

TEST SERIES CSIR-NET/JRF JUNE 2019

BOOKLET SERIES **D**

Full Length Test Series-1

Paper Code **01**

Test Type: **TEST SERIES**

CHEMICAL SCIENCES

Duration: 3:00 Hours

Date: 06-06-2019

Maximum Marks: 200

Read the following instructions carefully:

* Single Paper Test is divided into three Parts.

Part - A: This part shall carry 20 questions. The candidate shall be required to answer any 15 questions. Each question shall be of **2 marks**.

Part - B: This part shall contain 40 questions. The candidate shall be required to answer any 35 questions. Each question shall be of **2 Marks**.

Part - C: This part shall contain 60 questions. The candidate shall be required to answer any 25 questions. Each question shall be of **4 marks**.

* Darken the appropriate bubbles with HB pencil/Ball Pen to write your answer.

* There will be negative marking @25% for each wrong answer.

* The candidates shall be allowed to carry the Question Paper Booklet after completion of the exam.

* For rough work, blank sheet is attached at the end of test booklet.



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PART – A

1. How many diagonals are there in a regular polygon whose each external angle is 36° ?
 (a) 35 (b) 45 (c) 30 (d) 54
2. What should come in place of x ?
 0 6 24 60 x
 (a) 90 (b) 120 (c) 100 (d) 96
3. In the afternoon, Manu starts walking facing the Sun. After walking for 5 km he takes a right turn, and walks 6 km. After that he takes a left turn and walks for 3 km more and at this point he meets Mainak and the point of meeting is in which direction of the starting point ?
 (a) 10 km, North-west (b) 14 km, North
 (c) 10 km, North (d) 14 km, North-west
4. Pointing to a lady in a photo frame, Rita says, "She is the daughter of my father's only daughter-in-law". How is the lady in the photo frame related to Rita ?
 (a) Sister (b) Niece (c) Sister-in-law (d) Aunt
5. Six people A, B, C, D, E, F are to be seated in a round table facing the centre.
 F is second to the right of A.
 B and C sits opposite to each other.
 D does not sit between B and F.
 D is not a neighbour of A.
 B sits second to the right of E.
 Who sits to the immediate right of D ?
 (a) B (b) C (c) D (d) E
6. Two unbiased dice are thrown in random, what is the probability that sum of the outcomes is eight ?
 (a) $\frac{2}{9}$ (b) $\frac{1}{6}$ (c) $\frac{5}{6}$ (d) $\frac{5}{36}$
7. At what times past 4 pm the hours and minute hands of a clock would make a right angle ?
 (a) $5\frac{5}{11}$ mins, $31\frac{2}{11}$ mins (b) $3\frac{2}{11}$ mins, $32\frac{2}{11}$ mins
 (c) $4\frac{3}{11}$ mins, $33\frac{1}{11}$ mins (d) $5\frac{5}{11}$ mins, $38\frac{2}{11}$ mins
8. What is the unit digit of $(8522)^{162} - (529)^{102} - (153)^{401}$?
 (a) 5 (b) 2 (c) 1 (d) 0
9. Pipe A can fill a tank in 15 minutes while pipe B can fill it in 30 minutes. Amit opened both the pipes and left. But when the tank was supposed to be filled he returned and found that the outlet pipe was also open and he immediately closed the outlet pipe. After closing the outlet pipe it took 5 more minutes to fill the tank. In how much time the outlet pipe can empty the full tank ?
 (a) 20 mins (b) 10 mins (c) 12 mins (d) 30 mins
10. If $x + \frac{1}{x} = 1$, then what is the value of $x^9 + \frac{1}{x^6} = ?$
 (a) 1 (b) 2 (c) -1 (d) 0
11. If the radius ratio of two circular cylinders is in ratio 1 : 2 and curved surface area is in the ratio 2 : 3, then what is the ratio of heights of the cylinders ?
 (a) 1 : 3 (b) 4 : 3 (c) 2 : 1 (d) 3 : 2

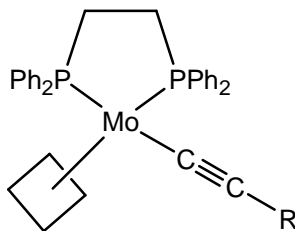
12. What should be the code for 'MINE' if the code for 'MOM' is 'NLN' and code for 'TAKE' is 'GZPV'?
- (a) NRMF (b) NHMF (c) NRMV (d) NHMV
13. In a bottle there was pure syrup of 10 litre. Each time one litre is taken out and replaced by water. This process is repeated for total of 3 times. What is the present ratio of syrup and water in the bottle ?
- (a) 5 : 2 (b) 100 : 81 (c) 1000 : 729 (d) 729 : 271
14. **Direction:** In the question below are few statements followed by the conclusions numbered accordingly. You have to take the given statements to be true even if they seem to be at variance from commonly known facts and then decide which of the given conclusions logically follows from the statements disregarding commonly known facts.
- Statements:** **Conclusions:**
- (1) Some X are Y (i) Some Z are Y
- (2) All X is Z (ii) Some X are A
- (3) Some Z are A (iii) Some Y are A
- (a) Only (i) follows (b) All follows (c) None follows (d) (i) and (ii) follows
15. In an exam there are 4 questions and every question has five different options. In how many ways a student can not give correct answer for all the questions ?
- (a) 624 (b) 19 (c) 625 (d) 99
16. Find the odd one out .
- (a) Kolkata (b) Delhi (c) Dispur (d) Patna
17. If the day of the 7th January in 1992 was Tuesday and it was Ram's birthday, then what will the day of Ram's birthday be in 1997?
- (a) Tuesday (b) Monday (c) Wednesday (d) Sunday
18. A news paper vendor sells the A, B and C news papers in equal numbers to 302 persons. Seven get B and C, twelve get A and C, nine get A & B and 3 get all the three papers. How many persons get only A?
- (a) 90 (b) 100 (c) 95 (d) 91
19. How many terms of the series given below must be added so that the sum may be 54?
- 12, -9, -6, -3,
- (a) 10 (b) 12 (c) 15 (d) 18
20. Aman knows that y is an integer greater than 5 and less than 8 but Anu knows that y is an integer greater than 6 but less than 10.
- (a) y can be exactly determined (b) y can not be exactly determined
- (c) y has two values (d) y has no fixed value

PART – B

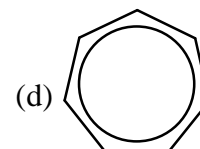
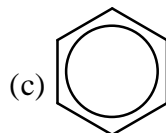
21. If ground state energy of He-atom is $-2.85 E_h$, then first ionization energy of helium is given by (where E_h = atomic unit energy)
- (a) 27.2 eV (b) 24.3 eV (c) 23.12 eV (d) 13.6 eV
22. In case of rigid-rotor the constant of motion defined by
- (a) \hat{L}_x (b) \hat{L}_y (c) \hat{L}_z (d) All
23. Which of the following molecule shows the changes in appearance of Mössbauer spectrum with temperature (phen = 1, 10 phenanthroline)
- (a) $[\text{Fe}(\text{phen})_3]$ (b) $[\text{Fe}(\text{phen})_2(\text{NCS})_2]$
- (c) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (d) $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$



