

Test Booklet No.

प्रश्नपत्रिका क्र.

F

## Paper-II

### CHEMICAL SCIENCES

Seat No.

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(In figures as in Admit Card)

Seat No.

(In words)

OMR Sheet No.

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(To be filled by the Candidate)

#### Signature and Name of Invigilator

1. (Signature) .....

(Name) .....

2. (Signature) .....

(Name) .....

### DEC - 33213

Time Allowed : 1¼ Hours]

[Maximum Marks : 100

Number of Pages in this Booklet : 16

Number of Questions in this Booklet : 50

#### 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 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).
- 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 महत्त्वाच्या सूचना

- परिक्षार्थींनी आपला आसन क्रमांक या पृष्ठावरील वरच्या कोपऱ्यात लिहावा. तसेच आपणांस दिलेल्या उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
- सदर प्रश्नपत्रिकेत 50 बहुपर्याय 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 विद्यार्थ्यांला प्रश्नपत्रिका दिली जाईल. सुरुवातीच्या 5 मिनीटांमध्ये आपण सदर प्रश्नपत्रिका उघडून खालील बाबी अवश्य तपासून पहाव्यात.
  - 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 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.
  - 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 काळा/निळा 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 लिहिलेली 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 व्यतिरीक्त इतर कोठेही नाव, आसन क्रमांक, फोन नंबर किंवा ओळख पटेल अशी कोणतीही खूप केलेली आढळून आल्यास अथवा असभ्य भाषेचा वापर किंवा इतर गैरमार्गाचा अवलंब केल्यास विद्यार्थ्यांला परीक्षेस अपात्र ठरविण्यात येईल.
- परीक्षा संपल्यानंतर विद्यार्थ्यांनी मूळ ओ.एम.आर. उत्तरपत्रिका पर्यवेक्षकांकडे परत करणे आवश्यक आहे. तथापी, प्रश्नपत्रिका व ओ.एम.आर. उत्तरपत्रिकेची द्वितीय प्रत आपल्याबरोबर नेण्यास विद्यार्थ्यांना परवानगी आहे.
- फक्त निळा किंवा काळा बॉल पेनचाच वापर करावा.
- कॅलक्युलेटर किंवा लॉग टेबल वापरण्यास परवानगी नाही.
- चुकीच्या उत्तरासाठी गुण कपात केली जाणार नाही.

**DEC - 33213/II**

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## Chemical Sciences Paper II

**Time Allowed : 75 Minutes]**

**[Maximum Marks : 100**

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

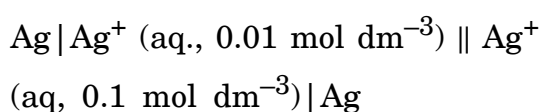
1. Which of the following is *not* a Lewis base ?

- (A)  $\text{CN}^-$   
(B)  $\text{C}_2\text{H}_5\text{OH}$   
(C)  $\text{AlCl}_3$   
(D)  $(\text{CH}_3)_3\text{N}$

2. The bond orders of the  $\text{O}_2$ ,  $\text{O}_2^+$  and  $\text{O}_2^-$  are respectively :

- (A) 2.5, 2.0, 1.5  
(B) 2.0, 2.5, 1.5  
(C) 2.0, 1.5, 2.5  
(D) 2.0, 2.5, 2.5

3. For the concentration cell



the EMF of the cell,  $E$  at a temperature  $T$  equals :

- (A)  $2.303 \frac{RT}{F}$   
(B)  $-2.303 \frac{RT}{F}$   
(C)  $E_{\text{Ag}^+, \text{Ag}}^0 + 2.303 \frac{RT}{F}$   
(D)  $E_{\text{Ag}^+, \text{Ag}}^0 - 2.303 \frac{RT}{F}$

4. The pH of a  $1.0 \times 10^{-3} \text{ mol dm}^{-3}$  solution of a weak acid HA is 4.0. The dissociation constant of the acid is :

- (A)  $1.0 \times 10^{-3}$   
(B)  $1.0 \times 10^{-4}$   
(C)  $1.0 \times 10^{-5}$   
(D)  $2.0 \times 10^{-5}$

