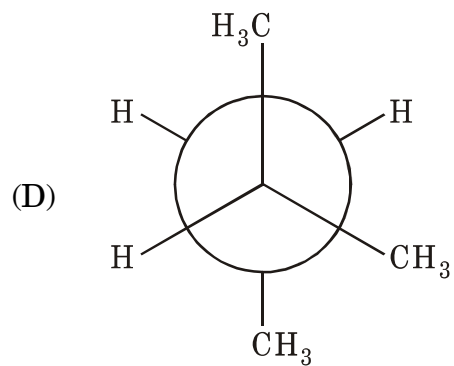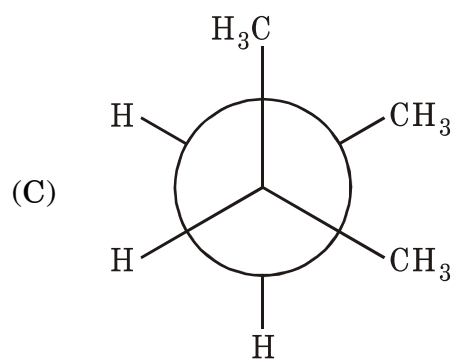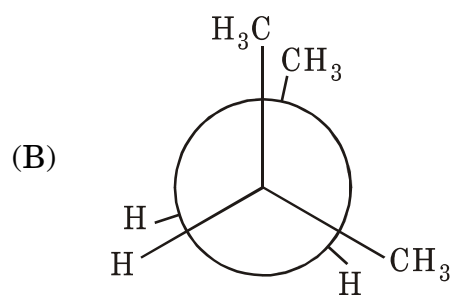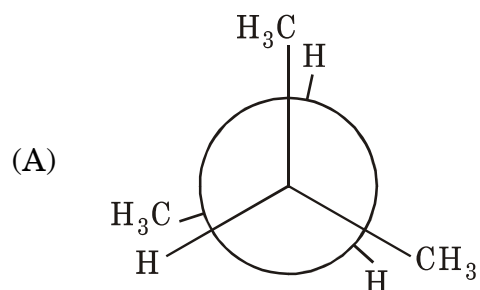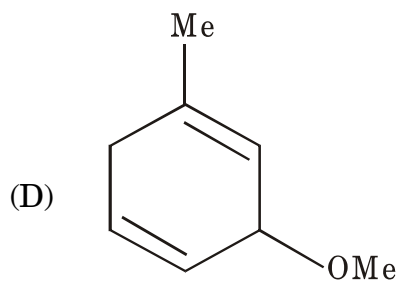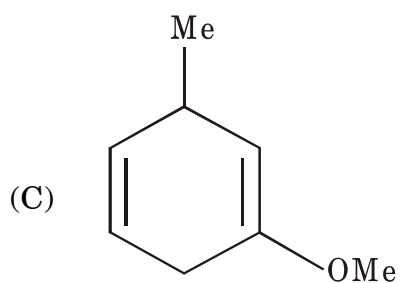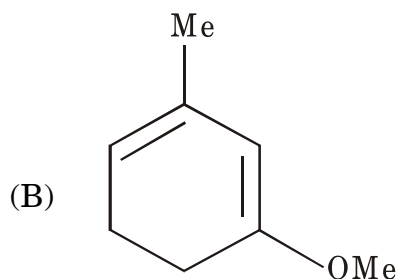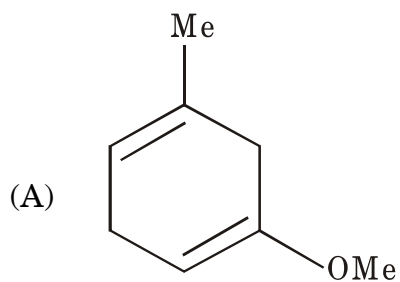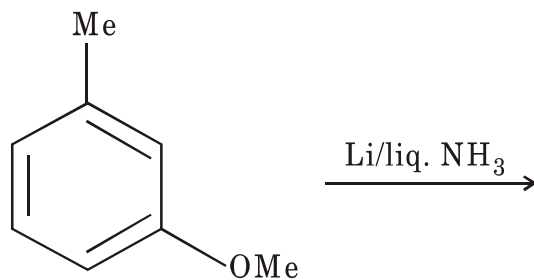
13. Major product formed in the following reaction is :