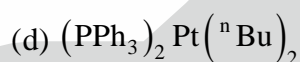
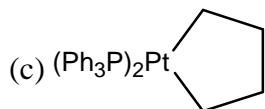
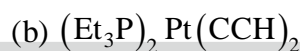
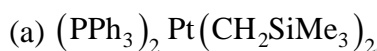
24. Oxy-hemerythrin is is
 (a) colourless and diamagnetic (b) pink and diamagnetic
 (c) O₂ transporter and paramagnetic (d) heme protein and paramagnetic
25. The missing planar, unsaturated and conjugated carbocyclic haptic ligand in the complex (X) is



(b) COD



26. The most unstable platinum σ -complex among the following is



27. The number of microstates for ^3P and ^3F terms are respectively

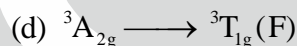
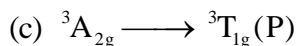
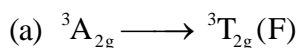
(a) 15 and 21

(b) 9 and 15

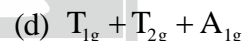
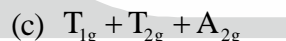
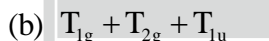
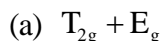
(c) 15 and 9

(d) 9 and 21

28. The electronic absorption spectrum of an aqueous solution of $[\text{Ni}(\text{en})_3]^{2+}$ exhibits broad absorption with $\lambda_{\text{max}} = 325, 550$ and 900 nm. The visible region band absorb in



29. The Mulliken symbols for the spectroscopic states arising from the free ion term F are



30. The number of P-S and P-P bonds in the compound P_4S_4 are respectively

(a) 6 and 4

(b) 8 and 2

(c) 2 and 8

(d) 7 and 3

31. The structure of TeF_4 and TeCl_4 , respectively are

(a) Monomeric and monomeric

(b) Polymeric and tetrameric

(c) Tetrameric and tetrameric

(d) Tetrameric and polymeric

32. The most basic among the following is

(a) $\text{Lu}(\text{OH})_3$

(b) $\text{Ce}(\text{OH})_3$

(c) $\text{Al}(\text{OH})_3$

(d) $\text{Eu}(\text{OH})_3$

33. The actual magnetic moment shows a large deviation from the spin-only formula in the case of

(a) Ti^{3+}

(b) V^{3+}

(c) Gd^{3+}

(d) Sm^{3+}

34. The HOMO to LUMO electronic transition responsible for the observed colour of chalcogen molecules (liquid) is

(a) $\sigma \rightarrow \sigma^*$

(b) $\pi \rightarrow \sigma^*$

(c) $\pi \rightarrow \pi^*$

(d) $\pi^* \rightarrow \sigma^*$

35. 2 moles of monoatomic gas is expanded from 5L to 10L at constant temperature. The change in entropy ($\text{JK}^{-1}\text{mol}^{-1}$) is

(a) 11.52

(b) 6.23

(c) 5.76

(d) 13.56

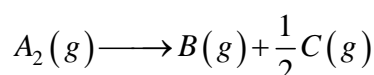


36. For any gas, the product of isobaric thermal expansion coefficient (α) and isothermal compressibility factor (β) is

(a) $-\frac{1}{V} \left(\frac{\partial V}{\partial T} \right)_P \left(\frac{\partial V}{\partial P} \right)_T$ (b) $\frac{1}{V^2} \left(\frac{\partial T}{\partial P} \right)_V \left[\left(\frac{\partial V}{\partial T} \right)_P \right]^2$

(c) $-\frac{1}{V^2} \left(\frac{\partial V}{\partial T} \right)_P \left(\frac{\partial P}{\partial V} \right)_T$ (d) 1

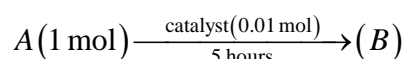
37. A gaseous reaction,



shows increase in pressure from 100 mmHg to 120 mmHg in 5 min. The rate of disappearance of A_2 is

- (a) 5 mmmin⁻¹ (b) 8 mmmin⁻¹ (c) 12 mmmin⁻¹ (d) 16 mmmin⁻¹

38. The turnover frequency for the catalytic reaction,



with 90% yield of the product is

- (a) 18 hr⁻¹ (b) 20 hr⁻¹ (c) 22 hr⁻¹ (d) 24 hr⁻¹

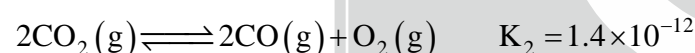
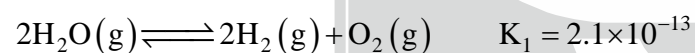
39. Which one of the following pairs has four magic numbers for closed nuclear shells?

- (a) 2, 8, 18, 50 (b) 8, 18, 32, 50 (c) 18, 32, 28, 50 (d) 8, 20, 50, 82

40. Assuming that the hydrogen molecule have a root mean square speed of 1560 m/s at 400K. The value of rms at 1600K is

- (a) 1620 m/s (b) 2800 m/s (c) 3120 m/s (d) 1.470 m/s

41. The equilibrium constants at 1395 K for the following reaction



The equilibrium constant for the reaction,



- (a) 0.15 (b) 2.58 (c) 66.66 (d) 43.15

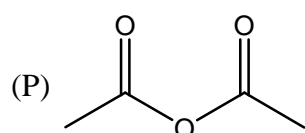
42. Magnesium crystallizes in hcp structure. If the lattice parameter is 0.32 nm, the closest distance between the Magnesium atoms in this structure is

- (a) 0.32 nm (b) 0.64 nm (c) 0.16 nm (d) 0.53 nm

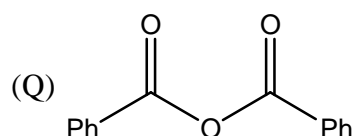
43. The correctly match structure and carbonyl stretching frequency (in cm⁻¹) set is

