

Test Booklet No.

प्रश्नपत्रिका क्र.

M

# Paper-III

## CHEMICAL SCIENCE

Signature and Name of Invigilator

Seat No.

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(In figures as in Admit Card)

1. (Signature) .....

(Name) .....

Seat No. ....

(In words)

2. (Signature) .....

(Name) .....

OMR Sheet No.

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(To be filled by the Candidate)

AUG - 33315

Time Allowed : 2½ Hours]

[Maximum Marks : 150

Number of Pages in this Booklet : 32

Number of Questions in this Booklet : 75

### Instructions for the Candidates

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

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

### विद्यार्थ्यांसाठी महत्वाच्या सूचना

- परिक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
- सदर प्रश्नपत्रिकेत 75 बहुपर्यायी प्रश्न आहेत. प्रत्येक प्रश्नास दोन गुण आहेत. या प्रश्नपत्रिकेतील सर्व प्रश्न सोडविणे अनिवार्य आहे. सदरचे प्रश्न हे या विषयाच्या संपूर्ण अभ्यासक्रमावर आधारित आहेत.
- परीक्षा सुरु झाल्यावर 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 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.
  - वरीलप्रमाणे सर्व पडताळून पहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा नंबर लिहावा.
- प्रत्येक प्रश्नासाठी (A), (B), (C) आणि (D) अशी चार विकल्प उत्तरे दिली आहेत. त्यातील योग्य उत्तराचा रकाना खाली दर्शविल्याप्रमाणे ठळकपणे काळ्या/निळ्या करावा.  
**उदा. :** जर (C) हे योग्य उत्तर असेल तर.  

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

**AUG - 33315/III**

**Chemical Science**  
**Paper III**

**Time Allowed : 2½ Hours]****[Maximum Marks : 150**

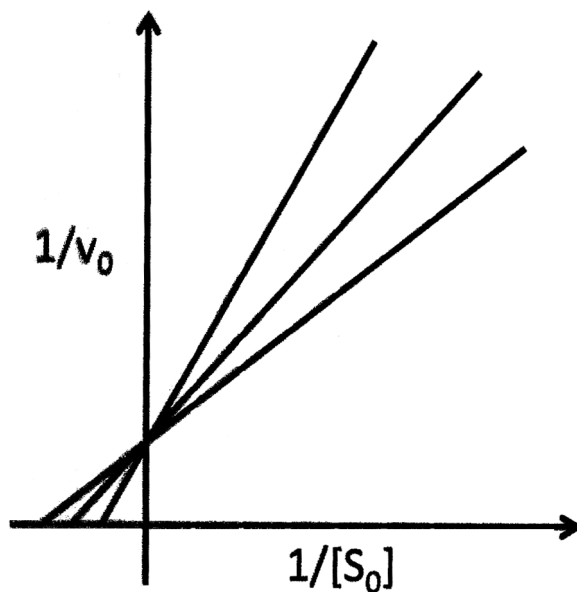
**Note :** This paper contains **Seventy Five (75)** multiple choice questions, each question carrying **Two (2)** marks. Attempt *All* questions.

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1. The contribution of rotation to heat capacity is :

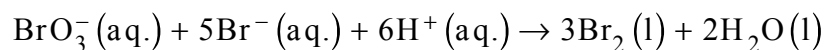
- |          |                    |
|----------|--------------------|
| (A) $R$  | (B) $\frac{R}{2}$  |
| (C) $2R$ | (D) $\frac{3R}{2}$ |

2. The following Lineweaver-Burk plot is for :



- (A) uncompetitive inhibition  
(B) competitive inhibition  
(C) non-competitive inhibition  
(D) mega-competitive inhibition

3. The quantity  $\lim_{T \rightarrow 0} \left( \frac{\partial P}{\partial T} \right)_V$  equals to :
- (A) 1 (B) 1/2  
(C) 0 (D) 2
4. The symmetric deformation ( $\nu_2$ ) vibration in  $\text{NO}_3^-$  anion is :
- (A) IR active, Raman inactive  
(B) Raman active, IR inactive  
(C) Active in the IR and Raman  
(D) Neither observed in IR nor in Raman
5. For the reaction :



the following initial rate laws were obtained :

Set	$[\text{BrO}_3^-]_0$	$[\text{Br}^-]_0$	$[\text{H}^+]_0$	$R_0$
1	0.10M	0.10M	0.10M	1
2	0.20M	0.10M	0.10M	2
3	0.20M	0.20M	0.10M	4
4	0.10M	0.10M	0.20M	4

Which of the following rate laws is *correct* ?

- (A)  $R = K [\text{BrO}_3^-] [\text{Br}^-]^2 [\text{H}^+]^1$   
 (B)  $R = K [\text{BrO}_3^-] [\text{Br}^-]^1 [\text{H}^+]^2$   
 (C)  $R = K [\text{BrO}_3^-]^2 [\text{Br}^-]^1 [\text{H}^+]^1$   
 (D)  $R = K [\text{BrO}_3^-]^1 [\text{Br}^-]^5 [\text{H}^+]^6$

6. The term symbol of  $\text{Ni}^{2+}$  ion representing its lowest energy state is :

(A)  $^3\text{F}$

(B)  $^3\text{P}$

(C)  $^1\text{S}$

(D)  $^1\text{G}$

7. For the first order consecutive reaction :



Rate of change of concentration of [B] with time can be expressed as :

(A)  $\frac{d[\text{B}]}{dt} = -k_1 [\text{A}] + k_2 [\text{B}]$

(B)  $\frac{d[\text{B}]}{dt} = -k_1 [\text{A}] - k_2 [\text{B}]$

(C)  $\frac{d[\text{B}]}{dt} = k_1 [\text{A}]_0 e^{-k_1 t} - k_2 [\text{B}]$

(D)  $\frac{d[\text{B}]}{dt} = k_1 [\text{A}]_0 e^{-k_2 t} - k_2 [\text{B}]$

8. The degeneracy of the energy level that corresponds to energy  $\frac{19}{m} \left( \frac{\pi \hbar}{a} \right)^2$  of a particle in a cubic box of length 'a' is :