$(i)\ B_2H_6$
$(ii)\ H_2O_2,\ NaOH$

(A)

(B)

(C)

(D)
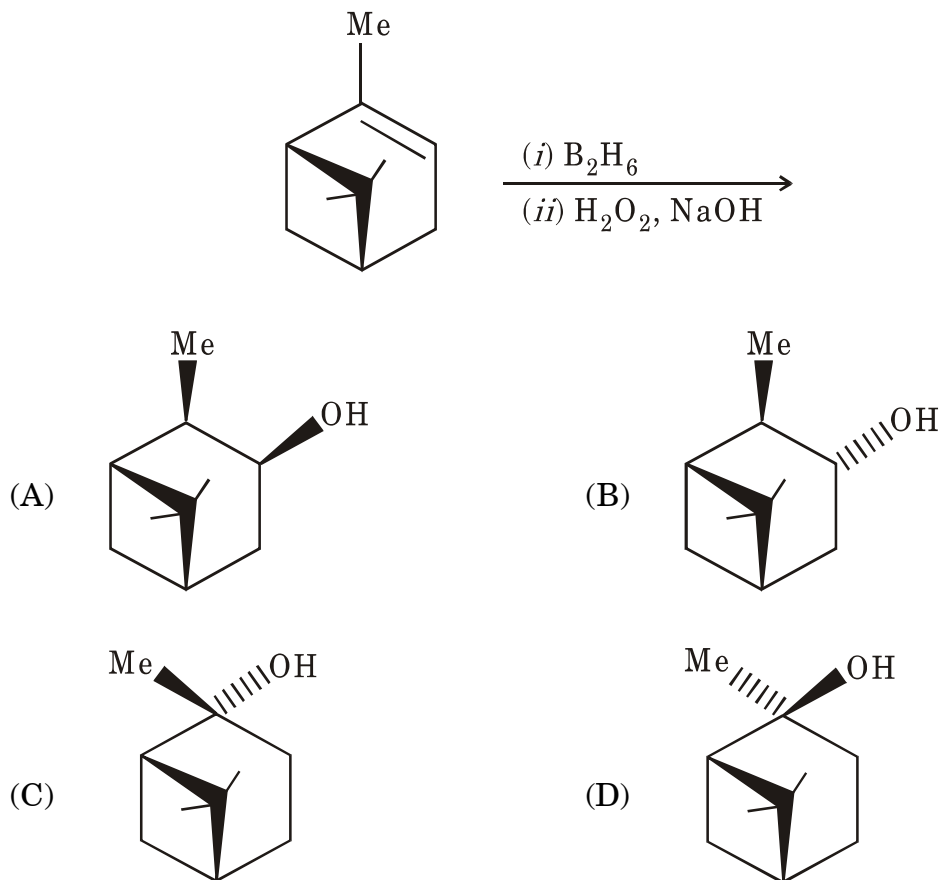
14. Chiral compound amongst the following is :

(A)

(B)

(C)

(D)

$Cr(CO)_3$

10
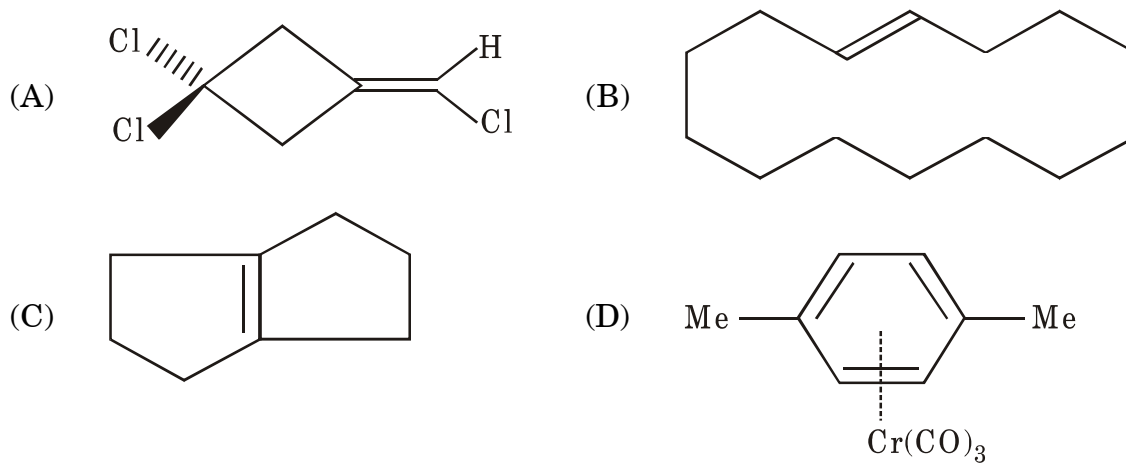
15. The freezing point of a mixture containing 1·60 g of naphthalene (molar mass = 128 g mol^{-1}) and 20 g of benzene (molar mass = 78 g mol^{-1}) is 2·8°C and that of pure benzene is 5·5°C. The value of the molal freezing point depression constant of benzene is :

