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Your Personal Exams Guide

OCT-33226
Paper-II
CHEMICAL SCIENCES

Series **C**

Question Booklet Serial No. प्रश्नपत्रिका अनुक्रमांक

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)

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

Number of Pages in this Booklet : **32**

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

C

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 (B) is the correct response.
   (A) ● (C) (D)
   Following wrong methods should not be used as they are not recognised by scanning machine in digitized assessment. Candidate using such method will be responsible for their loss.

WRONG METHODS
(A) (B) (C) (D) (A) (B) (C) (D) (A) (●) (C) (D) (A) (B) (C) (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 OMR उत्तरपत्रिकेचा क्रमांक त्याखाली लिहावा.
2. सदर प्रश्नपत्रिकेत **100** बहुविकल्प 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. **स्टीकर 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 नोंद घ्यावी.
   (iii) वरीलप्रमाणे सर्व पडताळून पाहिल्यानंतरच प्रश्नपत्रिकेवर ओ.एम.आर. उत्तरपत्रिकेचा क्रमांक 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 (B) हे योग्य उत्तर असेल तर.
   (A) ● (C) (D)
   खालील चुकीच्या पद्धती वापरू नये, कारण डिजिटाइज्ड (Digitized) मूल्यांकनात स्कॅनिंग मशीन त्यांना ओळखत नाही. त्या पद्धती वापरून नुकसान झाल्यास त्यास विद्यार्थीच जबाबदार असतील.

चुकीची पद्धती
(A) (B) (C) (D) (A) (B) (C) (D) (A) (●) (C) (D) (A) (B) (C) (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. उत्तरपत्रिकेवर 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 गैरमार्गांचा 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.

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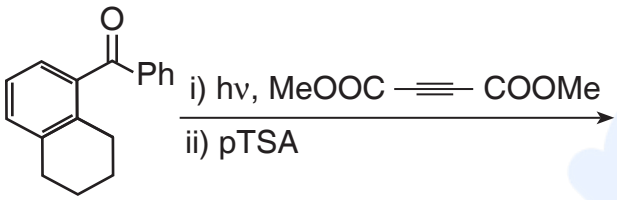
Chemical Sciences

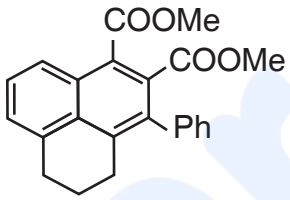
Paper II

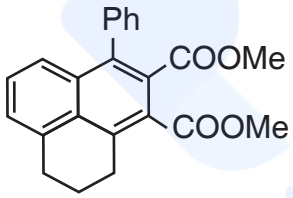
Time Allowed : 120 Minutes] **[Maximum Marks : 200**

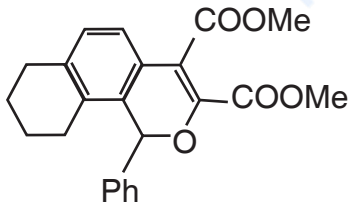
Note : This Paper contains **Hundred (100)** multiple choice questions. Each question carrying **Two (2)** marks. Attempt *All* questions.

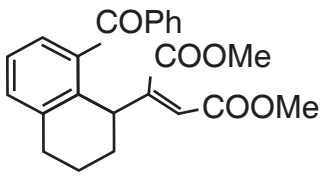
1. The major product formed in the following reaction is



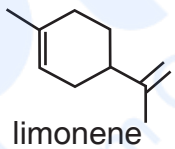
(A) 

(B) 

(C) 

(D) 

2. The sequence of reactions involved in the synthesis of following molecule using 2-methyl-1,3-butadiene and methyl vinyl ketone is



limonene

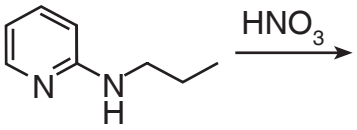
(A) Diels-Alder reaction followed by Reformatsky reaction

(B) Wittig reaction followed by Diels-Alder reaction

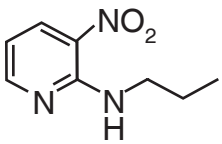
(C) Wittig reaction followed by Peterson olefination

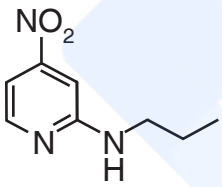
(D) Diels-Alder reaction followed by Wittig reaction

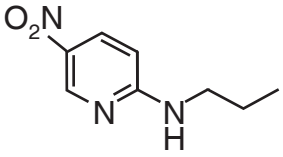
3. The correct structure of major product formed in the following reaction based on the given spectral data is

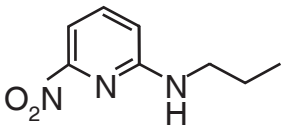


^{1}H NMR (δ ppm) : 8.0 (1H, d, J = 8.2 Hz), 6.7 (1H, d, J = 7 Hz), 4.0 (1H, s), 3.1 (2H, t), 1.6 (2H, m), 0.9 (3H, t)

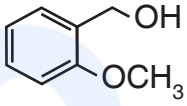
(A) 

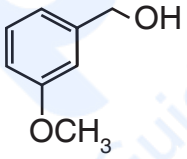
(B) 

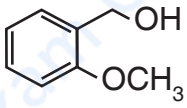
(C) 

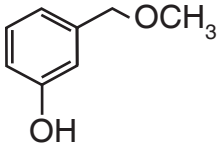
(D) 

4. The compound that does not change color with $FeCl_3$ and shows the following spectral data is ^{1}H NMR δ (ppm) 3.9 (s, 3H), 4.6 (s, 2H), 5.3 (bs, 1H, Exchanges with D_2O), 6.9 (dd, J = 8, 2 Hz, 1H), 6.95 (d, J = 2 Hz, 1H), 7.0 (dd, J = 8, 2 Hz, 1H), 7.3 (t, J = 8 Hz, 1H) MS : m/z 138, 107

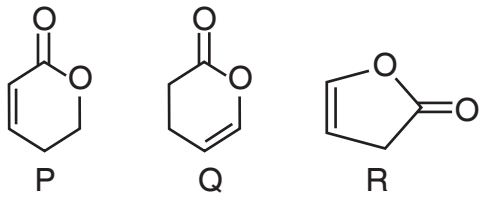
(A) 

(B) 

(C) 

(D) 

5. The correct order of C ═ O stretching frequency in IR spectrum for the following compounds is



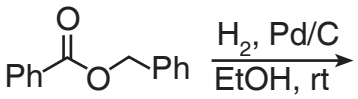
(A) P > R > Q

(B) R > Q > P

(C) Q > P > R

(D) R > P > Q

6. The products formed in the following reaction are



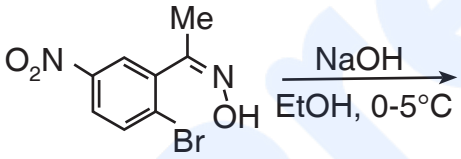
(A) Benzoic acid and benzyl alcohol

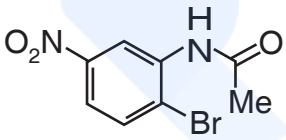
(B) Cyclohexane carboxylic acid and toluene