(A) 3

(B) 6

(C) 9

(D) 1

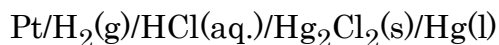
9. The reaction between O and O<sub>2</sub> is found to be third order. The possible units for the rate constant is :

(A)  $\text{cm}^6 \text{ mol}^{-2} \text{ s}^{-1}$  (B)  $\text{cm}^{-3} \text{ mol}^{-1} \text{ s}^{-1}$   
(C)  $(\text{L/molecule})^2 \text{ s}^{-2}$  (D)  $(\text{L/molecule})^2 \text{ s}$

10. The rotational constant of CO molecule is  $1.8 \text{ cm}^{-1}$ . The wave number of incident radiation in a Raman spectrophotometer is  $20487 \text{ cm}^{-1}$ . What is the wave number of second Stokes line ?

(A)  $20505 \text{ cm}^{-1}$  (B)  $20479 \text{ cm}^{-1}$   
(C)  $20469 \text{ cm}^{-1}$  (D) None of these

11. Consider the following cells :



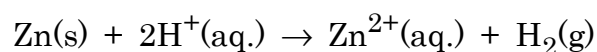
The EMF at 293 K and 303 K were found to be +0.2699 V and +0.2669 V, respectively. The change in entropy is :

(A)  $-38 \text{ J K}^{-1} \text{ mol}^{-1}$  (B)  $-58 \text{ J K}^{-1} \text{ mol}^{-1}$   
(C)  $-68 \text{ J K}^{-1} \text{ mol}^{-1}$  (D)  $-48 \text{ J K}^{-1} \text{ mol}^{-1}$

12. The energy of  $1 \text{ kJ mol}^{-1}$  equals :

- (A)  $96.48 \text{ cm}^{-1}$  (B)  $27.21 \text{ cm}^{-1}$   
 (C)  $83.59 \text{ cm}^{-1}$  (D)  $13.6 \text{ cm}^{-1}$

13. The cell with the following reaction,



An addition of  $\text{H}_2\text{SO}_4$  in the Cathode compartment will :

- (A) Increase  $E_{\text{cell}}$  and shift the equilibrium to the left  
 (B) Lower  $E_{\text{cell}}$  and shift the equilibrium to the right  
 (C) Increase  $E_{\text{cell}}$  and shift the equilibrium to the right  
 (D) Lower  $E_{\text{cell}}$  and shift the equilibrium to the left
14. The matrix for  $C_n^2(z)$  operator (rotation angle  $2\theta$ ) is given by :

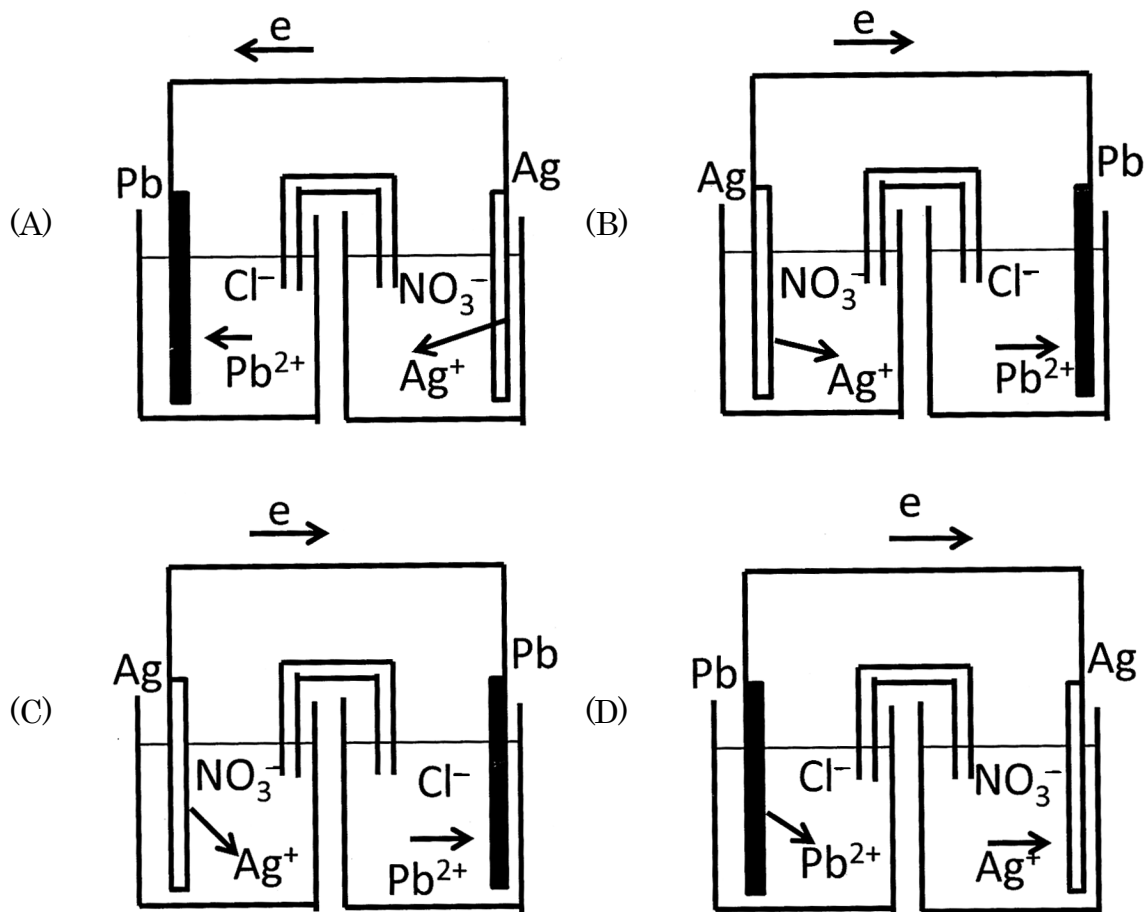
$$C_n^2(z) = \begin{pmatrix} \cos 2\theta & \sin 2\theta & 0 \\ -\sin 2\theta & \cos 2\theta & 0 \\ 0 & 0 & x \end{pmatrix}$$