Column-I

Column-II

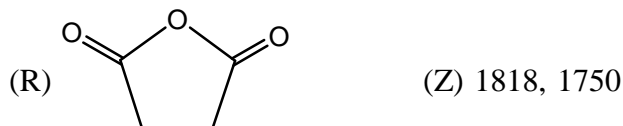


(X) 1775, 1720



(Y) 1865, 1782





(a) P-Y, Q-Z, R-X
(c) P-Z, Q-Y, R-X

(b) P-Z, Q-X, R-Y
(d) P-X, Q-Z, R-Y

44. The correct order of λ_{\max} (nm) and μ in the UV-Visible spectrum of compounds (I-III) is

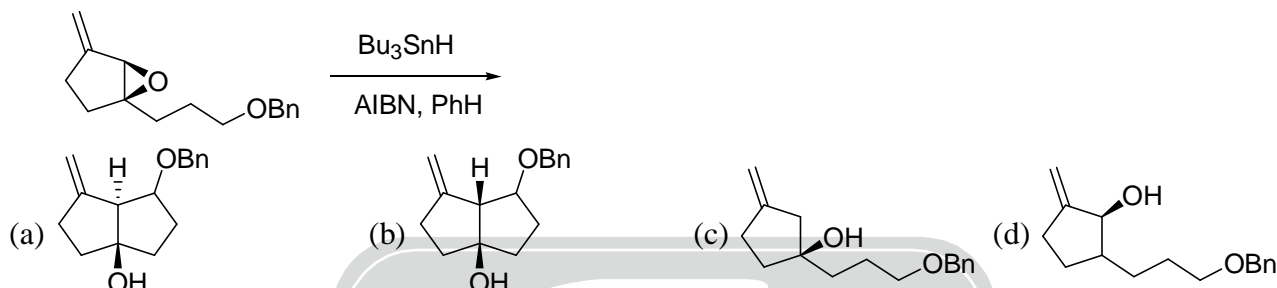
Ethylene 1,3-Butadiene 1,3,5-Hexatriene

(I) (II) (III)

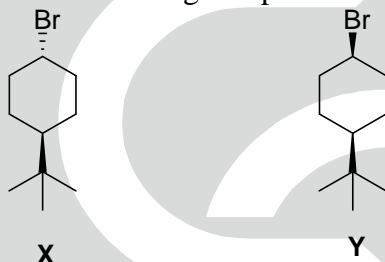
(a) λ_{\max} (nm): I>II>III; ϵ : III>II>I (b) λ_{\max} (nm): III>II>I; ϵ : III>I>II

(c) λ_{\max} (nm): I>II>III; ϵ : I>II>III (d) λ_{\max} (nm): III>II>I; ϵ : III>II>I

45. The major product formed in the following reaction is



46. Consider the statements about the following compounds X and Y



(I) X and Y are conformational isomers

(II) X and Y are configurational isomers

(III) X reacts faster than Y by S_N1 reaction

(IV) Y reacts faster than X by S_N1 reaction

The correct statements are

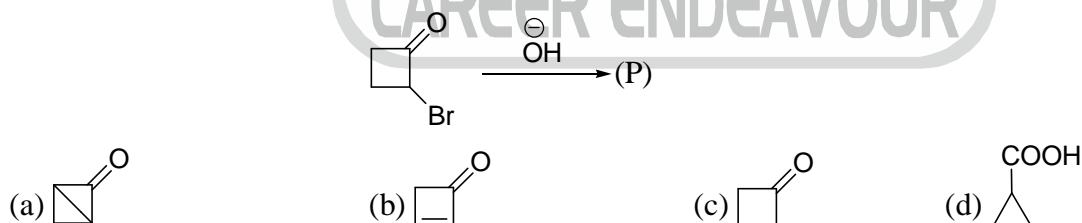
(a) I and III

(b) II and III

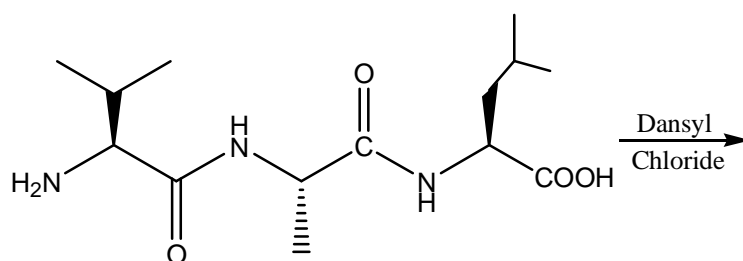
(c) II and IV

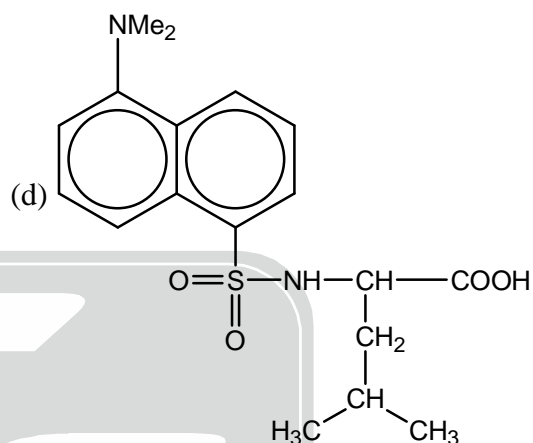
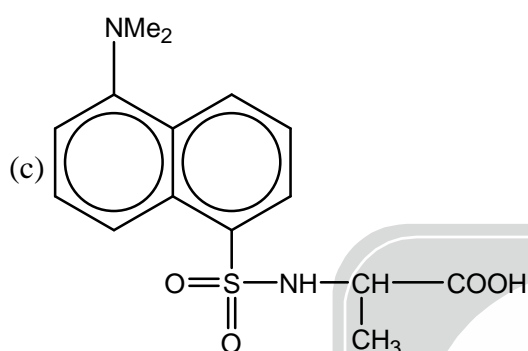
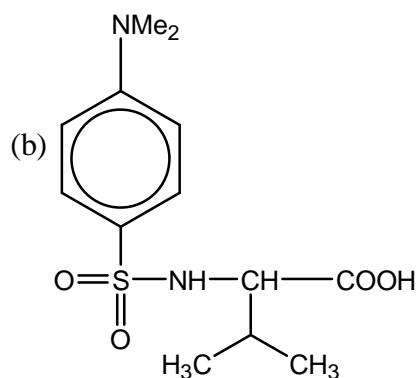
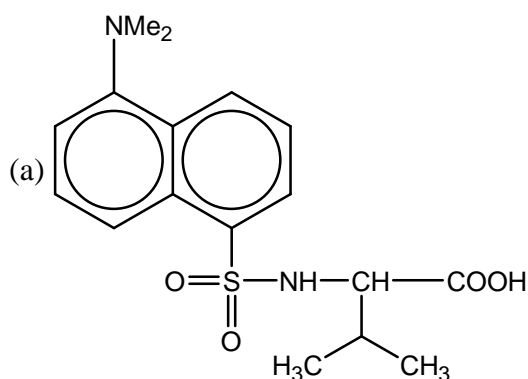
(d) I and IV

47. The major product (P) formed in the following reaction is

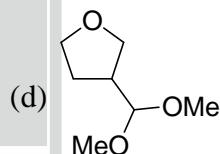
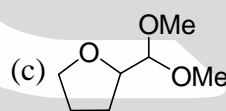
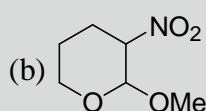
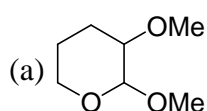
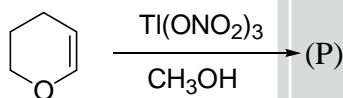