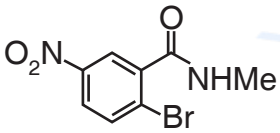
(C) Benzoic acid and toluene

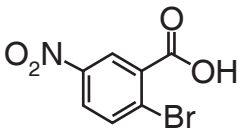
(D) Only benzyl alcohol

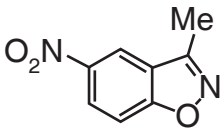
7. The major product formed in the following reaction is



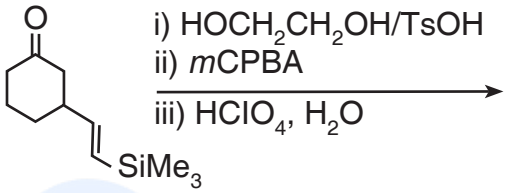
(A) 

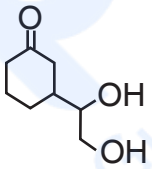
(B) 

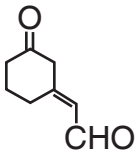
(C) 

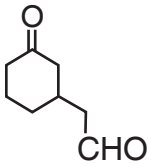
(D) 

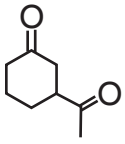
8. The major product formed in the following reaction sequence is



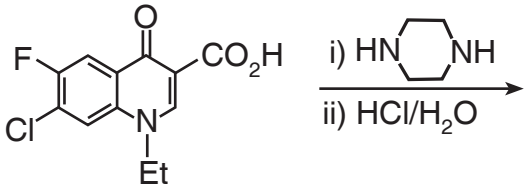
(A) 

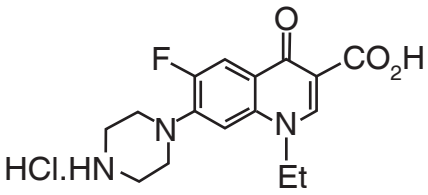
(B) 

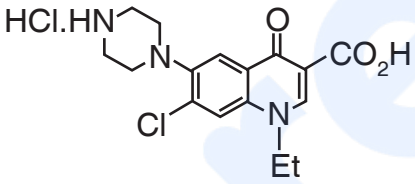
(C) 

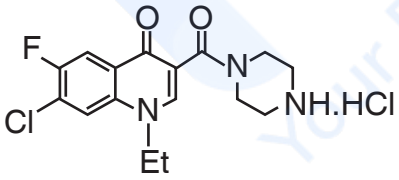
(D) 

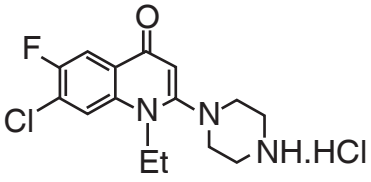
9. The major product formed in the following reaction is



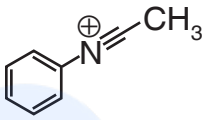
(A) 

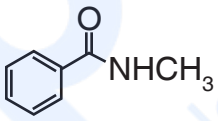
(B) 

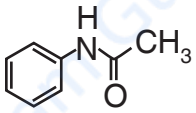
(C) 

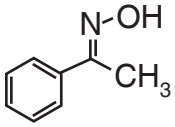
(D) 

10. The correct statement for the reaction of acetophenone with hydroxyl amine followed by Beckmann rearrangement is

I. 

II. 

III. 

IV. 

(A) The intermediate I is responsible for the formation of II

(B) II and III have identical physical and chemical properties

(C) The oxime IV leads to I

(D) The oxime IV leads to II

11. The magnitude of change in entropy of a cup of tea which cools is

(A) Greater than the magnitude of change in entropy of the surrounding

(B) Less than the magnitude of change in entropy of the surrounding

(C) Equal to the magnitude of change in entropy of the surrounding

(D) Can be more or less than the magnitude of change in entropy of the surrounding

12. When each system is characterized by constant μ, V and T it is

(A) Closed isothermal system

(B) Grand canonical ensemble

(C) Micro canonical ensemble

(D) Condensed system

13. Contribution of zero point energy to heat capacity is

(A) Zero

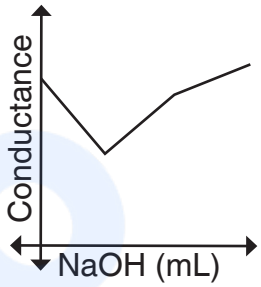
(B) R

(C) 3R/2

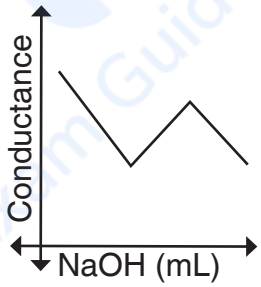
(D) R/2

14. Conductometric titration curve of equivalent mixture of 0.1N HCl and HCN against 0.1N NaOH (aq.) would have a form

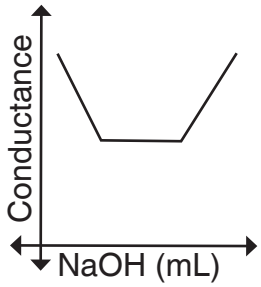
(A)



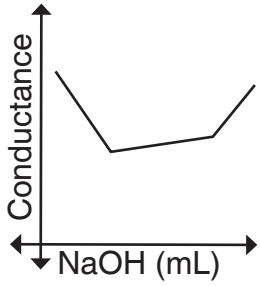
(B)



(C)



(D)



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15. Which thermodynamic equation correctly represents the relationship for temperature coefficient of an electrochemical cell ?

(A) $\Delta G^\circ = nFT\left(\frac{\partial E^\circ}{\partial T}\right)$

(B) $\Delta G^\circ = -nFE^\circ$

(C) $\Delta S^\circ = nF\left(\frac{\partial E^\circ}{\partial T}\right)$

(D) $\Delta E = E^\circ + \frac{RT}{nF}\ln\left(\frac{a_R}{a_o}\right)$

16. Dynamic Light Scattering (DLS) measures the hydrodynamic radius of nanoparticles suspended in liquid media. The technique is based on

(A) Differential absorption of polarized light.

(B) Fluctuation in scattered light intensity caused by Brownian motion via Stokes-Einstein equation.

(C) Thermally induced refractive index gradient at particle-media interface.

(D) Elastic deflection of high energy primary electron.

17. The powder XRD recorded on nanoparticle samples, the Scherrer equation, $D = \frac{K\lambda}{\beta\cos\theta}$ is used to estimate the crystalline size. 'β' in this equation is

(A) Full Width Half Maxima (FWHM) of diffraction peak in radian

(B) Bragg's diffraction angle in degree

(C) X-ray wavelength in $\mathring{A}$

(D) Lattice mismatch due to strain factor

18. Which supramolecular structure is formed by self-assembly in water ?

(A) Rotaxane

(B) Micelle

(C) Catenane

(D) Fullerene

19. Vitamin B_{12} contains

(A) Fe

(B) Mo

(C) Co

(D) Cu

20. $[Co(NH_3)_5Br]$ and $[Co(NH_3)_5SO_4]$ Br are ionization isomers. Which of the following will react under aqueous conditions ?