The value of  $x$  is :

- (A) 2 (B) 1  
 (C)  $\cos 2\theta$  (D) 0

15. An  $\text{AgNO}_3$  solution containing Ag electrode is connected by means of salt bridge to  $\text{PbCl}_2$  solution containing Pb electrode.

Which of the *correct* representation of Galvanic cell ?



16. Zeta potential or electrokinetic potential depends on :

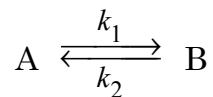
- (A) viscosity
- (B) dielectric constant
- (C) velocity of colloidal particles when electric field is applied
- (D) all three i.e. viscosity, dielectric constant and mobility



17. The ratio of de Broglie wavelengths of proton to that of deuterium having the same kinetic energies is :

(A) 2 (B) 1/2  
(C)  $\sqrt{2}$  (D)  $1/\sqrt{2}$

18. From the temperature jump method, the relaxation time for the reaction :



is determined to be 10  $\mu$ s. The corresponding equilibrium constant is  $10^{-3}$ . The rate constant for the backward reaction ( $k_2$ ) is :

(A)  $10^5 \text{ s}^{-1}$  (B)  $10^8 \text{ s}^{-1}$   
(C)  $10^6 \text{ s}^{-1}$  (D)  $10^3 \text{ s}^{-1}$

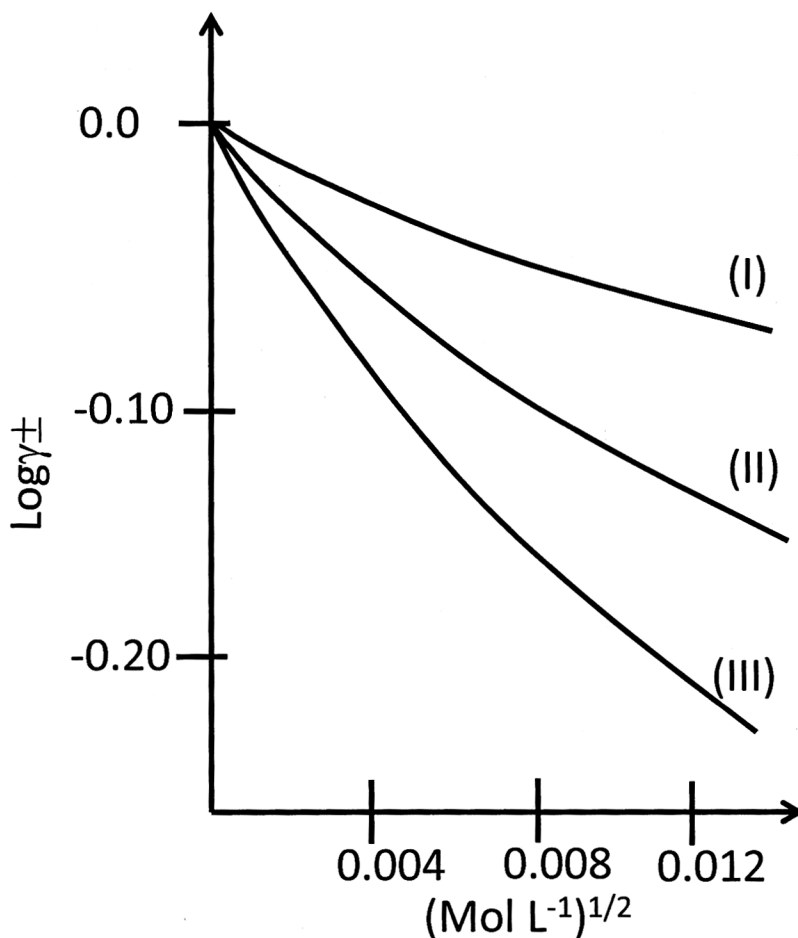
19. If the residual entropy of a crystal was observed to be  $13.38 \text{ J K}^{-1} \text{ mol}^{-1}$  the molecule adopts how many configurations (close lying in energies) at 0 K :

(A) 3 (B) 5  
(C) 6 (D) 2

20. A packet of colloidal system is held stationary by means of membrane. The two electrodes are immersed in the medium and voltage is applied. The liquid medium moves under the influence of electric field, this phenomenon is called :

(A) Tyndal effect (B) Electrophoresis  
(C) Electrodialysis (D) Electro-osmosis

21. The delocalization energy of butadiene molecule within the HMO framework of theory ( $\beta$  being the empirical parameter therein) is given by :
- (A)  $\beta$  (B)  $0.472\beta$   
 (C)  $2\beta$  (D)  $4\beta$
22. Consider the following plots for three electrolytes NaCl,  $\text{MgCl}_2$  and  $\text{MgSO}_4$ . Base on the trend :



- (A) (I), (II) and (III) correspond to  $\text{MgSO}_4$ ,  $\text{MgCl}_2$  and NaCl respectively  
 (B) (I), (II) and (III) belong to NaCl,  $\text{MgCl}_2$  and  $\text{MgSO}_4$  respectively  
 (C) (I), (II) and (III) belong to  $\text{MgCl}_2$ , NaCl and  $\text{MgSO}_4$  respectively  
 (D) (I), (II) and (III) belong to  $\text{MgSO}_4$ , NaCl and  $\text{MgCl}_2$  respectively