48. The structure of products formed in the terminal analysis of given tripeptide by Dansyl method

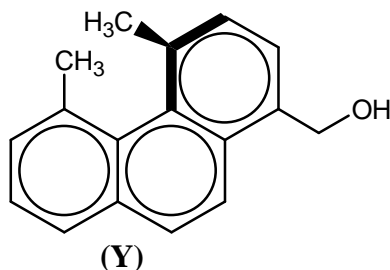
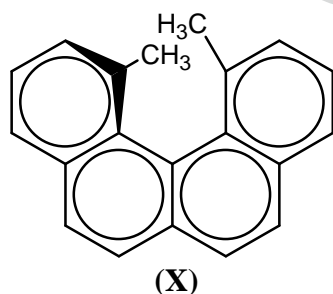




49. The major product (P) formed in the following reaction is

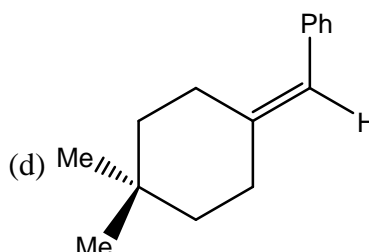
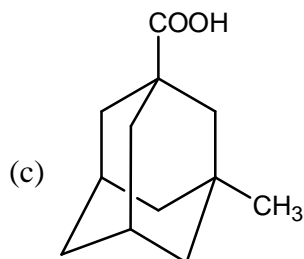
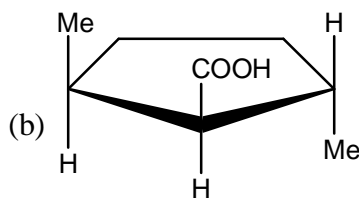
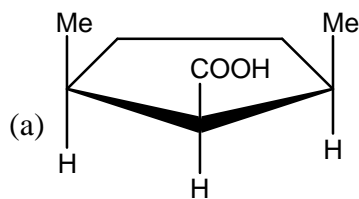


50. Which of the following statements is true regarding compound (X) and (Y)

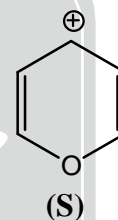
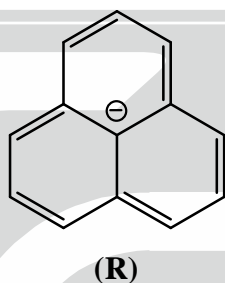
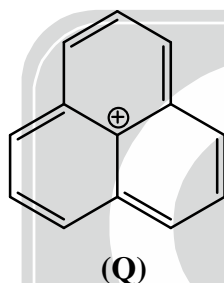
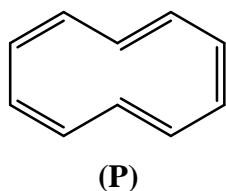


- (a) X and Y both are chiral and having 'M' configuration
 (b) X and Y both are achiral and having 'P' configuration
 (c) X having 'M' configuration and chiral whereas Y having 'P' configuration and also chiral.
 (d) X having 'P' configuration and chiral whereas Y having 'M' configuration and also chiral.

51. Among the following identify the chiral molecule.



52. Among the followings, the aromatic species are



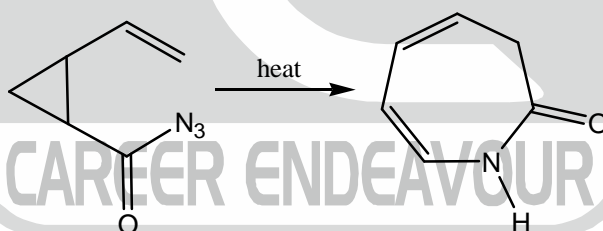
(a) P and Q only

(b) R and S only

(c) Q, R and S

(d) All of these

53. In the following, product (P) formed through the following rearrangement



(a) [2, 3]-sigmatropic rearrangement

(b) [3, 3]-sigmatropic rearrangement

(c) [1, 5]-hydrogen shift rearrangement

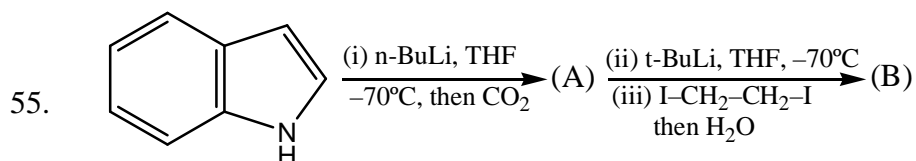
(d) [4+2] cycloaddition

54. A molecule AX_2 shows the following IR and Raman spectra

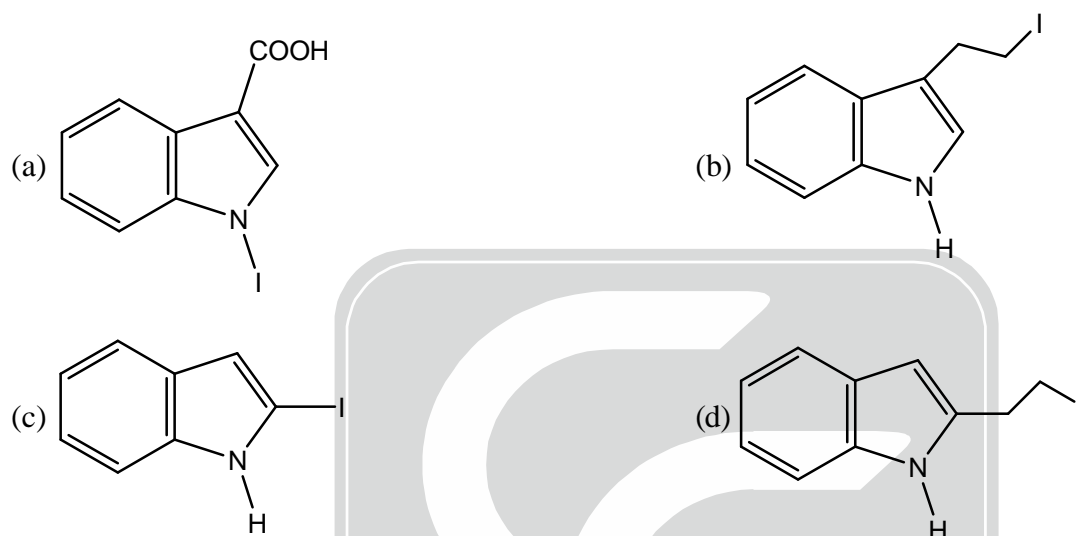
$\bar{\nu}(\text{cm}^{-1})$	IR	Raman
3756	vs : perpendicular(\perp)	
3652	s - parallel(\parallel)	s : polarised
1595	vs : parallel(\parallel)	-