(A) $[Co(NH_3)_5Br]SO_4 + Ba^{2+}$

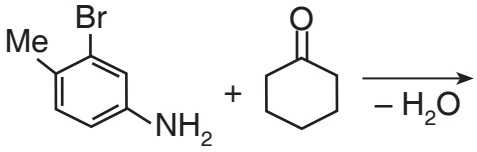
(B) $[Co(NH_3)_5\ SO_4]Br + Ba^{2+}$

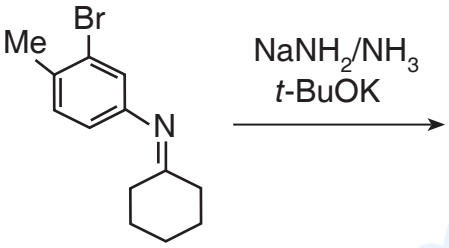
(C) $[Co(NH_3)_5\ SO_4]Br + Mg^{2+}$

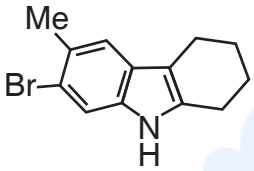
(D) $[Co(NH_3)_5Br]SO_4 + Ag^{+}$

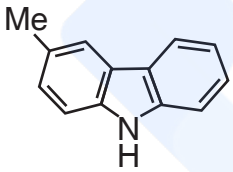
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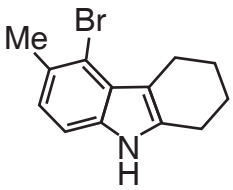
21. The major product formed in the following reaction sequence is

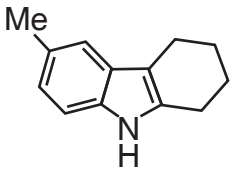




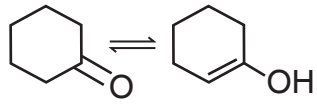
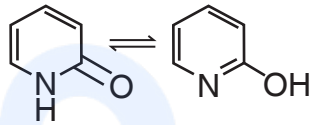
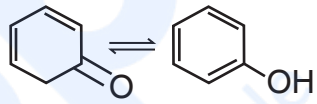
(A) 

(B) 

(C) 

(D) 

22. The correct match of the given set of equilibria from Column – I with the respective equilibrium constant from Column – II.

Column – I	Column – II
I. 	p. 1.1×10^{-3}
II. 	q. 1.1×10^{13}
III. 	r. 2.0×10^{-6}

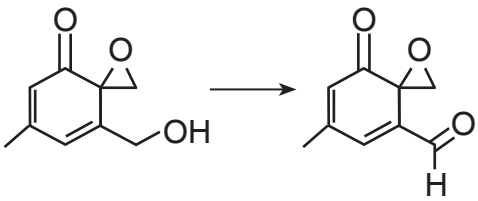
(A) I – r, II – p, III – q

(B) I – q, II – r, III – p

(C) I – p, II – r, III – q

(D) I – r, II – q, III – p

23. The most suitable reagents that effect the following transformation is



I. CrO_3, H_2SO_4

II. Dess-Martin periodinane

III. Ag_2CO_3 on celite

IV. MnO_2

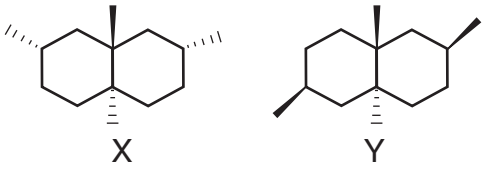
(A) I, III and IV

(B) I, II and III

(C) II, III and IV

(D) I, II and IV

24. The number of axial methyl groups in the most stable chair conformations of X and Y, respectively, are



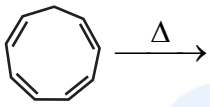
(A) Three and three

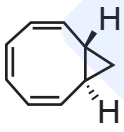
(B) Two and three

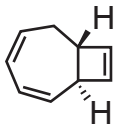
(C) Three and two

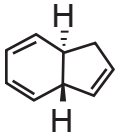
(D) Two and two

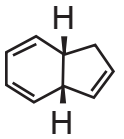
25. The major product formed in the following reaction is



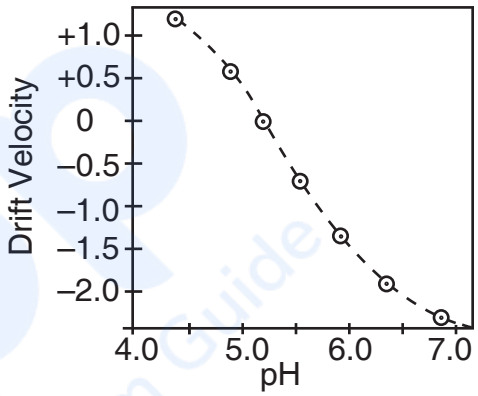
(A) 

(B) 

(C) 

(D) 

26. Following plot represents the drift-velocity of Bovin Serum Albumin (BSA) recorded at varied pH values, under the influence of electric field in aqueous media. The iso-electric point for the said protein is around



(A) 1.2

(B) 7.0

(C) 5.0

(D) 1.0

27. For cubic crystal system, the essential symmetry is

(A) One fourfold axis

(B) Three fourfold axes

(C) Four threefold axes

(D) Two twofold axes

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28. A polymer sample consists of 80 parts by weight of a polymer having molecular weight 80000 and 20 parts by weight of another polymer having molecular weight 20000. The number-average molecular weight and weight-average molecular weight, respectively, are

(A) 50000 and 68000

(B) 60000 and 68000

(C) 60000 and 50000

(D) 68000 and 40000

29. Which experimental technique is most directly associated with determination of the number-average molecular weight of a polymer ?

(A) Turbidimetry

(B) Viscosity

(C) Osmometry

(D) Light scattering

30. A statistical test which provides with a specified probability, whether the mean of two determination differ significantly

(A) F-test

(B) Q-test

(C) t-test

(D) Variance ratio test

31. The Δ_0 of a certain ML_6 complex will vary in the order

(A) $H_2O < I^- < PR_3 < NH_3$

(B) $Br^- < H_2O < CO < NH_3$

(C) $Cl^- < H_2O < NH_3 < CO$

(D) $NH_3 < I^- < CO < H_2O$

32. Which of the following metal ions will have the same CFSE for an ML_6 octahedral complex ?

(A) V^{2+} and Fe^{2+} (Low spin)

(B) Cr^{3+} and Ni^{2+}

(C) V^{3+} and Ni^{2+}

(D) Cu^{2+} and Ti^{3+}

33. Which of the following metal ions will have the same crystal field stabilization energy but different number of unpaired electrons for a given ML_6 octahedral metal complex ?