5. The point groups of 1, 2-dichlorobenzene, 1, 3-dichlorobenzene and 1, 4-dichlorobenzene are respectively :
- (A)  $C_{2v}$ ,  $C_{2v}$ ,  $D_{2h}$   
(B)  $D_{2h}$ ,  $D_{2h}$ ,  $C_{2v}$   
(C)  $C_{2h}$ ,  $C_{2h}$ ,  $D_{2h}$   
(D)  $C_{2v}$ ,  $D_{2h}$ ,  $C_{2v}$
6. The term symbol for a particular state of an atom is  $^3D_3$ . The values of L, S and J for this term are respectively :
- (A) 3, 1, 3  
(B) 2, 1, 3  
(C) 2, 0, 3  
(D) 3, 2, 3
7. Given that the standard potentials of the  $Cu^{2+}/Cu$  and  $Cu^+/Cu$  couples are + 0.340 V and 0.522 V respectively, the standard potential of  $Cu^{2+}/Cu^+$  couple is :
- (A) 0.182 V  
(B) 0.862 V  
(C) + 0.158 V  
(D) - 0.158 V
8. Which of the following molecules does *not* possess a centre of symmetry ?
- (A) trans-dichloroethene  
(B) naphthalene  
(C) eclipsed ethane  
(D) staggered ethane
9. An ideal gas in a thermally insulated vessel expands, quickly against vacuum. For this process :
- (A) the temperature remains constant  
(B) a finite, non-zero amount of work is done by the gas  
(C) heat flows into the gas  
(D) intermolecular interactions decrease upon expansion
10. Standard enthalpies of formation (in  $kJ\ mol^{-1}$ ) of four compounds A, B, C and D are - 200, - 50, + 10 and - 100 respectively. For the reaction :  $A + 2C = 3B + 4D$ . The standard enthalpy of reaction, in  $kJ\ mol^{-1}$ , is :
- (A) 40  
(B) 0  
(C) -340  
(D) -370

11. The efficiency of a reversible heat engine, operating between absolute temperatures of  $T_1$  and  $T_2$  (where  $T_2 < T_1$ ) is :

(A)  $1 + \frac{T_1}{T_2}$

(B)  $1 - \frac{T_1}{T_2}$

(C)  $1 - \frac{T_2}{T_1}$

(D)  $1 + \frac{T_2}{T_1}$

12. The osmotic pressure ( $\pi$ ) of a solution of a polymer with molecular weight of  $M$  is recorded at different concentrations ( $C$ , in  $\text{gl}^{-1}$ ) of the polymer and at different absolute temperatures ( $T$ ). The plot of  $\pi/C$  against  $T$  is a straight line, in which :

(A) The intercept is  $R/M$

(B) The intercept is  $M/R$

(C) The slope is  $M/R$

(D) The slope is  $R/M$

13. The reaction  $A + B \rightarrow P$  is first order with respect to each of the two reactants.  $a_0$ ,  $b_0$  are the initial concentrations of A and B, respectively.  $x$  is the concentration of P at time  $t$ . The appropriate rate equation for this reaction is :

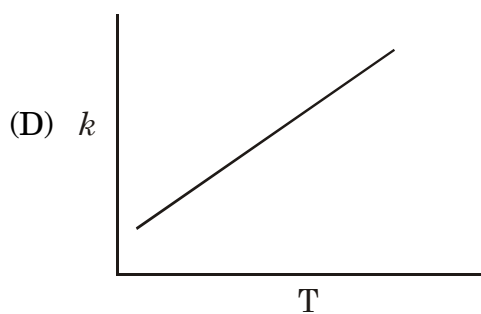
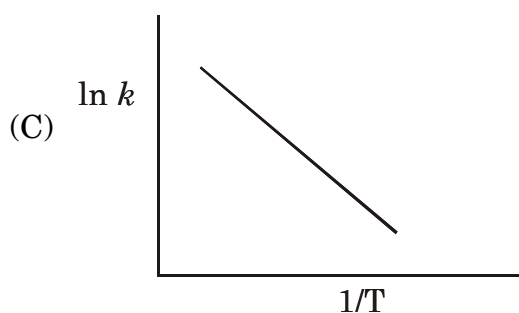
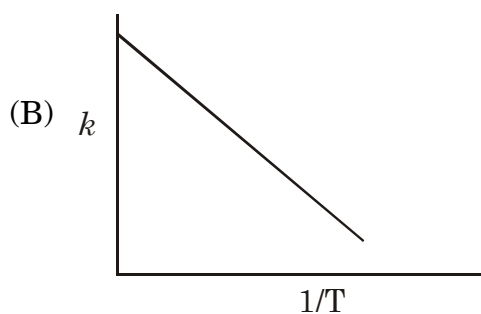
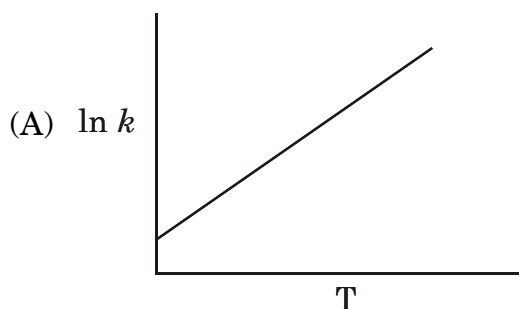
(A)  $k = \frac{1}{t(a_0 - b_0)} \ln \left[ \frac{b_0(a_0 - x)}{a_0(b_0 - x)} \right]$