The structure of the molecule is

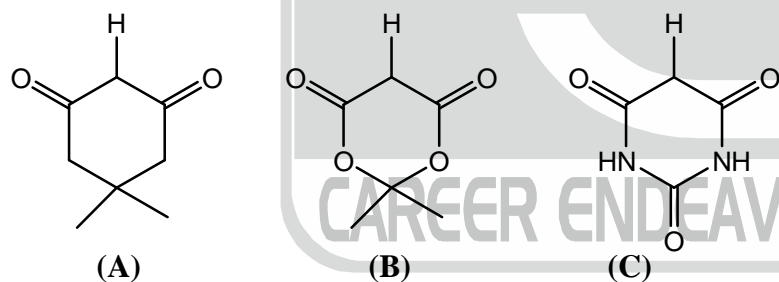
- (a) Linear symmetrical ($D_{\infty h}$) (b) Bent symmetrical (C_{2v})
 (c) Linear asymmetrical ($C_{\infty v}$) (d) Bent asymmetrical (C_s)



The major product (B) formed in the following reaction sequence



56. The decreasing order of pK_a values of the followings is



- (a) $A > B > C$ (b) $C > B > A$ (c) $A > C > B$ (d) $C > A > B$

57. Point group of the following object is

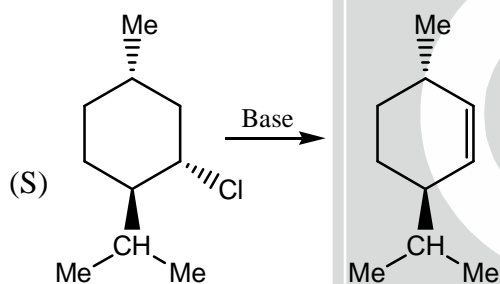
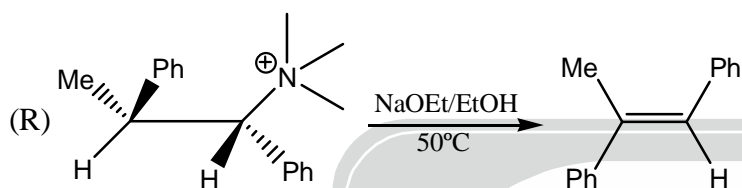
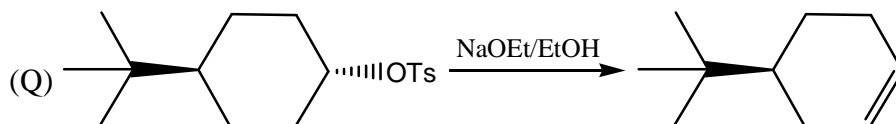
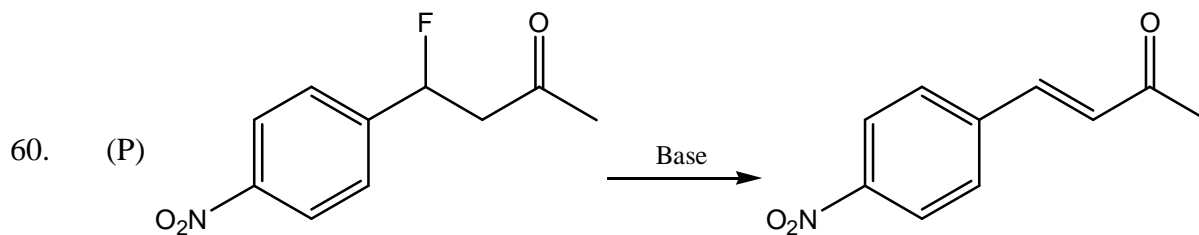


- (a) C_4 (b) C_{4h} (c) D_{4h} (d) C_{2h}

58. A conductometric titration curve, shows decrease in conductance initially and increase in conductance after end point. The titration is

- (a) strong acid vs strong base (b) Strong acid vs weak base
 (c) weak acid vs strong base (d) weak acid vs weak base

59. If Λ_m and Λ_m^0 of HCOOH are 4 and $400 \text{ } \Omega^{-1}\text{cm}^2\text{mol}^{-1}$ respectively. The value of α for HCOOH
 (a) 10^{-4} (b) 10^{-2} (c) 100 (d) 4

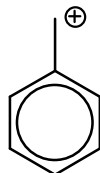


Choose the correct option regarding above reactions (P-S) with appropriate mechanism.

- | | P | Q | R | S |
|-----|------|----|------|----|
| (a) | E1 | E1 | E2 | E2 |
| (b) | E1cB | E1 | E1 | E2 |
| (c) | E2 | E2 | E1cB | E1 |
| (d) | E1cB | E1 | E2 | E2 |

PART - C

61. In case of Benzyl cation, what is the π -electron density at the terminal C-atom

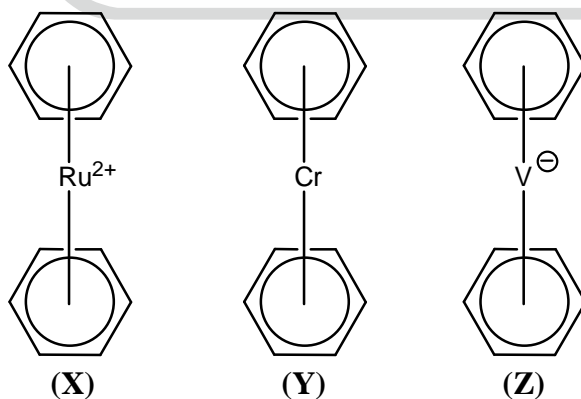


- (a) $\frac{5}{7}$ (b) $\frac{4}{7}$ (c) $\frac{3}{7}$ (d) $\frac{1}{7}$

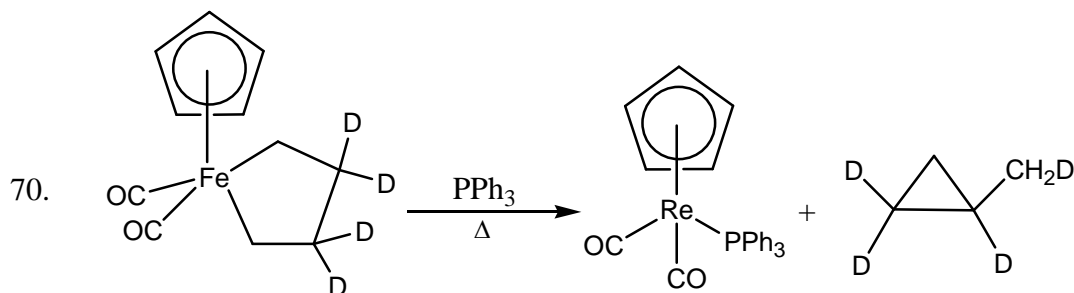
62. For a particle in a rectangular well of depth V_0 and width ℓ , the number of bound-state energy levels increases when

- (a) V_0 increases and ℓ decreases. (b) V_0 and ℓ both increases
 (c) V_0 decreases and ℓ increases (d) V_0 and ℓ both decreases