(A) Ti^{3+} and Co^{3+} (High spin)

(B) Ni^{2+} and V^{3+}

(C) Fe^{3+} and Mn^{3+} (both are high spin complexes)

(D) Co^{2+} (high spin) and V^{2+}

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34. The decrease in the ionic radii from La^{+} to Lu^{3+} is *not* attributed to

(A) Increase in effective atomic number Z

(B) Poor shielding of 4f subshells

(C) Poor basic character of the cations

(D) Subtle contribution from relativistic effects

35. The ground state term symbol for Pr^{3+} (f^2) is

(A) $^3H_4$

(B) $^3F_2$

(C) ^1D

(D) ^1G

36. A certain Mn^{2+} (I = 5/2) high spin octahedral complex displays an EPR (ESR) spectrum of five sextets (5×6=30 lines). Ignoring the spin-spin interaction between metal and ligands, this spectrum can be interpreted as

(A) $\pm\frac{1}{2}$ spin states from Zeeman splitting

(B) Due to 0, ±1, ±2 spin states

(C) Four spin states from Zeeman splitting

(D) Non degenerate Kramer doublets in zero field

37. When 100 mg sample of calcium oxalate monohydrate (Mol. wt. 146.12 g) was heated at the rate of 10°C/min in air, loss of 7.0 mg was noted at onset temperature of 140°C corresponding to water. The percentage (w/w) of calcium oxalate monohydrate in the original sample is

(A) 56.82%

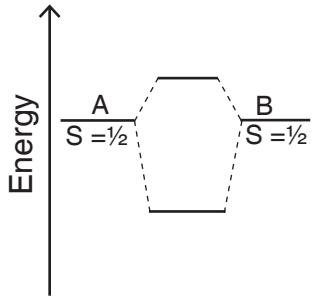
(B) 56.00%

(C) 61.32%

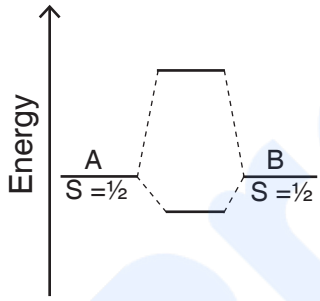
(D) 56.21%

38. Oxyhemocyanin is diamagnetic because of antiferromagnetic coupling of unpaired electron on two similar Cu(II) centers. The diagram that correctly represents this spin-spin coupling is

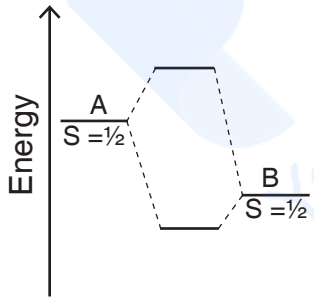
(A)



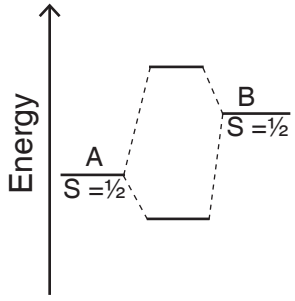
(B)



(C)



(D)



39. Match the mode of dioxygen binding (column – II) to the proteins (column – I).

Column – I	Column – II
i. Hemoglobin	P. η^1-end-on peroxo
ii. Hemocyanin	Q. η^1-end-on superoxo
iii. Hemerythrin	R. $\mu-\eta^1:\eta^1$ -end-on peroxo
iv. Hemosiderin	S. $\mu-\eta^2:\eta^2$ -side-on peroxo
	T. $\mu-\eta^2$-oxo

(A) i – P , ii – R , iii – T , iv – S

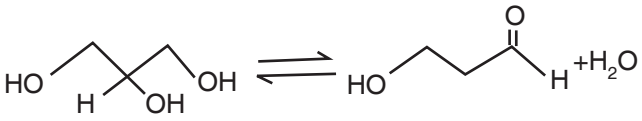
(B) i – Q , ii – S , iii – P , iv – T

(C) i – T , ii – P , iii – Q , iv – R

(D) i – R , ii – S , iii – T , iv – P

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40. The given Vit-B_{12}-dependent isomerization is catalyzed by the enzyme



(A) diol dehydratase

(B) glutamate mutase

(C) glycerol dehydratase

(D) glyceraldehyde synthase

41. The resonance integral β in Hückel molecular orbital theory is usually

(A) Positive

(B) Negative

(C) Zero

(D) Equal to α

42. What is the correct order of bond strength for the oxygen molecule and its ions ?

(A) $O_2^- > O_2 > O_2^+$

(B) $O_2^+ > O_2 > O_2^-$

(C) $O_2 > O_2^+ > O_2^-$

(D) $O_2^+ > O_2^- > O_2$

43. According to the variational principle, if ψ_{trial} is an arbitrary normalized, well behaved trial wave function for a quantum system governed by a time-independent Hamiltonian '$\hat{H}$' with ground state energy E_0, which inequality must the expectation value $E_{trial} = \langle \psi_{trial} | H | \psi_{trial} \rangle$ satisfy ?

(A) $E_{trial} = 0$

(B) $E_{trial} \leq E_0$

(C) $E_{trial} \geq E_0$

(D) $E_{trial} \leq 0$

44. The number of irreducible representations of a point group is equal to

(A) The number of symmetry operations

(B) The order of the group

(C) The number of classes

(D) The number of generators

45. In a character table, the Mulliken symbol "E" typically denotes

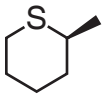
(A) A singly degenerate irreducible representation

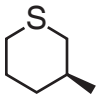
(B) A doubly degenerate irreducible representation

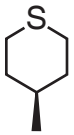
(C) A triply degenerate irreducible representation

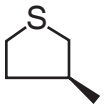
(D) A totally symmetric irreducible representation

46. The compound which on oxidation with dimethyl dioxirane (1 equivalent) furnishes achiral product is

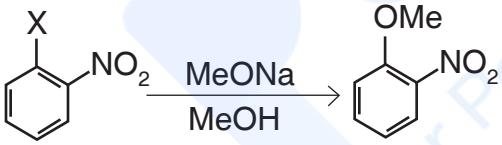
(A) 

(B) 

(C) 

(D) 

47. The correct order for the rate of substitution of the following nitrobenzenes is



X = F, Br and I

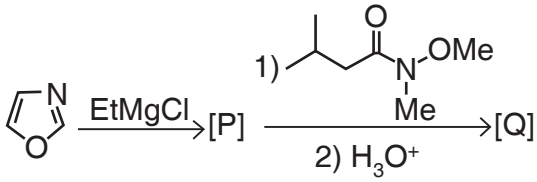
(A) Br > I > F

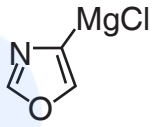
(B) I > Br > F

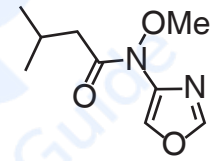
(C) Br > F > I

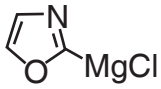
(D) F > Br > I

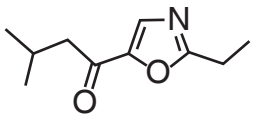
48. The major products [P] and [Q] formed in the following sequence of reactions are

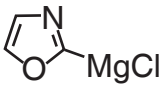


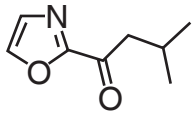
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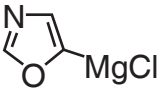
[Q] = 

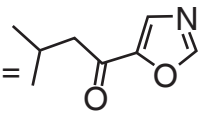
(B) [P] = 

[Q] = 

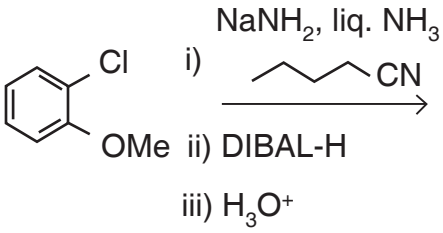
(C) [P] = 

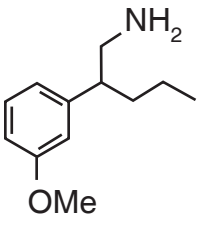
[Q] = 

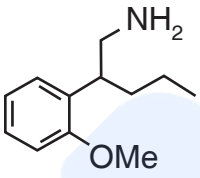
(D) [P] = 

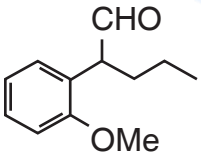
[Q] = 

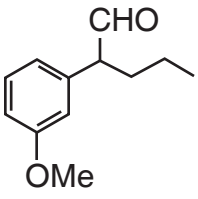
49. The major product formed in the sequence of following reactions is