23. If we 'hypothetically' switch of the charges on ions, the chemical potential expression will take a form :

(A)  $\mu_j = \mu_j^\theta + RT \ln a_j$  (B)  $\mu_j = \mu_j^\theta + RT \ln x_j$

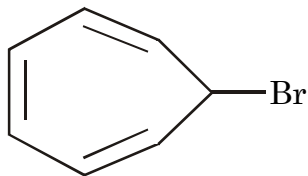
(C)  $\mu_j = \mu_j^\theta + RT \ln \gamma_j$  (D)  $\mu_j = RT \ln \gamma_j$

24. The most probable distance of  $2s$  electron (in Å) in the ground state of H atom is :

(A) 1.058 (B) 2.116

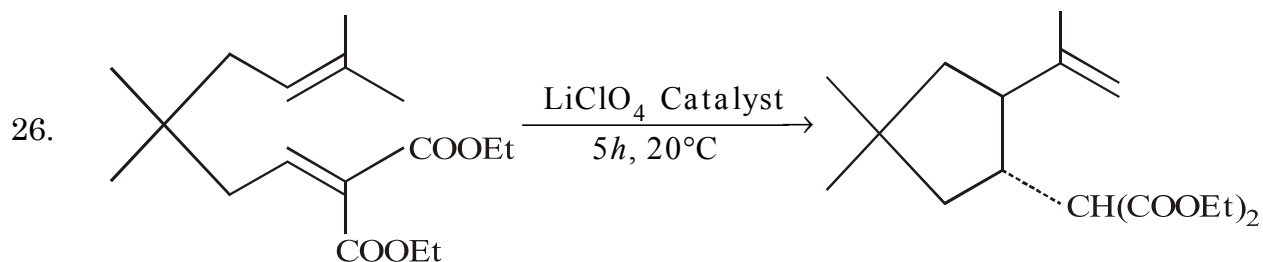
(C) 0.529 (D) 0.794

25. Cycloheptatrienyl bromide has structure :



This compound is to :

- (A) behave like covalent compound and dissolves in non-polar solvents  
 (B) behave like ionic compound and dissolves in polar solvents like water  
 (C) behave like coordination compounds  
 (D) behave like ionic compound but dissolves in non-polar solvent



The above reaction is an example of :

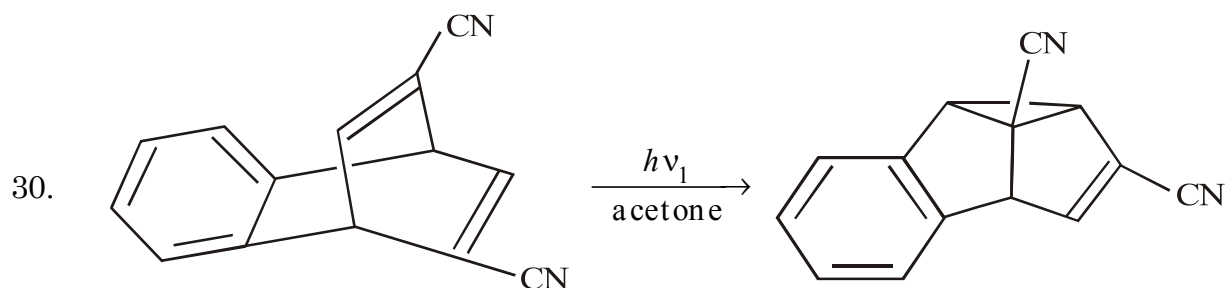
- (A) Claisen rearrangement
  - (B) Diels-Alder reaction
  - (C) Ene reaction
  - (D) Sommelet-Hauser rearrangement
27. The reagents X and Y that convert acetaldehyde and isobutyraldehyde respectively, (after an acidic work-up) into 3-methylbutan-2-ol are :
- (A) X = iso-PrMgCl      Y = MeMgCl
  - (B) X = MeMgCl      Y = iso-PrMgCl
  - (C) X = *n*-PrMgCl      Y = EtMgCl
  - (D) X = EtMgCl      Y = *n*-PrMgCl

28. Trans-3, 4-dimethylcyclobut-1-ene on heating undergoes ring opening. The statement which best describes the process is :

- (A) Two conrotatory modes are enantiomeric and lead to the same product
- (B) Two conrotatory modes of opening are possible but lead to two different products
- (C) Two products corresponding to the two conrotatory modes of opening are possible but one of them is formed exclusively
- (D) The ring opening occurs by disrotatory mode and gives two products

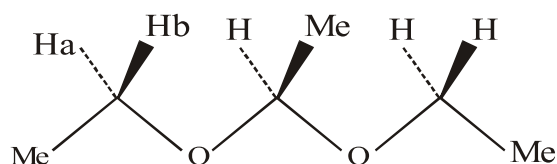
29. Polydispersity index of a polymer is ratio of its :

- (A) Weight average molecular weight to number average molecular weight
- (B) Number average molecular weight to weight average molecular weight
- (C) Weight average molecular weight to viscosity average molecular weight
- (D) Weight average molecular weight to sedimentation average molecular weight



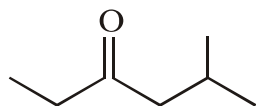
The above reaction is an example of :

- (A) Cope rearrangement
  - (B) [2 + 2] cycloaddition
  - (C) [4 + 2] cycloaddition
  - (D) Di-Pi-methane rearrangement
31. In the diacetal (X), protons Ha and Hb are :

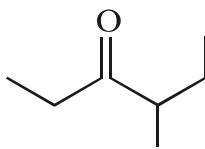


- (A) Enantiotopic
- (B) Diastereotopic
- (C) Homotopic
- (D) Heterotopic

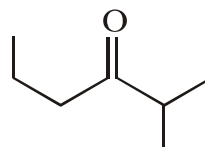
32. Consider four isomeric ketones P, Q, R and S :