63. For the particle in a box in $(-L, L)$, the value of $\langle x^2 \rangle$ in the $n \rightarrow \infty$ limit would be
- (a) $\frac{L^2}{2}$ (b) $\frac{L^2}{3}$ (c) $\frac{L^2}{4}$ (d) $\frac{L^2}{8}$
64. The diatomic molecule $^1\text{H} \ ^{79}\text{Br}$ has fundamental band in the vibrational spectra at 4.56μ (micron). If the hydrogen (^1H) is replaced by Deuterium (^2H). The corresponding band for the molecule $^2\text{H} \ ^{79}\text{Br}$ will be shifted by approximately
- (a) 4.12μ (b) 2.56μ (c) 3.25μ (d) 1.32μ
65. Tungsten has five natural isotopes. Only one isotope ^{183}W is $\frac{1}{2}$ spin magnetic nuclei with 14% natural abundance, other isotopes are non-magnetic. Total number of lines and their intensity ratio (including the satellites) for ^{19}F NMR of WF_6 molecule will be
- (a) Two, 1 : 14 (b) Three, 1 : 6 : 1 (c) Three, 1 : 12 : 1 (d) Four, 1 : 6 : 6 : 6
66. In photosynthesis ferredoxin, the number of iron atom, sulfur bridges and cysteine ligands are
- | | Fe atom | Sulfur bridge | Cysteine |
|-----|---------|---------------|----------|
| (a) | 1 | 0 | 4 |
| (b) | 2 | 2 | 2 |
| (c) | 2 | 2 | 4 |
| (d) | 4 | 4 | 4 |
67. Consider the following statement(s)
- (A) Cooperative binding of O_2 in Hb and Mb is due to decrease in size of iron followed by changes in the protein conformation.
- (B) O_2 coordinate to metal ion centres in oxy-hemocyanin is superoxide
- (C) The reaction of CO_2 with carbonic anhydrase is a type of electrophilic addition reaction
- The incorrect statement(s) is/are
- (a) A and B (b) A, B and C (c) A and C (d) B only
68. The pair, which undergo substitution by associative mechanism
- (a) $[\text{CpFe}(\text{CO})_2 \text{PPh}_3]^+$ and $[\text{Pt}(\text{PPh}_3)_4]$ (b) $[\text{ReH}_7(\text{PPh}_3)_2]$ and $[\text{Mo}(\text{CO})_4(\text{dppe})]$
- (c) $[\text{PtCl}_2(\text{PPh}_3)_2]$ and $[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$ (d) $[\text{Mo}(\text{CO})_6]$ and $[\text{Fe}(\text{CO})_5]$
69. Identify the most shielded and deshielded benzene nucleus in the following complex respectively,

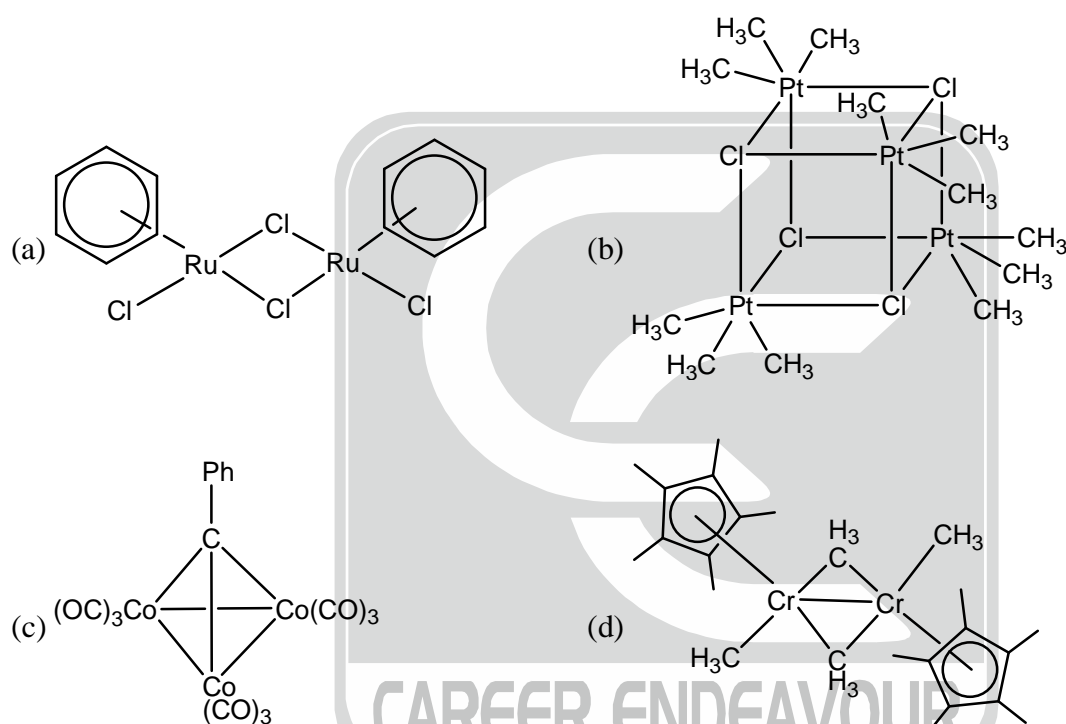


- (a) X and Z (b) Z and X (c) X and Y (d) Y and Z



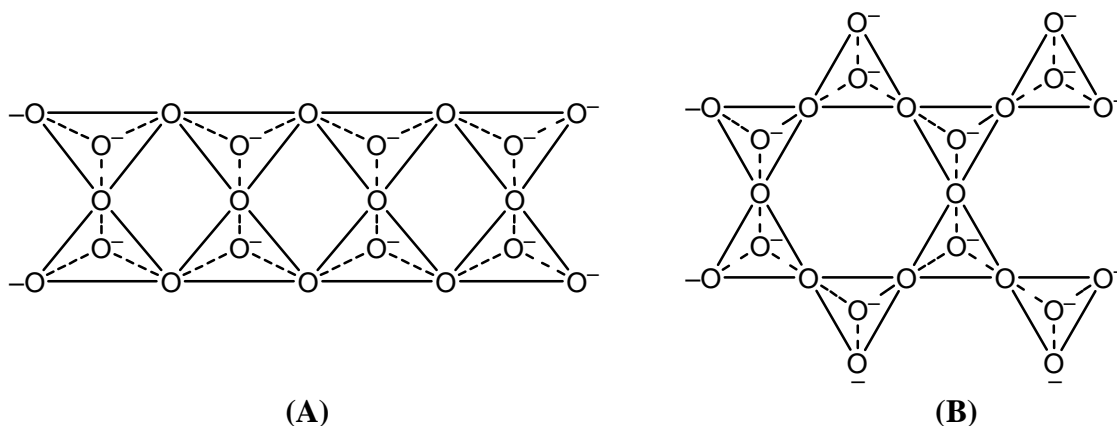
The correct mechanism for the above reaction is

- (a) β -elimination, alkene insertion and followed by reductive elimination
 (b) Reductive elimination
 (c) Reductive elimination followed by oxidative addition
 (d) Reductive elimination, alkene insertion followed by β -elimination
71. Which of the following complex does not satisfy the 18 electron rule