   (A)   4·3°C kg mol^{-1}
   (B)   4·3°C g mol^{-1}

   (C)   4·3°C mol kg^{-1}
   (D)   5·1°C mol g^{-1}

16. The vapour pressure of 0·5 M aqueous KNO_3 solution is 749·7 torr at 100°C. The activity of water in this solution at 100°C is :

   (A)   0·9218
   (B)   1·0023

   (C)   1·0230
   (D)   0·9864

17. When an ideal kept in a closed container at constant volume was cooled from 50°C to 25°C, it will lead to :

   (A)   Increase in the numbers of collisions per unit time

   (B)   Increase in the mean free path of the gas

   (C)   Increase in the average velocity of the gas

   (D)   Decrease in the average velocity of the gas

18. For the decomposition reaction

$$A_3 \rightarrow 3/2A_2$$
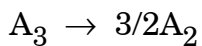
The following concentration *Vs.* time profiles were obtained. At time t_A, percentage of A_3 decomposed is :
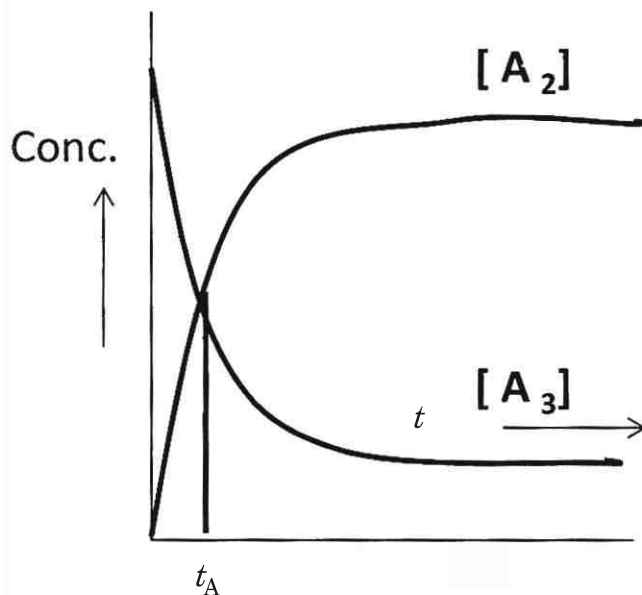
(A)   75   (B)   50
(C)   25   (D)   10

19. In the reaction :

$$Cl_{2(g)} + 3F_{2(g)} \rightleftharpoons 2ClF_3; \quad \Delta H_r = -329 \text{ kJ}$$

When the reaction is in equilibrium, which of the following will increase the amount of ClF_3 ?
   (I)   Increasing the temperature
   (II)   Increasing the volume of the reactor
   (III) Removing Cl_2
   (IV)   Adding F_2
   (A)   I, II and III   (B)   IV only
   (C)   I and IV   (D)   II and IV

20. In the reaction :

$$ZnO + X + heat \rightarrow Zn + XO$$

Which element represented by X is industrially used to produce Zn metal ?
   (A)   Cu   (B)   C
   (C)   Hg   (D)   Pb

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21. Which of the following is *not* a redox reaction ?