(B)  $k = \frac{1}{t(2a_0 - b_0)} \ln \left[ \frac{b_0(a_0 - x)}{a_0(b_0 - x)} \right]$

(C)  $k = \frac{1}{t(2a_0 - b_0)} \ln \left[ \frac{b_0(a_0 - x)}{a_0(b_0 - x)} \right]$

(D)  $k = \frac{1}{t} \ln \left[ \frac{b_0(a_0 - x)}{a_0(b_0 - x)} \right]$

14.  $k$  is the rate constant of a reaction and  $T$  is the absolute temperature. The correct plot among the following is :



15. A catalyst lowers the energy of the :

- (A) reactant  
(B) product  
(C) transition state  
(D) intermediate

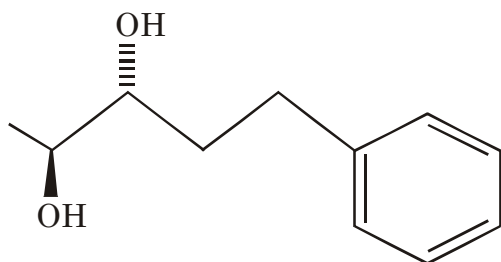
16. A solid,  $\text{MX}$ , is formed of a metal ion  $\text{M}^+$  and a halide ion  $\text{X}^-$ . The following data are available :

Process	$\Delta H/\text{kJ mol}^{-1}$
Decomposition of $\text{MX}(\text{g})$	+ 500
Ionization of $\text{M}(\text{g})$	+ 400
Sublimation of $\text{M}(\text{s})$	+ 100
Dissociation of $\frac{1}{2} \text{X}_2(\text{g})$	+ 150
Electron attachment to $\text{X}(\text{g})$	- 400

The lattice energy for  $\text{MX}$  (in  $\text{kJ mol}^{-1}$ ) is :

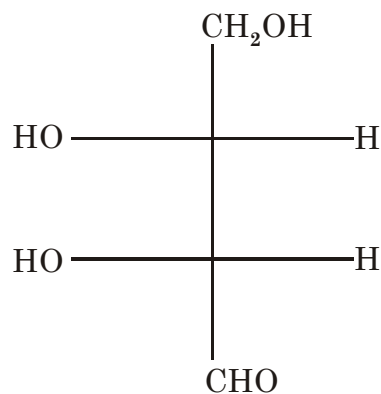
- (A) 1150  
(B) 750  
(C) -1150  
(D) -750

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



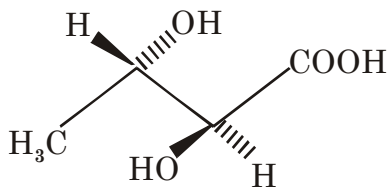
- (A) (2S, 3R)—5—Phenylpentane-2, 3-diol
- (B) (3S, 4R)—1—Phenylpentane-3, 4-diol
- (C) (2R, 3S)—5—Phenylpentane-2, 3-diol
- (D) (3R, 4S)—1—Phenylpentane-3, 4-diol

18. The following compound, is :



- (A) optically inactive and belongs to D-family
- (B) optically active and belongs to D-family
- (C) optically active and belongs to L-family
- (D) optically inactive and belongs to L-family
19. The number of stereoisomers of 2, 3, 4-trichloropentane is :
- (A) 2
- (B) 6
- (C) 8
- (D) 4

20. The correct Fischer projection representation of the following compound



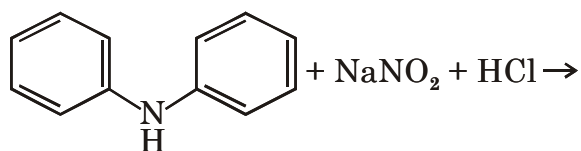
is :