72. $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]\text{Cl}_3$ will react with $\text{NaNO}_2/\text{conc. HCl}$ to form a compound which exist in both yellow and red form. This is due to
- (a) Linkage isomerism
 (b) Coordination isomerism
 (c) Ionisation isomerism
 (d) Ligand isomerism
73. Identify the correct statement(s)
- (I) Ground state term for Ni^{2+} ion is ${}^3\text{F}$.
 (II) The highest energy orbital in trigonal bipyramidal complex is d_{z^2} .
 (III) In MnCr_2O_4 , Mn^{2+} will have CFSE in octahedral site whereas Cr^{3+} will not.
 (IV) CoCl_4^{2-} shows spin allowed and Laporte partially allowed transition.
- (a) I and II
 (b) I and III
 (c) I, II and IV
 (d) All of these

74. The two structures corresponding to two double chain silicates are :



- (a) The stoichiometry of both (A) and (B) structures is $(\text{Si}_2\text{O}_5)^{2-}$
 (b) The stoichiometry of (A) is $(\text{Si}_2\text{O}_5)^{2-}$ and that of (B) is $(\text{Si}_4\text{O}_{11})^{6-}$
 (c) The stoichiometry of both (A) and (B) silicates is $(\text{Si}_4\text{O}_{11})^{6-}$
 (d) The stoichiometry of both (A) and (B) silicates is SiO_4^{4-}

75. Match items in column-A with items in column-B:

Column-A

1. H_2SO_4 in HSO_3F
2. $\text{Cs}_2\text{SO}_3 + \text{SOCl}_2 \xrightarrow{\text{liq. SO}_2} 2\text{CsCl} + 2\text{SO}_2$
3. HClO_4 in HF
4. $\text{H}_2\text{S}_2\text{O}_7$ in H_2SO_4

- (a) 1-B, 2-C, 3-D, 4-A
 (c) 1-C, 2-A, 3-D, 4-B

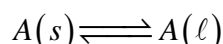
Column-B

- A. Neutralization
 - B. Amphoteric
 - C. Weak acid
 - D. Weak base
- (b) 1-D, 2-A, 3-B, 4-C
 (d) 1-B, 2-A, 3-D, 4-C

76. The masses recorded when a substance is weighed 6 times are 10.6, 10.4, 11.0, 11.2, 11.4 and 11.6 mg. The variance is closest to

- (a) 1.89 (b) 1.54 (c) 1.74 (d) 1.32

77. For the first order phase transition,



The temperature at which the slope of pressure versus temperature is 0.4 atmK^{-1} is (Given:

$\Delta H = 20 \text{ kJmol}^{-1}$, $\rho_{\text{solid}} = 1000 \text{ gL}^{-1}$, $\rho_{\text{liquid}} = 800 \text{ gL}^{-1}$, molar mass of A = 20 g)

- (a) 986 K (b) $9.86 \times 10^4 \text{ K}$ (c) 12345 K (d) $1.23 \times 10^4 \text{ K}$

78. The change in Gibb's free energy at 1 bar and 300K for $A \rightleftharpoons B$ is 200 Jmol^{-1} . The temperature at which

the reaction become spontaneous at 1 bar is $\{\Delta S_r = 60 \text{ JK}^{-1}\}$

- (a) 333.3 K (b) 313.3 K (c) 301.3 K (d) 303.3 K

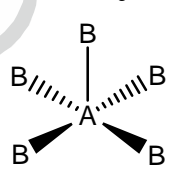
79. The rate constant of a certain reaction is given by

$$\log K = 5.4 - \frac{212}{T} + 2.17 \log T$$

The value of activation energy at 127°C is

- (a) 2.7 kcal (b) 4.2 kcal (c) 6.8 kcal (d) 5.7 kcal



80. The activation energy of the gas phase association between F_2 and IF_5 , a first order reaction in each of the reactants is 58.6 kJ mol^{-1} . The activation enthalpy at 340 K is
 (a) 53 kJ mol^{-1} (b) 55.8 kJ mol^{-1} (c) 58.6 kJ mol^{-1} (d) 61.4 kJ mol^{-1}
81. A 0.01 mm thick ${}^7_3\text{Li}$ target is bombarded with a beam of intensity 10^{13} protons per sec. As a result 10^8 neutrons per sec. are produced. The cross-section of the reaction, if the density of lithium is 500 kg/m^3 , is approximately
 (a) 0.43 barn (b) 0.33 barn (c) 0.23 barn (d) 0.13 barn
82. Which of the following statement is incorrect?
 (a) Dodecahedron geometry is less favoured as there is repulsion due to the presence of all triangular faces.
 (b) Odd electrons participate in hybridisation when side atoms are more electronegative and lone pair is absent on the central atom.
 (c) Lower energy orbitals are more directed towards electronegative substituents and higher energy orbitals are more directed towards electropositive substituents.
 (d) Cs along with the Au forms an ionic compound $[\text{Cs}^+\text{Au}^-]$ whereas this is not possible with Cu and Ag due to relativistic effect.
83. The correct pairs which consist of isogeometric as well as isostructural species are
 (A) XeOF_3^+ and IF_4^+ (B) IOF_2^+ and SOCl_2
 (C) C_5N_4 and C_6N_4 (D) HNO_2 and O_3
 (a) A and B (b) C and D (c) A, B and D (d) B, C and D
84. Consider the following statements
 (A) Ionisation energy along with standard reduction potential are the deciding factors for reducing power of an element.
 (B) The electron affinity of Cl is higher than that of F, thus, Cl_2 is more powerful oxidising agent than F_2 .
 (C) Relativistic contraction is significant for 6th and 7th period and applied mainly for s-electrons.
 (D) If difference in ionisation energy $[\text{I.E.}_{(n+1)} - \text{I.E.}_{(n)}]$ lies in between 11 to 17 eV/atom (approximately), then variable oxidation states will be possible.
 The correct statements are
 (a) A and C (b) A, C and D (c) B and D (d) All of these
85. A square pyramid molecule AB_5 is taken for NMR of magnetic nuclei B. The major nuclear properties of A and B nuclei are given below.
- | | Spin | Natural abundance |
|----------|------|-------------------|
| A nuclei | 1/2 | 20% |
| B nuclei | 1/2 | 100% |
- How many total lines are expected in the NMR signal of B nuclei including the satellite signal?
 (a) 21 (b) 25 (c) 10 (d) 30
- 
86. Consider the following statements for inner transition elements
 (A) Among lanthanoids, Lu(III) ion have the highest partition coefficient between tri-n-butyl phosphate and concentrated HNO_3 .
 (B) Lanthanide (III) ions can be separated by ion exchange chromatography
 (C) Third ionisation energy of Yb is higher than Lu.
 (D) The strong yellow colour of Ce(IV) solutions arises due to f-f spectra.
 The correct statement(s) are
 (a) A, B and D only (b) A, B and C only (c) B and C only (d) A and D only