    (A) $CuO + H_2 \longrightarrow Cu + H_2O$

    (B) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

    (C) $2K + F_2 \longrightarrow 2KF$

    (D) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

22.
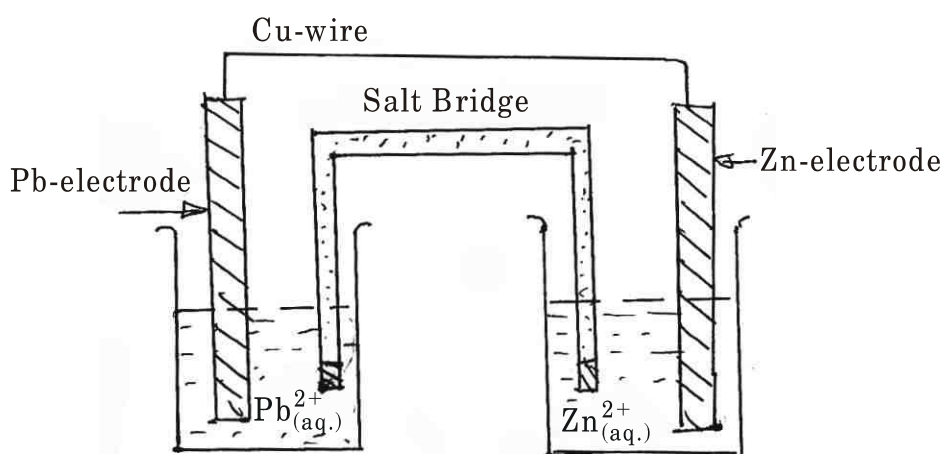
Which of the following statements best describes the flow of electrons in the above electrochemical cell ?

    (A)   From Pb electrode to Zn electrode through the Cu wire

    (B)   From Pb electrode to Zn electrode through the salt bridge

    (C)   From the Zn electrode to Pb electrode through the salt bridge

    (D)   From Zn electrode to Pb electrode through Cu wire

23. A radioactive substances has half life of 140 days. The fraction of the substance that will remain after 2 years and 250 days is :

    (A)   1/7   (B)   1/14

    (C)   127/128   (D)   1/128

24. To balance the following reaction :

$$SO_{3(aq.)}^{2-} + H_2O \longrightarrow SO_{4(aq.)}^{2-} + 2H^+ \text{ (aq.)}$$
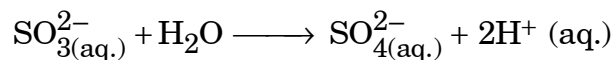
one needs to :

(A)   Add $2H_2O$ to the left side

(B)   Add $2e^-$ to the right side

(C)   Add $2e^-$ to the left side

(D)   Multiply both sides by a factor of 2

25. When a small amount of copper powder is added to $ZnSO_4$ solution, what would be the observation ?

(A)   Effervesence   (B)   Precipitation of a white solid

(C)   Formation of a blue solution   (D)   No reaction

26. General acid (A) Base (B) titration curve is represented as follows :
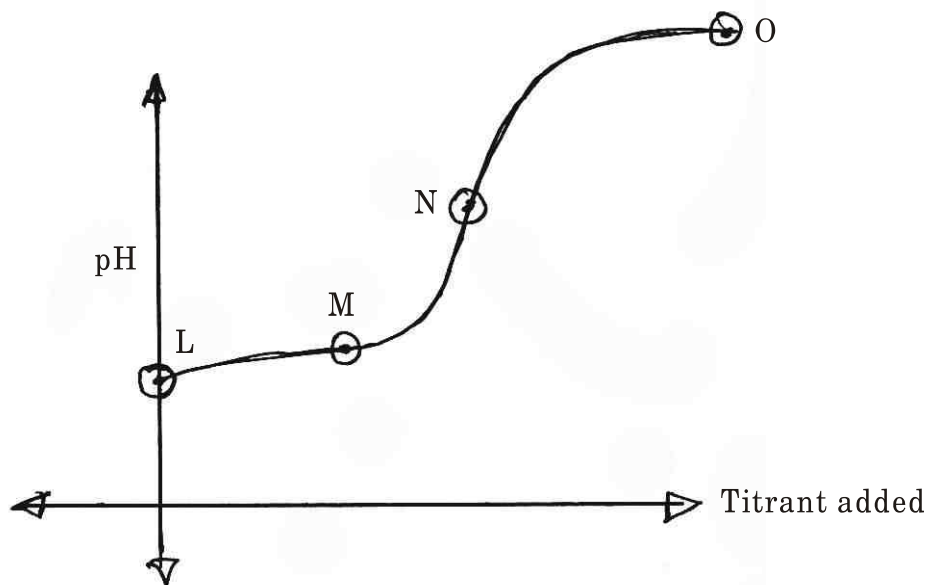
What should be the equation for estimation of pH at point (L) :