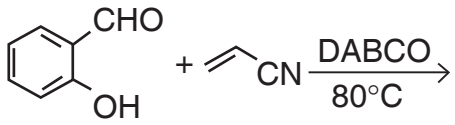
(A) 

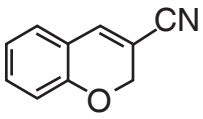
(B) 

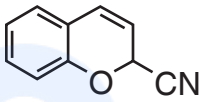
(C) 

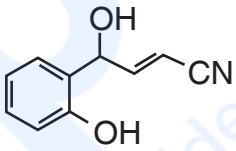
(D) 

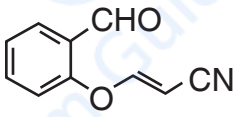
50. The major product formed in the following reaction is



(A) 

(B) 

(C) 

(D) 

51. The valence electron configuration of 13, 15 and 17 respectively correspond to

(A) $ns^2\ np^1$, $ns^2\ np^2$ and $ns^2\ np^3$

(B) $ns^2\ np^3$, $ns^2\ np^5$ and $ns^1\ np^2$

(C) $ns^2\ np^1$, $ns^2\ np^3$ and $ns^2\ np^5$

(D) $ns^1\ np^2$, $ns^2\ np^5$ and $ns^2\ np^3$

52. The highest oxidation state for a first row transition metal is achieved with which one of the following valence electron configuration ?

(A) $nd^5\ ns^2$

(B) $nd^5\ (n + 1)s^2$

(C) $(n + 1)d^5\ ns^2$

(D) $nd^7\ (n + 1)s^2$

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53. The correct order of bond enthalpy for O_2, $O_2^{+\cdot}$ and $O_2^{-\cdot}$ is

(A) $O_2^{+\cdot} > O_2 > O_2^{-\cdot}$

(B) $O_2^{-\cdot} > O_2^{+\cdot} > O_2$

(C) $O_2 > O_2^{+\cdot} > O_2^{-\cdot}$

(D) $O_2 > O_2^{-\cdot} > O_2^{+\cdot}$

54. For the heterodiatomic molecule ICl

(A) I contributes to non bonding orbital

(B) The bonding orbitals are predominantly Cl in character

(C) The bonding orbitals have equal contributions from I and Cl

(D) LUMO is a non bonding orbital

55. Which of the following molecules exhibit the same shape ?

(A) CH_4 and XeF_4

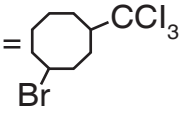
(B) PCl_5 and $Sb(Ph)_5$

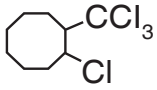
(C) NH_3 and $(SO_4)^{2-}$

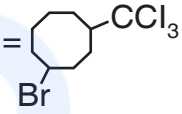
(D) SO_3 and $(CO_3)^{2-}$

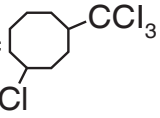
56. The major products [X] and [Y] formed in the following reactions are

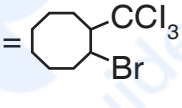


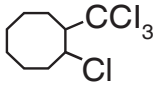
(A) [X] = 

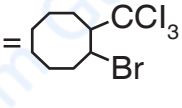
[Y] = 

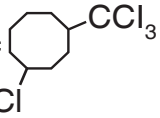
(B) [X] = 

[Y] = 

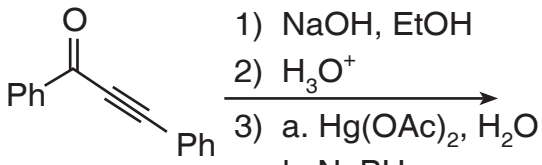
(C) [X] = 

[Y] = 

(D) [X] = 

[Y] = 

57. The major product formed in the following reaction sequence is



(A) Benzoic acid and acetophenone

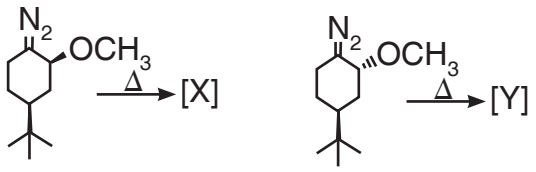
(B) Benzoic acid and phenylacetaldehyde

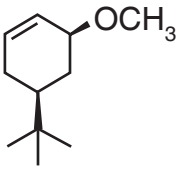
(C) Benzyl alcohol and acetophenone

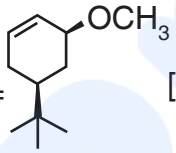
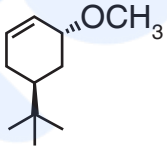
(D) Benzaldehyde and acetophenone

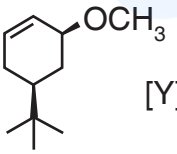
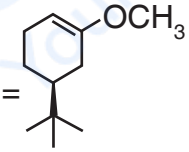
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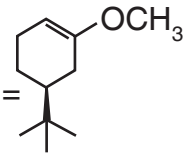
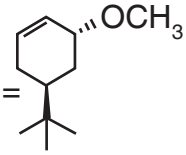
58. The major products [X] and [Y] formed in the following set of the reactions are



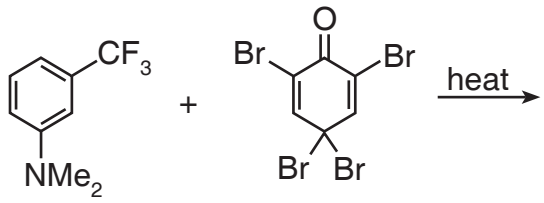
(A) [X] = [Y] = 

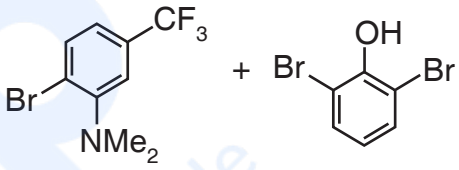
(B) [X] =  [Y] = 

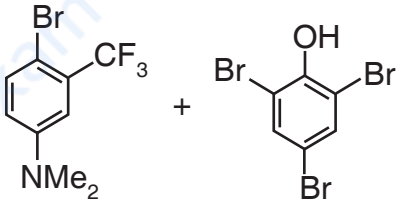
(C) [X] =  [Y] = 

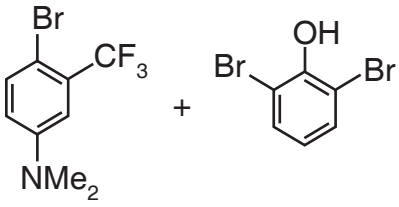
(D) [X] =  [Y] = 

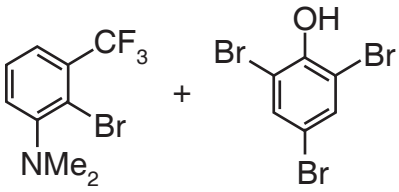
59. The major products formed in the following reaction is



(A) 

(B) 

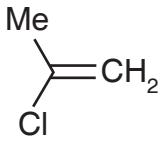
(C) 

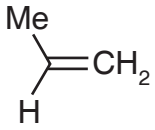
(D) 

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60. The correct order of reactivity of following compounds for the addition of one equivalent of HCl is

I. Me—≡—CH

II. 