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

21. The number of stereoisomers of  $(\text{H}_3\text{C})_2\text{C} = \text{CH}-\text{CH} = \text{CH}-\text{CH}(\text{OH})\text{COOH}$  is :

- (A) 4  
(B) 2  
(C) 6  
(D) 8

22. The major product of the following reaction is :

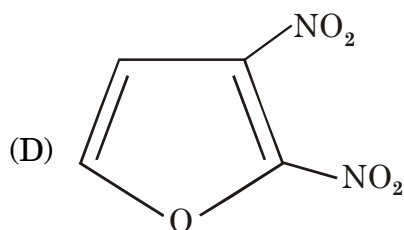
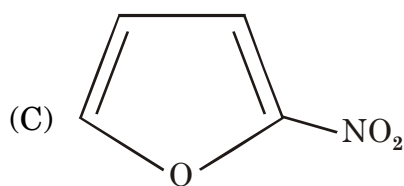
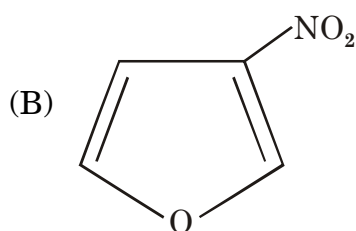
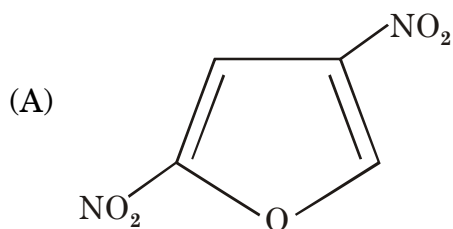
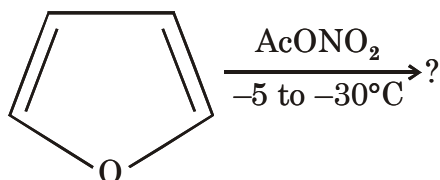


is :

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



23. The major product of the following reaction is :



24. Addition of an ester enolate to the carbonyl carbon of another ester gives :

- (A) diester
- (B) an anhydride
- (C)  $\alpha$ ,  $\beta$ -unsaturated ester
- (D)  $\beta$ -keto ester

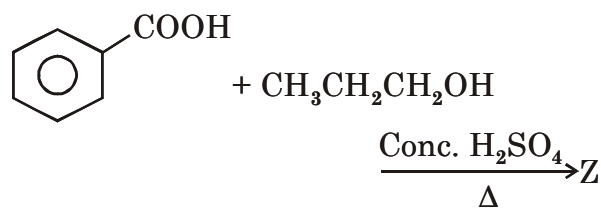
25. Among the following reducing agents the one that can be used under acidic conditions is :

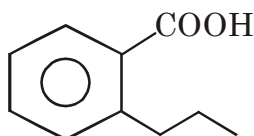
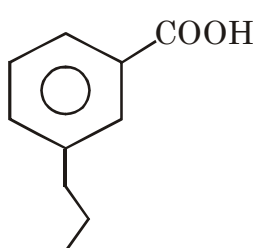
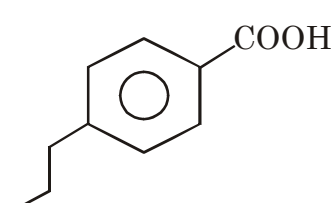
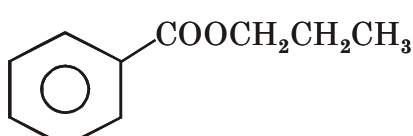
- (A)  $\text{NaBH}_4$
- (B)  $\text{NaCNBH}_3$
- (C)  $\text{LiAlH}_4$
- (D) DIBAL

26. Which of the following rearrangements does not proceed through a nitrene intermediate ?

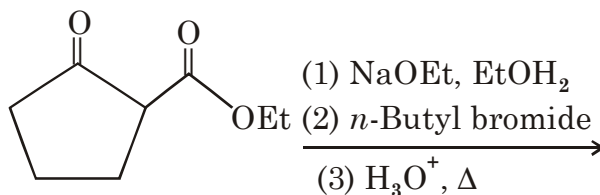
- (A) Beckmann
- (B) Curtius
- (C) Lossen
- (D) Schmidt