(A) $pH = pK_w + \log [B]$ (B) $pH = \dfrac{1}{2}pK_a + \dfrac{1}{2}pK_w$

(C) $pH = \dfrac{1}{2}pK_a - \dfrac{1}{2}\log [A]_{initial}$ (D) $pH = pK_a$

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27. The stoichiometric point of the titration of $25 \cdot 0$ mL, $0 \cdot 100$ M HClO with $0 \cdot 10$ M NaOH$_{(aq)}$ occurs when the molar concentration of NaClO is $0 \cdot 050$ M. The pH of this solution is about (given pK_a of HClO = $7 \cdot 43$; log $0 \cdot 05$ = $- 1 \cdot 301$)

    (A) $2 \cdot 63$ (B) $3 \cdot 94$

    (C) $10 \cdot 10$ (D) $11 \cdot 36$

28. Hydride ion (H^-) is :

    (A)   Not isoelectric with He   (B)   Bronsted-Lowrry base of H_2

    (C)   Bronsted acid of OH^- (D)   A Lewis acid

29. The pH of $0 \cdot 2$M HCN$_{(aq.)}$ is (pK_a of HCN = $9 \cdot 31$; $\log_{10} 2 = 0 \cdot 3010$ and $\log_{10} 0 \cdot 2 = - 0 \cdot 6990$) :

    (A) $5 \cdot 0$ (B) $9 \cdot 6$

    (C) $8 \cdot 6$ (D) $4 \cdot 3$

30. Which of the following is the strongest conjugate base ?

    (A) $ClCH_2COO^-$ (B) $Cl \cdot CH_2 \cdot CH_2COO^-$

    (C) CH_3COO^- (D) Cl_2CHCOO^-

31. The number of Metal-Metal bonds in $[Re_2Cl_8]^{2-}$ is/are :

    (A) One   (B) Two

    (C) Three   (D) Four

32. The structure of $(NH_3)_3CrO_4$ is :

    (A) Trigonal bipyramid   (B) Pentagonal bipyramid

    (C) Square Pyramid   (D) Pentagonal Pyramid

33. In gas chromatography, the basis of separation of the components is the difference in :

    (A) Conductivity   (B) Molecular Weight

    (C) Molarity   (D) Partition Coefficient

34. The normality of a solution is determined by four separate titrations, the results being 0·2041, 0·2049, 0·2039 and 0·2043. The average deviation for the results is :

    (A) 0·0003   (B) 0·2043

    (C) 0·0006   (D) 0·0009

35. In the Kroll process Titanium is extracted by reducing $TiCl_4$ with.............. metal.

    (A) Barium   (B) Magnesium

    (C) Aluminum   (D) Zinc

36. The X-band EPR spectra of phenyl radical will exhibit.................lines.

    (A) 3   (B) 8

    (C) 18   (D) 28

37. The staggered configuration of ferrocene $[Fe(\eta^5\text{-}C_5H_5)_2]$ belong to................. symmetry group.

   (A) C_{5v} (B) C_{5h}

   (C) D_{5d} (D) D_{5h}

38. The spin only magnetic moment for a first row transition metal ion with $3F_4$ ground state term is :

   (A) 3·87 B.M.   (B) 4·90 B.M.

   (C) 2·83 B.M.   (D) 5·92 B.M.

39. Crystal Field Stabilization Energy for a d^3 ion in tetrahedral geometry is :

   (A) −1·2   (B) −0·8

   (C) −0·4   (D) 0·0

40. Which of the following statements is true with respect to ^{57}Fe Mossbauer spectra of (i) $FeSO_4 \cdot 7H_2O$, (ii) $K_4[Fe(CN)_6]$, (iii) $Na_2[Fe(CN)_5NO] \cdot 2H_2O$?