III. 

(A) II < III < I

(B) II < I < III

(C) I < II < III

(D) III < I < II

61. As the rotational quantum number (J) increases for a diatomic molecule

(A) Degeneracy increases, while population decreases

(B) Both degeneracy and population decrease

(C) Degeneracy decreases, while population increases

(D) Both degeneracy and population increase

62. Selection rule for diatomic rigid rotator is

(A) $\mu_0 = 0, \Delta m = 0, \Delta l = \pm 1$

(B) $\mu_0 \neq 0, \Delta m = \pm 1, \Delta l = 0$

(C) $\mu_0 = 0, \Delta m = 0, \Delta l = 0$

(D) $\mu_0 \neq 0, \Delta m = 0, \pm 1, \Delta l = \pm 1$

63. Suppose $\vec{\mu}_{if}$ is the transition dipole moment associated with pair of stationary states ψ_i and ψ_f of a molecule, the probability of transition from the state ψ_i to ψ_f is directly proportional to

(A) $|\vec{\mu}_{if}|$

(B) $|\vec{\mu}_{if}|^2$

(C) $1/|\vec{\mu}_{if}|$

(D) $1/|\vec{\mu}_{if}|^2$

64. Some ideal gas molecules are confined in a part of an adiabatic chamber with a partition. At some instant the partition is removed and the gas expands against vacuum to fill the whole chamber. Which among the following is correct ?

(A) Entropy will increase

(B) Temperature will decrease

(C) Work done is positive

(D) Gibb's free energy will increase

65. For an irreversible process, the change in entropy of the system is

(A) $ds = \frac{dq_{rev}}{T}$

(B) $ds = \frac{dq}{T}$

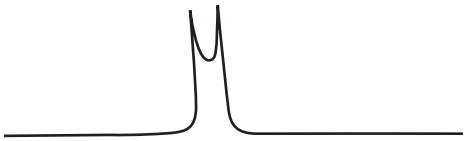
(C) $ds = dq_{rev} \times T$

(D) $ds = dq \times T$

66. The ^{31}P NMR spectrum of $RhCl(PPh_3)_3$ at 30°C is shown in (Given Rh I = ½, 100%)

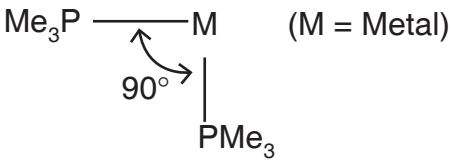
(A) 

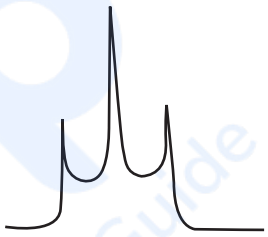
(B) 

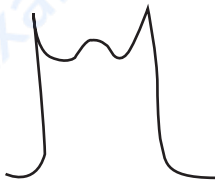
(C) 

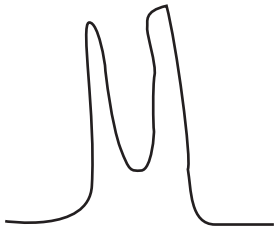
(D) 

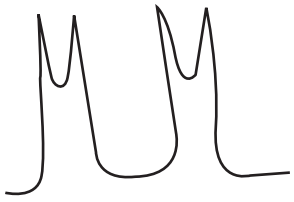
67. The ^{1}H NMR spectrum of the following species is correctly shown in (Given ^{31}P, I = ½)



(A) 

(B) 

(C) 

(D) 

68. The following nuclear reaction is an example of

$^{7}_{4}Be + ^{0}_{-1}e \longrightarrow ^{7}_{3}Li + \nu$

(A) Proton emission

(B) β emission

(C) K-electron capture

(D) γ radiation

69. For the following decay series

$^{141}_{56}Ba \xrightarrow[t_{1/2}^{(A)}]{\beta} ^{141}_{57}La \xrightarrow[t_{1/2}^{(B)}]{\beta} ^{141}_{58}Ce \xrightarrow[t_{1/2}^{(C)}]{\beta} ^{141}_{59}Pr$

The correct order of the half-lives $\left(t_{1/2}\right)$ is given by

(A) $t_{1/2}(B) < t_{1/2}(C) < t_{1/2}(A)$

(B) $t_{1/2}(A) = t_{1/2}(B) = t_{1/2}(C)$

(C) $t_{1/2}(B) = t_{1/2}(C) < t_{1/2}(A)$

(D) $t_{1/2}(A) < t_{1/2}(B) < t_{1/2}(C)$

70. In nuclear thermal reactors, $^{9}_{4}Be$ and $^{12}_{6}C$ serve as good moderators as they

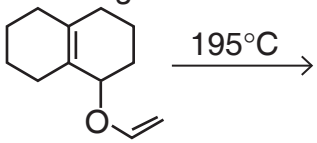
(A) Slow down neutrons

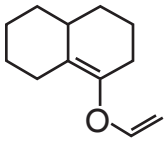
(B) Emit β particles

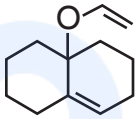
(C) Facilitate k-electron capture

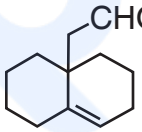
(D) Emits positrons

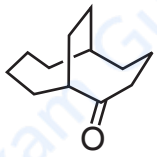
71. The major product formed in the following reaction is



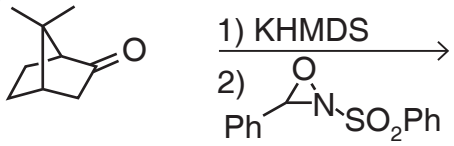
(A) 

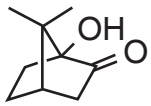
(B) 

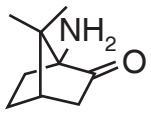
(C) 

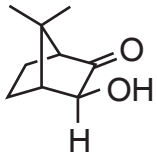
(D) 

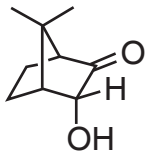
72. The major product formed in the following reaction sequence is



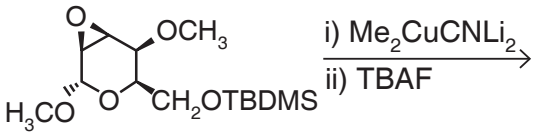
(A) 

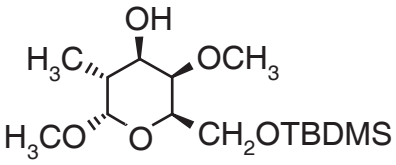
(B) 

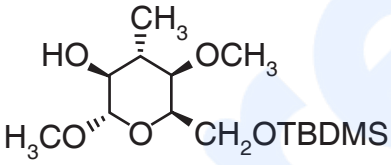
(C) 