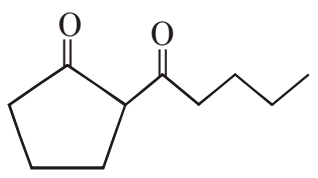
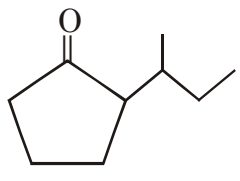
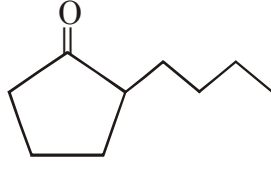
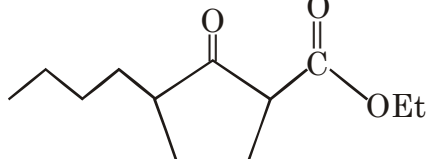
27. The major product (Z) of the following reaction is :



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

28. Which is the major product in the following reaction ?



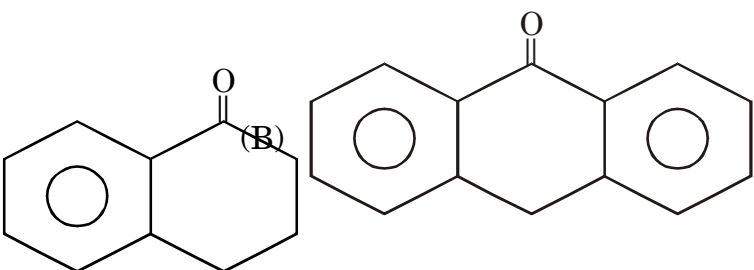
- (A) 
- (B) 
- (C) 
- (D) 

29. Robinson annulation involves :

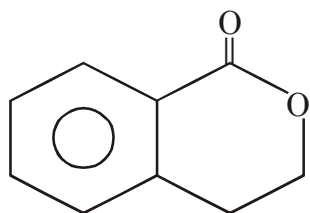
- (A) Two aldol condensation steps
- (B) Two Michael addition steps
- (C) Aldol condensation followed by Michael addition
- (D) Michael addition followed by aldol condensation

30. Among the following, the compound that shows carbonyl stretching at highest wave numbers in IR spectroscopy is :

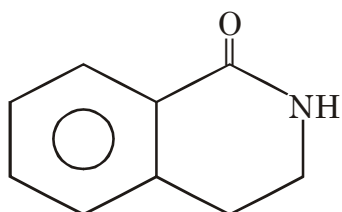
(A)



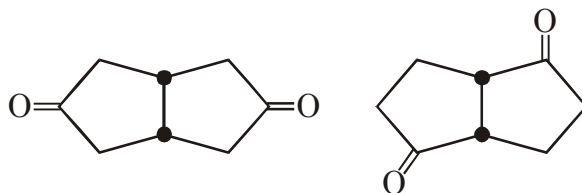
(C)



(D)



31.



Y

Z

The number of signals that appear in  $^{13}\text{C}$  NMR spectra of compounds Y and Z respectively are :

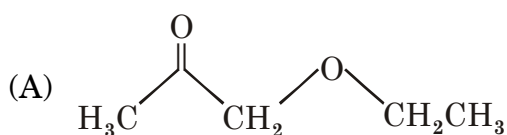
(A) 5, 5

(B) 3, 4

(C) 4, 5

(D) 5, 4

32. Identify the compound that displays the following signals in the  $^1\text{H-NMR}$  spectrum :  $\delta$  1.21 (t, 3H), 2.2 (s, 3H), 3.6 (q, 3H), 4.2 (s, 2H) :



(B)

(C)

(D)

33. Which of the following molecules has the highest bond order ?

- (A) CO  
(B) NO  
(C) O<sub>2</sub>  
(D) Cl<sub>2</sub>

34. The acidic character in the following hydroxides of trivalent cations changes as :

- (A)  $\text{Al(OH)}_3 > \text{B(OH)}_3 > \text{Tl(OH)}_3 > \text{Fe(OH)}_3$   
(B)  $\text{B(OH)}_3 > \text{Tl(OH)}_3 > \text{Al(OH)}_3 > \text{Fe(OH)}_3$   
(C)  $\text{Tl(OH)}_3 > \text{Fe(OH)}_3 > \text{Al(OH)}_3 > \text{B(OH)}_3$   
(D)  $\text{B(OH)}_3 > \text{Al(OH)}_3 > \text{Fe(OH)}_3 > \text{Tl(OH)}_3$

35. According to VSEPR theory, the shape of  $\text{XeOF}_4$  is predicted to be :

- (A) Octahedral  
(B) Trigonal bipyramidal  
(C) Square pyramidal  
(D) distorted octahedral