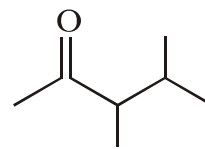
(P)



(Q)



(R)



(S)

Two of these show a peak in the mass spectrum at  $m/e$  86. These are :

(A) P and S

(B) Q and R

(C) R and S

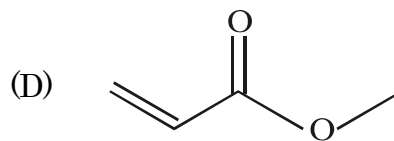
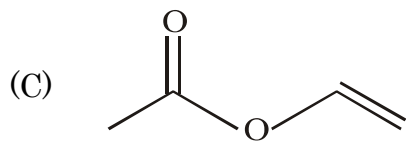
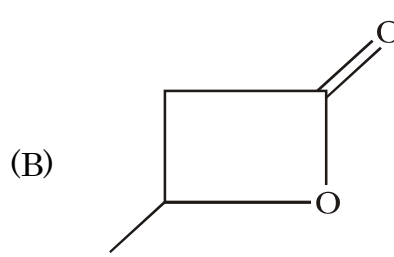
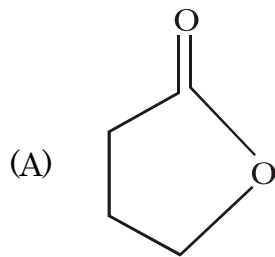
(D) P and R

33. The *correct* structure which corresponds to the spectral data given below is :

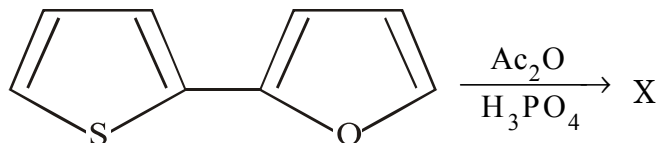
IR :  $1760\text{ cm}^{-1}$

PMR :  $\delta$  7.28, *dd*, 1H; 4.88, *dd*, 1H; 4.56, *dd*, 1H, 2.08, *s*, 3H

CMR :  $\delta$  141.7, *d*, 96.6, *t*, 17.4, *q*, 167.0, *s*.



34. In free radical polymerization, the degree of polymerization is :
- (A) directly proportional to concentration of initiator used
  - (B) directly proportional to square root of concentration of initiator used
  - (C) inversely proportional to concentration of the initiator used
  - (D) inversely proportional to square root of the concentration of initiator used
35. The major product in the following reaction, (X) is :



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



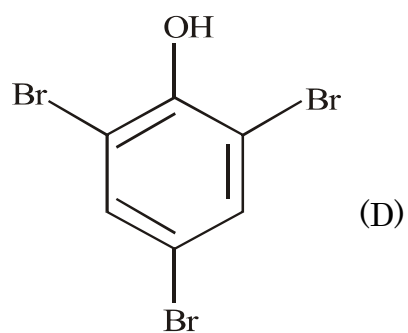
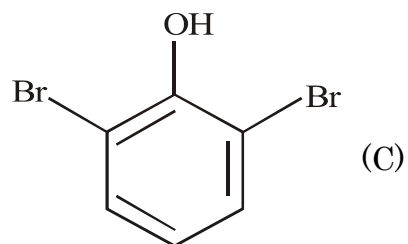
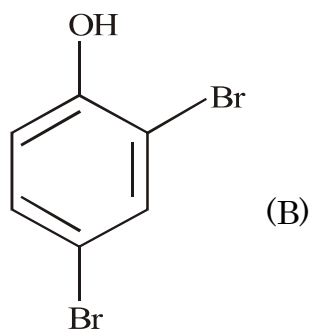
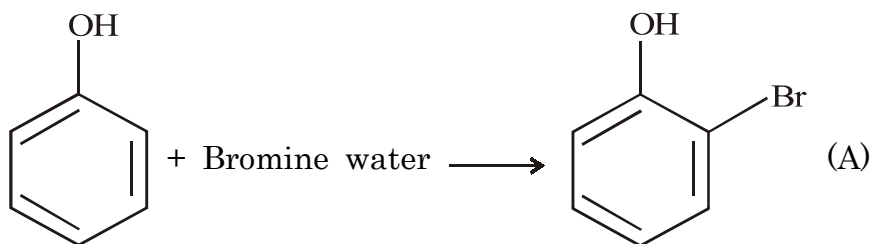
36. Find out the *correct* statement :

- (A) Pyridine is a weak base and Pyridine-N-oxide is a strong base
- (B) Pyridine is a strong base and Pyridine-N-oxide is a strong acid
- (C) Pyridine is a weak base and Pyridine-N-oxide is a salt like nature  
(neutral in nature)
- (D) Both, Pyridine and Pyridine-N-oxides are weak bases

37. The reaction that amino acid undergoes in the living system are :

- (A) *Trans*-amination and Decarboxylation
- (B) *Trans*-esterification and Deamination
- (C) *Trans*-esterification and Decarboxylation
- (D) *Trans*-amination and Dehydration