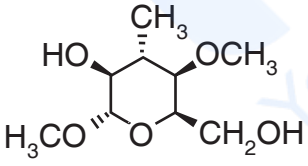
(D) 

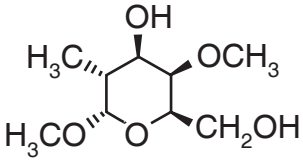
73. The major product formed in the following reaction is



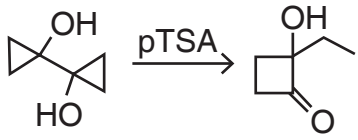
(A) 

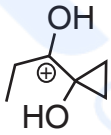
(B) 

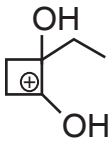
(C) 

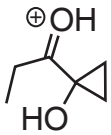
(D) 

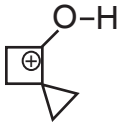
74. The cation which is the least likely to be an intermediate in the following reaction is



(A) 

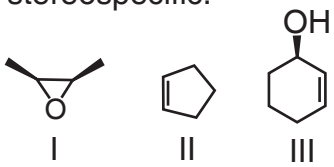
(B) 

(C) 

(D) 

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75. Classify the following reactions as either stereoselective or stereospecific.



i. Reaction of epoxide I with NaN_3

ii. Epoxidation of II with *m*-CPBA

iii. Epoxidation of III with *m*-CPBA

(A) i stereospecific ii stereospecific iii stereoselective

(B) i stereospecific ii stereoselective iii stereoselective

(C) i stereoselective ii stereospecific iii stereoselective

(D) i stereoselective ii stereoselective iii stereospecific

76. The set of compounds that do *not* undergo autoionization in liquid phase at normal laboratory conditions is

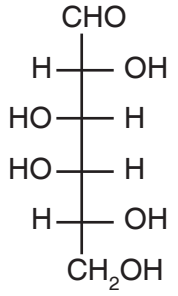
(A) IF_5, $AsCl_3$, BrF_3

(B) $POCl_3$, $AsCl_3$, BrF_3

(C) AsF_3, BrF_3, ClF_3

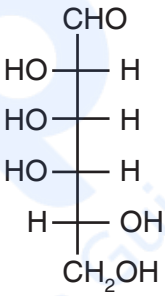
(D) IF_5, $AsCl_3$, $POCl_3$

77. Using the indicated structure of D-galactose, the possible structure of L-galactose is

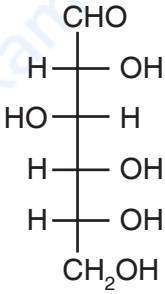


D-galactose

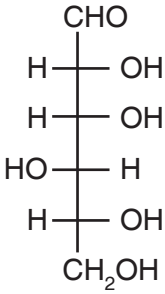
(A)



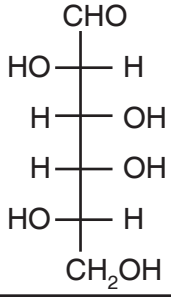
(B)



(C)



(D)



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78. The correct match of molecules given in Column – I with the class of biomolecules given in Column – II is

Column – I	Column – II
a. Keratin	i. Terpenoid
b. Quinine	ii. Carbohydrate
c. Glycogen	iii. Proteins
d. Taxol	iv. Alkaloids

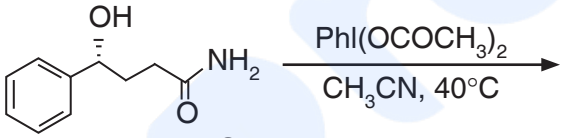
(A) a – ii, b – iii, c – i, d – iv

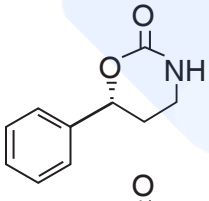
(B) a – iii, b – iv, c – ii, d – i

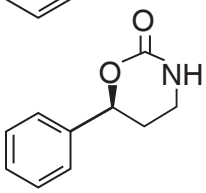
(C) a – iii, b – i, c – ii, d – iv

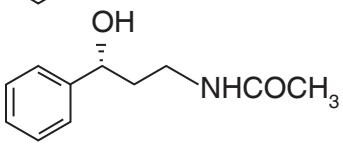
(D) a – i, b – iv, c – iii, d – ii

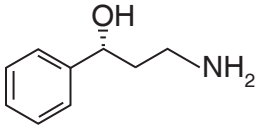
79. The major product formed in the following reaction is



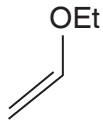
(A) 

(B) 

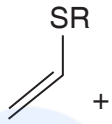
(C) 

(D) 

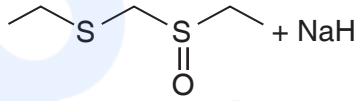
80. Which of the following reagents can act as formyl anion equivalent ?

(A) 

+ *sec*-BuLi

(B) 

+ *sec*-BuLi

(C) 

(D) $CH_3CH_2NO_2$ + base

81. From the given data, identify the strongest base to (i) H^+ (in gas phase) and (ii) trimethyl borane.

J	K	L
CH_3NH_2	$(CH_3)_2NH$	$(CH_3)_3N$
2-methyl pyridine	pyridine	4-Methyl pyridine

(A) (i) – J; (ii) – L

(B) (i) – L; (ii) – L

(C) (i) – K; (ii) – J

(D) (i) – L; (ii) – K

82. The correct statement regarding the solubility and colours of silver halides in water is

(A) AgI has highest solubility because of flavourable soft acid-soft base interaction and yellow colour is because of large band gap

(B) AgBr is more soluble than AgI as bromine is the most polarizable halide and is yellow coloured due to ligand to metal charge transfer

(C) Solubility of silver halides decreases from AgF to AgI due to increasing covalent character and colours change from white for AgF and AgCl to yellow for AgBr and AgI due to ligand to metal charge transfer

(D) Solubility of AgF is highest due to high hydration energy of $F^{\ominus}$ ion and it is white because of decreased band gap

83. The mixed halo organo compound R_2PCl can be prepared from PCl_3 by treatment with

(A) LiR

(B) RMgCl

(C) HgR_2

(D) RCl

84. Phosphazines contain

(A) P atom in (+V) oxidation state and N atom in (+III) oxidation state

(B) P atom in (+III) oxidation state and N atom in (+V) oxidation state

(C) Both P and N atoms in (+III) oxidation state

(D) Both P and N atoms in (+V) oxidation state

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85. In Thermite reaction, aluminum becomes white hot upon reaction with

(A) N_2

(B) Cl_2

(C) NaOH

(D) O_2

86. The dimension of the Debye-Hückel constant 'A', in the Debye-Hückel limiting law is

(A) mol^2kg^2

(B) $mol^{-2}kg^{-2}$

(C) $mol^{-0.5}kg^{0.5}$

(D) $mol^{0.5}kg^{-0.5}$

87. For the consecutive reaction

$A \xrightarrow{K_1} B \xrightarrow{K_2} C$

starting with $[A] = [A]_0$; $[B]_0 = [C]_0 = 0$ the value for K_1 and K_2 are estimated to be 2.0 s^{-1} and 1.0 s^{-1}, respectively. At what time, the concentration [B], will passed through maxima ?