   (A) singlet in (i), doublet in (ii) and (iii)

   (B) singlet in (ii), doublet in (i) and (iii)

   (C) singlet in (i), and (iii), doublet in (ii)

   (D) doublet in (i), (ii) and (iii)

41. The geometry of the interhalogen compound BrF_3 is :

   (A) Square planar   (B) Tetrahedral

   (C) Octahedron   (D) Trigonal bipyramid

42. The IUPAC nomenclature of $[Co \cdot Cl \cdot CN \cdot NO_2 \cdot (NH_3)_3]$ is :

    (A) Triamminechloridocyanidonitrocobalt (III)

    (B) Chloridocyanidonitrotriamminecobalt (III)

    (C) Cyanidochloridonitrotriamminecobalt (III)

    (D) Triamminechloridonitrocyanidocobalt (III)

43. The cation of dichloro bis(ethylenediamine) cobalt (III) belongs to D_3 symmetry is an example of :

    (A) Coordination isomerism   (B) Optical isomerism

    (C) Linkage isomerism   (D) Ionization isomerism

44. The ^1G term of nd^2 configuration can be assigned to :

    (A) 45 microstates   (B) 9 microstates

    (C) 21 microstates   (D) 15 microstates

45. The F—N—F bond angle in NF_3 is :

    (A) 109° 28′   (B) 107° 48′

    (C) 102° 30′   (D) 104° 27′

46. The *correct* order of First Ionization energy of group 13 elements is :

    (A) B > Tl > Ga > Al > In   (B) B > Tl > Al > Ga > In

    (C) B > Al > Ga > In > Tl   (D) B > Ga > Tl > In > Al

47. The ionophore valinomycin is highly selective for :

    (A) K^+ (B) Na^+

    (C) Mg^{2+} (D) Ca^{2+}

48.   Common feature of CO, CN^- and NO^+ ligands is :

(A)   They have empty π orbitals

(B)   They act as π donor ligands

(C)   They are all weak field ligands

(D)   They decrease the value of Δ_0

49.   Number of stereoisomers possible for the compound, $CH_3CH = CH—CH(OH)CH = CHCH_3$ is :

(A)   4   (B)   6

(C)   7   (D)   8

50.   The *correct* order of acidity for the following compounds is :
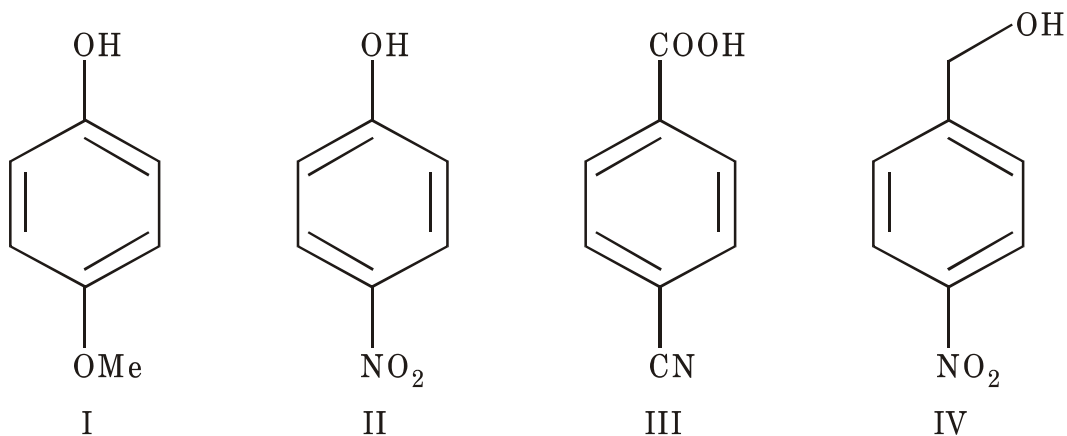
(A)   III > I > II > IV   (B)   II > III > I > IV

(C)   IV > II > I > III   (D)   III > II > I > IV

ROUGH WORK