38. The major product of the following reaction is :



- (A) Only (A)  
(B) Only (B)  
(C) Only (D)  
(D) All of the above products

39. Aldol reaction if carried out in the strong basic conditions, then it undergoes elimination path :

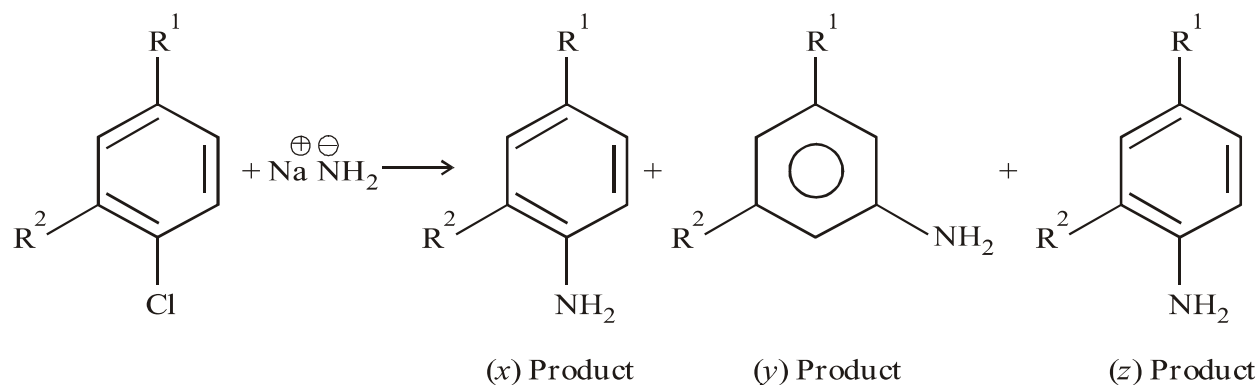
(A) of  $E_{cb}^1$  elimination

(B) of  $E^1$  elimination

(C) of  $E^2$  elimination

(D) of  $E^i$  elimination

40. The possible products of the following reaction are :



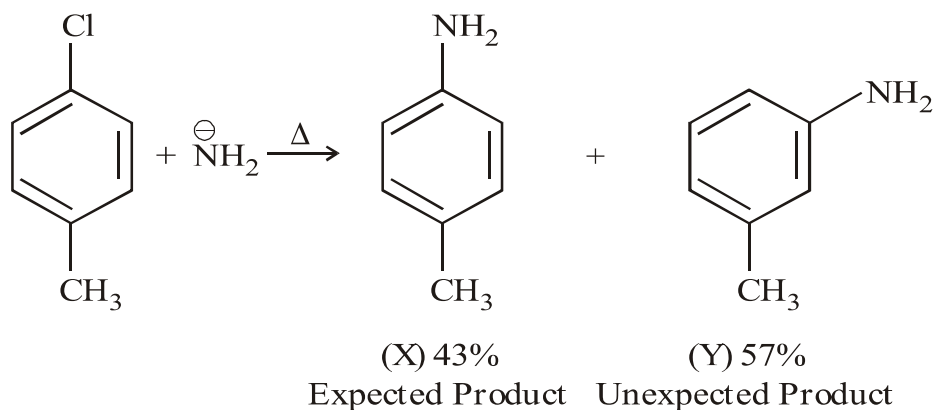
(A) (x) and (y) only

(B) (x) and (z) only

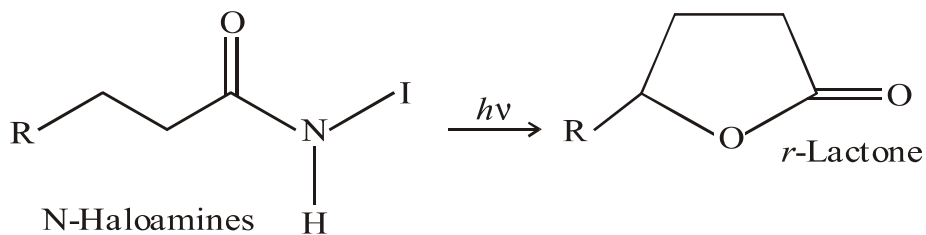
(C) (y) and (z) only

(D) (x), (y) and (z) all products

41. Identify the kind of IPSO substitution product in the following reaction :

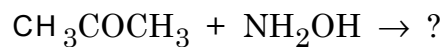


- (A) X only
- (B) Y only
- (C) X and Y both
- (D) Neither X nor Y but any other
42. Identify the following chemical conversion :



- (A) Barton Reaction
- (B) Bayer Villiger Reaction
- (C) Hofmann Reaction
- (D) Hofmann Löffler-Freytag Reaction

43. Identify the product of reaction of acetone with Hydroxylamine :



- (A) Ethanal oxime                      (B) Ethanol oxime
- (C) Ethyl amine                        (D) No reaction

44. Gilman reagent has one of the following names :

- (A) Lithium dimethyl cuperate
- (B) Lithium diethyl cuperate
- (C) Lithium methyl
- (D) Lithium isopropylamide

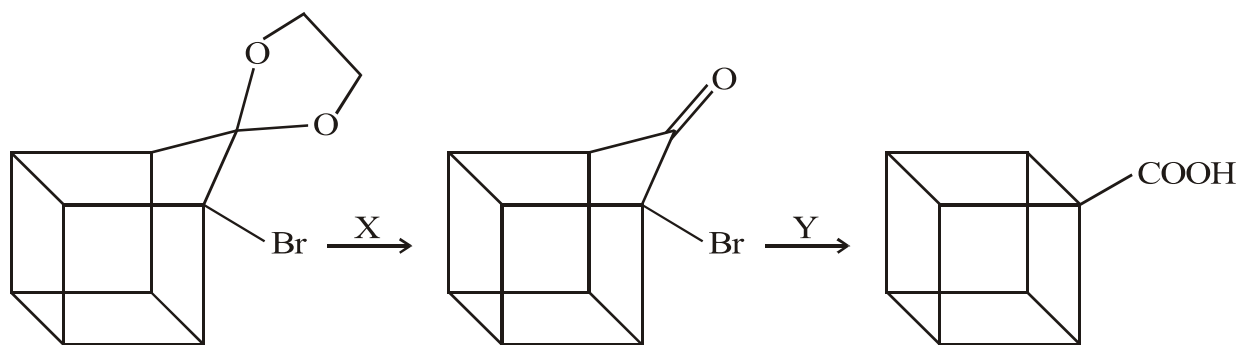
45. Which of the following statements is not *correct* for Benzene ?