(A) 0.2 s

(B) 0.1 s

(C) 0.4 s

(D) 0.3 s

88. According to the transition state theory the plot with slope equal to $\frac{-\Delta H^{\neq}}{R}$ is

(A) ln k vs. T

(B) $\ln\left(\frac{K}{T}\right)$ vs. T

(C) $\ln\left(\frac{K}{T}\right)$ vs. $\frac{1}{T}$

(D) ln k vs. $\frac{1}{T}$

89. For the enzymolysis following Michaelis-Menten Kinetics, $\nu = \frac{V_{max}[S]}{K_m + [S]}$.

What is the value of substrate concentration [S], when the rate of reaction ν, is 80% of the maximum rate (velocity) V_{max} ?

(A) 2 K_m

(B) 4 K_m

(C) 5 K_m

(D) 8 K_m

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90. The designers of new industrial plant wanted to use catalyst in a step involving the flourination of butadiene. The following data were obtained from the adsorption studies

p(Kpa)/V(cm^3)	15.1	30.0	44.9	60.1	75.2
p(Kpa)	10.0	20.0	30.0	40.0	50.0

The data would best fit in

(A) BET isotherm

(B) Langmuir isotherm

(C) Freunrich isotherm

(D) Physical adsorption isotherm

91. Potential energy of an electron and a proton separated by distance r is given by

(A) $V(r) = \frac{e^2}{4\pi \in_0 r}$

(B) $V(r) = -\frac{e^2}{4\pi \in_0 r}$

(C) $V(r) = -\frac{e^2}{4\pi \in_0 r^2}$

(D) $V(r) = \frac{e^2}{4\pi \in_0 r^2}$

92. An eigenvalue obtained on operating an operator $\frac{d^n}{dx^n}$ on a function $e^{\alpha x}$ will be

(A) $n\alpha\, e^{\alpha x}$

(B) $\frac{\alpha}{n} e^{\alpha x}$

(C) $n(n-1)\, e^{\alpha x}$

(D) $\alpha^n e^{\alpha x}$

93. An electron in a hydrogen atom occupies a 3d orbital. What is the minimum possible angle (θ_{min}) that the orbital that the angular momentum vector $\vec{L}$ can make with the positive z-axis ?

(A) 0°

(B) 10.2°

(C) 35.3°

(D) 45.8°

94. The radial probability density of an electron in hydrogenic orbital is given by $P = \frac{4}{a_0^3} r^2 e^{-2r/a_0}$. The most probable value of r for the state will be

(A) a_0

(B) $\frac{3}{2} a_0$

(C) $\frac{2}{3} a_0$

(D) $\frac{1}{2} a_0$

95. How many angular nodes are present in a 4s orbital ?

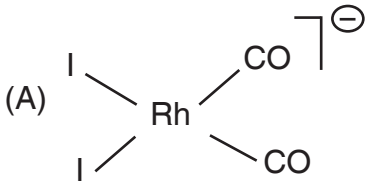
(A) 0

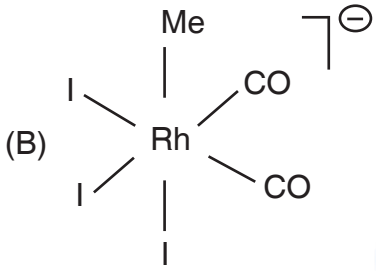
(B) 1

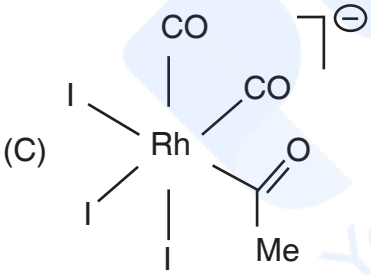
(C) 2

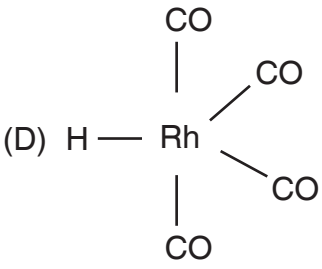
(D) 3

96. In Monsanto acetic acid process, the species that exhibits CO insertion is

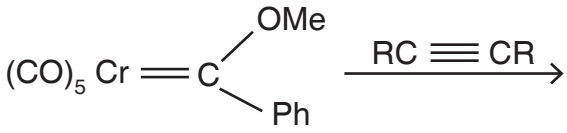
(A) 

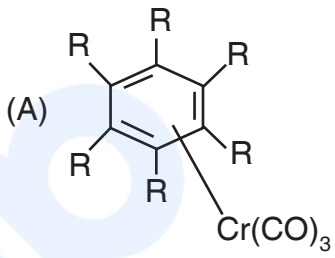
(B) 

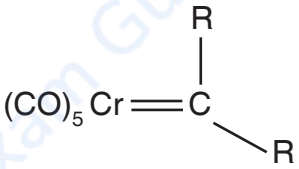
(C) 

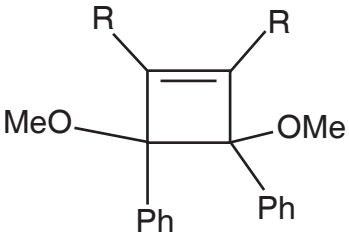
(D) 

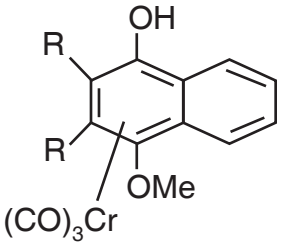
97. The following reaction produces



(A) 

(B) 

(C) 

(D) 

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98. The number of skeletal electron pairs in the naked p-block clusters, $(Bi_9)^{+5}$, $(Sn_9)^{-4}$ and $(Se_8)^{+2}$ respectively is

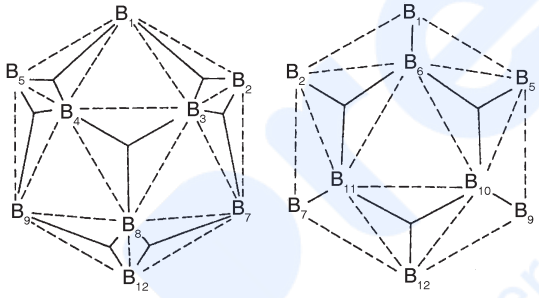
(A) 25, 16, 25

(B) 11, 11, 15

(C) 20, 20, 23

(D) 25, 20, 25

99. The front and back-side view of $[B_{12}H_{12}]^{2-}$ framework is given below, where s = number of B – H – B bonds, t = number of B – B – B bonds, y = number of B – B bonds and x = number of BH_2.



Front view Back view

The styx code for this molecule is

(A) (0, 12, 1, 0)

(B) (2, 8, 3, 0)

(C) (0, 11, 2, 0)

(D) (0, 10, 3, 0)

100. The statement(s) that correctly describe(s) the spacial arrangement and bonding of framework atoms in S_4N_4 ring is/are

i. All S – N bond distances within the ring are equal.

ii. The sulphur atoms form a square plane while nitrogen atoms form a surrounding tetrahedron.

iii. The four nitrogen atoms form a square plane with two non-bonding sulphur atoms at a distance of 258 pm.

iv. Both sulphur and nitrogen atoms form two interpenetrating coplanar squares.

(A) i and ii only

(B) ii and iv only

(C) i and iii only

(D) iii only

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