36. The spin moment of a system can be calculated using the expression :

- (A)  $[\text{S}(\text{S} + 1)]^{1/2}$   
(B)  $[2\text{S}(\text{S} + 2)]^{1/2}$   
(C)  $[4\text{S}(\text{S} + 1)]^{1/2}$   
(D)  $[n(n + 1)]^{1/2}$

37. Which of the following complex ions has magnetic moment value same as  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  ?
- (A)  $[\text{Mn}(\text{CN})_6]^{4-}$   
(B)  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$   
(C)  $[\text{Co}(\text{NH}_3)_6]^{2+}$   
(D)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
38. Which of the following is a Mossbauer active nucleus ?
- (A)  $^2\text{D}$   
(B)  $^{12}\text{C}$   
(C)  $^{78}\text{Se}$   
(D)  $^{119}\text{Sn}$
39. Which of the following orbitals is most destabilized in trigonal bipyramidal geometry ?
- (A)  $d_{xz}$   
(B)  $d_{xy}$   
(C)  $d_{x^2 - y^2}$   
(D)  $d_{z^2}$
40. The complex ion with CFSE equal to  $-12 Dq$  is :
- (A)  $[\text{Fe}(\text{CN})_6]^{4-}$   
(B)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$   
(C)  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$   
(D)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
41. Which of the following is ESR active ?
- (A)  $[\text{Fe}(\text{CN})_6]^{4-}$   
(B)  $[\text{Co}(\text{CN})_6]^{3-}$   
(C)  $[\text{Ni}(\text{CN})_4]^{2-}$   
(D)  $[\text{Cu}(\text{CN})_4]^{2-}$
42. The term symbol for the ground state in  $\text{V}^{2+}$  ion is :
- (A)  $^4\text{D}_{3/2}$   
(B)  $^3\text{F}_{9/2}$   
(C)  $^4\text{F}_{3/2}$   
(D)  $^4\text{D}_{9/2}$
43. The hybridization involved in  $\text{TiCl}_4$  is :
- (A)  $sp^3$   
(B)  $dsp^2$   
(C)  $sd^3$   
(D)  $sp^3d$

44. The total number of isomers possessed by trans- $\text{Na}_3[\text{Co}(\text{OX})_2\text{Cl}(\text{SCN})]$  is :
- (A) 1  
(B) 2  
(C) 3  
(D) 4
45. Which of the following molecules has a  $C_n$  axis and  $n$  number of  $C_2$  axes ?
- (A)  $\text{SO}_2\text{Cl}_2$   
(B)  $\text{B}(\text{OH})_3$   
(C)  $\text{NH}_3$   
(D)  $\text{PCl}_3$
46. The colour change of a pH indicator used for a volumetric experiment requires an overtitration of 0.03 ml. If the required volume of titrant is 25.0 ml, the percent relative error in the measurement will be :
- (A) + 0.12%  
(B) + 0.06%  
(C) + 0.03%  
(D) - 0.03%
47. The oxidation of oxalate with permanganate in basic solution involves the change in oxidation state of manganese from :
- (A)  $\text{Mn}^{7+}$  to  $\text{Mn}^{2+}$   
(B)  $\text{Mn}^{7+}$  to  $\text{Mn}^{4+}$   
(C)  $\text{Mn}^{4+}$  to  $\text{Mn}^{2+}$   
(D)  $\text{Mn}^{4+}$  to  $\text{Mn}^0$
48.  $\text{Fe}^+$  and  $\text{NO}^+$  can be classified, respectively, as :
- (A) soft acid and soft base  
(B) hard acid and hard base  
(C) soft acid and hard base  
(D) hard acid and soft base
49. Which of the following can act as an oxidizing agent ?
- (A)  $[\text{Mn}(\eta^5\text{-C}_5\text{H}_5)_2]$   
(B)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)_2]$   
(C)  $[\text{Co}(\eta^5\text{-C}_5\text{H}_5)_2]$   
(D)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)(\text{CO})_3]$
50. Which of the following carbonyl clusters should possess bridging carbonyls ?
- (A)  $[\text{Os}_3(\text{CO})_{12}]$   
(B)  $[\text{Co}_4(\text{CO})_{12}]$   
(C)  $[\text{Ir}_4(\text{CO})_{12}]$   
(D)  $[\text{Os}_4(\text{CO})_{16}]$

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**ROUGH WORK**



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