- (A) It is a  $(4n + 2) = 6\pi$ -electron Annulene
- (B) It doesn't represented by a real cyclic structure
- (C) It doesn't show resonance phenomenon
- (D) It is entirely different than Annulene skeleton

46. The organic reaction occurs when the HOMO of nucleophile overlaps with the LUMO of electrophile to form :

- (A) A new  $\sigma$ -bond
- (B) A new  $\pi$ -bond
- (C) A new coordinate covalent bond
- (D) A new lone pair/non-bonding electron pair

**Directions :** Linked problem Q. No. 47 and Q. No. 48.



47. Reagents X and Y are respectively :

- (A) 25% KOH and 75%  $\text{H}_2\text{SO}_4$
- (B) 75%  $\text{H}_2\text{SO}_4$  and 25% KOH
- (C) Pd,  $\text{H}_2$  and dil.  $\text{HNO}_3$
- (D) dil.  $\text{HNO}_3$  and Pd,  $\text{H}_2$

48. The reaction involved in step 2 in the above sequence is :
- (A) Benzilic acid rearrangement
  - (B) Michael addition
  - (C) Favorskii reaction
  - (D) Baeyer-Villiger reaction
49. The gamma rays are produced by :
- (A) electronic relaxation
  - (B) nuclear relaxation
  - (C) photoelectric effect
  - (D) both photoelectric effect and electronic relaxation
50. For a particular radioactive sample, the total counting rate was 450 cpm and the value was obtained over 15.0 minutes counting period. The background was counted for 2.0 minutes and gave 12 cpm. What is the standard deviation associated with the corrected counting rate ?
- (A) 4.0
  - (B) 5.0
  - (C) 6.0
  - (D) 5.5

51. In neutron activation analysis, a neutron is captured by the analyte nucleus to give an isotope which has :
- (A) same atomic number but mass number is greater by one
  - (B) same atomic number but mass number is less by one
  - (C) same mass number but atomic number is greater by one
  - (D) same mass number but atomic number is less by one
52. The number of tetrahedral sites occupied by  $2n^{++}$  ions in zinc blende is :
- (A) 1
  - (B)  $1/2$
  - (C)  $2/3$
  - (D)  $1/4$
53. Which one of the following ions is linear ?
- (A)  $\text{NH}_2^-$
  - (B)  $\text{NH}_4^+$
  - (C)  $\text{I}_3^-$
  - (D)  $\text{NO}_2^-$
54. Borazine is commonly called as Inorganic benzene, because :
- (A) It is isoelectronic with benzene
  - (B) It appears like benzene
  - (C) It has same number of bonds with that of benzene
  - (D) It undergoes similar type of reactions as that of benzene



55. The common property possessed by  $\text{CaTiO}_3$  and  $\text{LaBa}_2\text{Cu}_3\text{O}_7$  is :
- (A) Superconductivity                      (B) Ferroelectric property
- (C) Piezoelectric property                  (D) Common structural features
56. "Actinide hypothesis" was useful in :
- (A) elucidating the properties of the heavier actinides
- (B) elucidating the properties of lighter actinides
- (C) elucidating the properties of the heavier lanthanides and actinides
- (D) elucidating the properties of the lighter lanthanides and actinides
57.  $\text{Pu}^{3+}$  and lighter actinides have absorption spectra similar to those of the lanthanides but exhibit broadening identical to transition metal ions, because of :
- (A) greater ligand-metal orbital interaction
- (B) smaller ligand-metal orbital interaction
- (C) lesser exposure of the  $5f$  orbitals
- (D) moderate exposure of the  $5f$  orbitals

58. The following combination of metal ion and ligands is preferred and is expected to lead to the formation of a more stable complex :
- (A)  $\text{Ti}^{4+}$  and  $\text{CN}^-$  (B)  $\text{Cu}^{2+}$  and  $\text{F}^-$   
(C)  $\text{Co}^{2+}$  and  $\text{SCN}^-$  (D)  $\text{Ti}^{4+}$  and  $\text{NCS}^-$
59. The value of spin only magnetic moment in the complex,  $[\text{Co}(\text{NO}_2)_6]^{4-}$  in BM units is :
- (A) 0 (B) 1.73  
(C) 3.87 (D) 4.9
60. The covalent compounds formed by the combination of two different halogens are called :
- (A) Polyhalide (B) Inter-halogen compound  
(C) Pseudo-halogens (D) Halogen compounds
61. Which of the following is *true* about the number of bands corresponding to  $\nu_{\text{CO}}$  in the IR spectra of *cis*- $[\text{M}(\text{CO})_4\text{Cl}_2]$  and *trans*- $[\text{M}(\text{CO})_4\text{Cl}_2]$  ?
- (A) The number of bands in both is equal  
(B) *cis*-isomer has more number of bands than the *trans*  
(C) The bands in both isomers appear at the same frequencies  
(D) The *trans* isomer does not have any significant band in the carbonyl stretching region

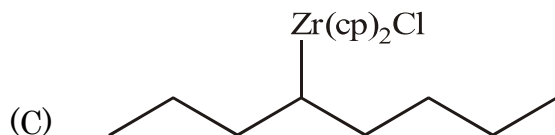
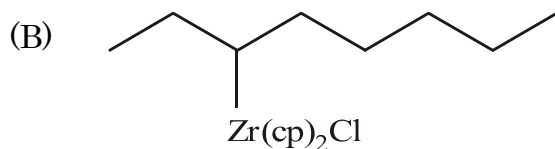
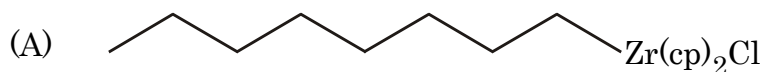
62. The synthetic attempts to obtain transition metal alkyls were failed for many years, because :

- (A) metal-carbon bond is less strong than main group metal-carbon bond
- (B) metal-carbon bond is thermodynamically stable
- (C) transition metal-alkyls undergo decomposition due to less kinetic stability
- (D) metal-carbon bond is not thermodynamically stable

63. Which of the following can act as a reducing agent ?

- (A)  $\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2$
- (B)  $\text{Mn}(\eta^5\text{-C}_5\text{H}_5)_2$
- (C)  $\text{Re}(\eta^5\text{-C}_5\text{H}_5)_2$
- (D)  $\text{Rh}(\eta^5\text{-C}_5\text{H}_5)_2$

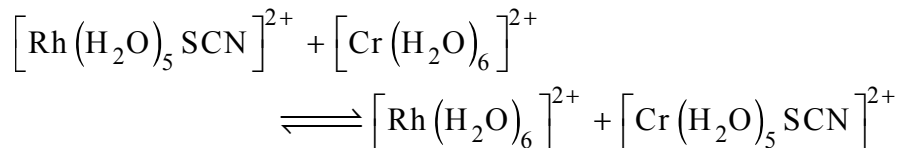
64. The reaction of 3-octene with  $\text{Zr}(\text{cp})_2\text{HCl}$  ( $\text{cp} = \eta^5\text{-C}_5\text{H}_5$ ) should yield :



- (D) A mixture of B and C

65.  $\text{Fe}(\text{COT})(\text{CO})_3$  (COT = Cyclooctatetraene) is a stable species having a dynamic proton NMR with a single sharp line at ambient temperatures becoming broad and splitting into four multiplets at lower temperature. This indicates that :
- (A) COT is bound to Fe as  $(\eta^2\text{---COT})$
  - (B) COT is bound to Fe as  $(\eta^4\text{---COT})$
  - (C) COT changes the binding mode from  $\eta^8$  at ambient temperature to  $\eta^2$  or  $\eta^4$  at lower temperature
  - (D) The molecule is fluxional
66. Dissociation mechanism of ligand substitution can be identified by the ligand field transition generally shifting during the reaction to :
- (A) higher energy and negative  $\Delta S$
  - (B) lower energy and positive  $\Delta S$
  - (C) higher energy and positive  $\Delta S$
  - (D) lower energy and negative  $\Delta S$
-

67. The reaction :

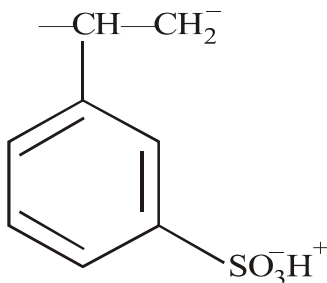


is an example of :

- (A) Aquation
  - (B) Ligand exchange
  - (C) Outer sphere electron transfer
  - (D) Inner sphere electron transfer
68. In photocatalytic water splitting by ruthenium bipy complexes, (bipy = 2, 2'-bipyridine), the following acts as a reducing species :
- (A)  $\left[\text{Ru}(\text{bipy})_3\right]^{2+}$
  - (B)  $\left[\text{Ru}(\text{bipy})_3\right]^{2+*}$
  - (C)  $\left[\text{Ru}(\text{bipy})_3\right]^{3+}$
  - (D)  $\left[\text{Ru}(\text{bipy})_3\right]^{3+*}$
69. The geometry of the active site in plastocyanins can be best described as :
- (A) Tetrahedral
  - (B) Tetragonal
  - (C) Square planar
  - (D) Pseudotetrahedral
70. The resting form of the water splitting  $\text{Mn}_4$  cluster in PS II has :
- (A) Cubane type structure and all Mn ions in 2+ oxidation state
  - (B) Cubane type structure and all Mn ions in 3+ oxidation state
  - (C) Tetrahedral structure will all Mn ions in 2+ oxidation state
  - (D) Cyclic structure will all Mn ions in 3+ oxidation state

71. The intense colour of  $[\text{Re}_2\text{Cl}_8]^{2-}$  anion can be attributed to the following :
- (A) Ligand field transition                      (B)  $\pi \rightarrow \pi^*$  transition
- (C)  $\delta \rightarrow \delta^*$  transition                      (D) Charge transfer transition
72. Copper (II) and Nickel (II) form complexes of  $[\text{M}(\text{en})_x]^{2+}$  formulae where  $x = 1 - 3$ . Which of the following is *not true* about the respective stability constants ? [en = 1, 2-ethane diamine]
- (A)  $K_2 < K_1$
- (B)  $K_3 < K_2$
- (C)  $K_1$  and  $K_2$  in  $\text{Cu}^{2+}$  complexes are higher than those in  $\text{Ni}^{2+}$  complexes
- (D)  $K_3$  in  $\text{Cu}^{2+}$  complexes is higher than that in  $\text{Ni}^{2+}$  complexes
73. In a reversed-phase column, a solute was found to have a retention time of 31.0 min. and an unretained species required 0.5 min. for elution when the mobile phase was 30% (by volume) methanol and 70% water. What is the retention factor ?
- (A) 61.0    (B) 62.0
- (C) 60.0    (D) 54.0

74. In a hydrogen-oxygen flame, the atomic absorption signal for calcium was found to decrease in the presence of :
- (A) EDTA
- (B) 8-hydroxyquinoline
- (C) ammonium salt of 1-pyrrolidinecarbodithioic acid
- (D) sulphate
75. Styrene-divinyl benzene copolymers, when completely monosulphonated and in  $H^+$ -form, consist predominantly of units :



Each unit has the formula weight 184.2 and carries one fixed ionic group.

The theoretical scientific weight capacity of this resin is :

- (A) 4.45 meq/g
- (B) 4.85 meq/g
- (C) 5.43 meq/g
- (D) 4.20 meq/g

AUG - 33315/III

## ROUGH WORK