87. A particle of mass m is constrained to move in a circular ring of radius R . When a perturbation

$$V' = \frac{a}{R^2} \cos^2 \phi$$

(where a is a real constant) is added, the shift in energy of the ground state, to first order in a is

- (a) $\frac{a}{R^2}$ (b) $\frac{2a}{R^2}$ (c) $\frac{a}{2R^2}$ (d) $\frac{a}{\pi R^2}$

88. The Bragg angle at which the second order Bragg reflection is observed from (110) plane in a rock salt crystal of fcc unit cell of side 2.828 \AA when X-ray of wavelength 1.414 \AA is used, is

- (a) 30° (b) 45° (c) 60° (d) 90°

89. In the phase diagram of Eutectic system. The isopleth intersect the tie line of 10 cm in the ratio of $2 : 3$ from solidus to liquidus curve. The percentage of solid in a system at that point is

- (a) 20% (b) 40% (c) 60% (d) 80%

90. For a plot of Langmuir adsorption, the value of intercept and slope is found to be $3 \times 10^{-3} \text{ atmL}^{-1}$ and 10^{-4} L^{-1} . The distribution coefficient (K) is

- (a) 0.33 atm^{-1} (b) 0.033 atm^{-1} (c) 0.0033 atm^{-1} (d) 0.004 atm^{-1}

91. The plot of reduced viscosity (η_r) and concentration gives the intercept value of $2 \times 10^3 \text{ Lmol}^{-1}$ and slope is 4×10^{-4} . In Mark-Houwink equation, the value of K is 10^{-6} Lg^{-1} and $a = 0.5$, the value of viscosity average mass is

- (a) $3.5 \times 10^7 \text{ g mol}^{-1}$ (b) $4.2 \times 10^6 \text{ g mol}^{-1}$ (c) $3.7 \times 10^5 \text{ g mol}^{-1}$ (d) $4 \times 10^{18} \text{ g mol}^{-1}$

92. In a polarographic experiment, when diffusion current is $1.5 \mu\text{A}$ then concentration of electroactive species is 0.04 M . If concentration is increased to 0.06 M , then diffusion current is

- (a) $3 \mu\text{A}$ (b) $0.75 \mu\text{A}$ (c) $2.25 \mu\text{A}$ (d) None of these

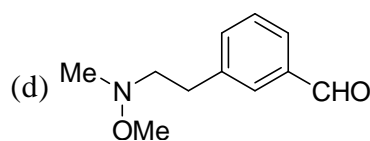
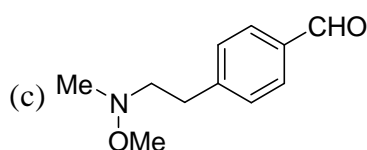
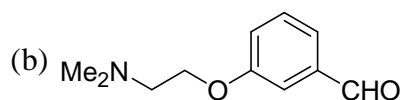
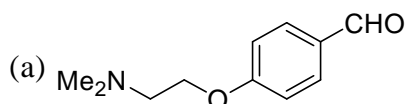
93. For isoelectronic species $[\text{V}(\text{CO})_6]^-$, $\text{Cr}(\text{CO})_6$ and $[\text{Mn}(\text{CO})_6]^+$, the energies of MLCT transitions follow the order:

- (a) $[\text{V}(\text{CO})_6]^- < \text{Cr}(\text{CO})_6 < [\text{Mn}(\text{CO})_6]^+$ (b) $[\text{Mn}(\text{CO})_6]^+ < \text{Cr}(\text{CO})_6 < [\text{V}(\text{CO})_6]^-$
 (c) $\text{Cr}(\text{CO})_6 < [\text{V}(\text{CO})_6]^- < [\text{Mn}(\text{CO})_6]^+$ (d) $[\text{V}(\text{CO})_6]^- < [\text{Mn}(\text{CO})_6]^+ < \text{Cr}(\text{CO})_6$

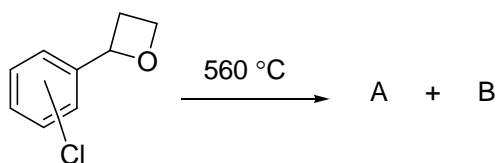
94. Select the incorrect statement among the following:

- (a) Base hydrolysis of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{3+}$ is an overall second order reaction whereas that of $[\text{Co}(\text{CN})_6]^{3-}$ is of first order.
 (b) The rate of base hydrolysis follow the order: $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+} > [\text{Co}(\text{RNH}_2)_5\text{Cl}]^{2+} > [\text{Co}(\text{CN})_5\text{Cl}]^{3-}$.
 (c) The rate of base hydrolysis follow the order: $[\text{Co}(\text{RNH}_2)_5\text{Cl}]^{2+} > [\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+} > [\text{Co}(\text{CN})_5\text{Cl}]^{3-}$.
 (d) S_N1cB mechanism is observed in the case of $[\text{Co}(\text{RNH}_2)_5\text{Cl}]^{2+}$ and $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

95. The structure of the compound that matches the $^1\text{H NMR}$ data given below is $^1\text{HNMR}$ (δ, ppm): 2.32 (6H, s), 3.05 (2H, t, $J = 6 \text{ Hz}$), 4.20 (2H, t, $J = 6 \text{ Hz}$), 6.97 (2H, d, $J = 7 \text{ Hz}$), 7.82 (2H, d, $J = 7 \text{ Hz}$) and 9.97 (1H, s).



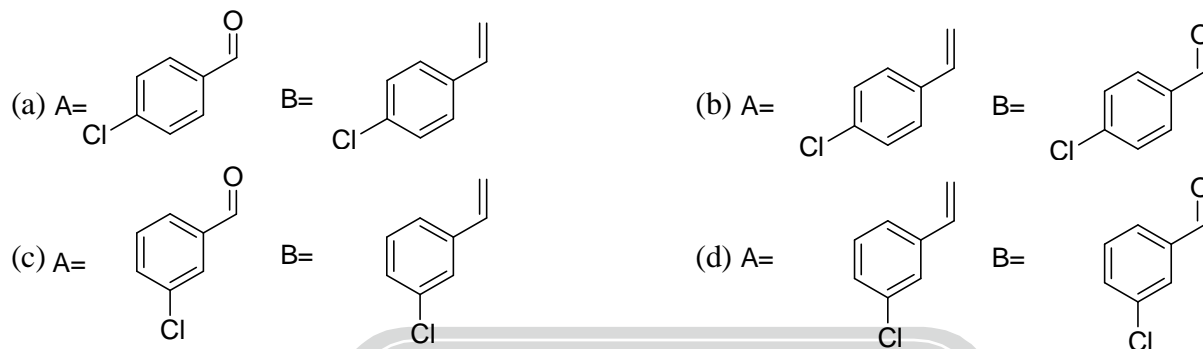
96. Products A and B formed in the following reaction exhibited following characterization data:



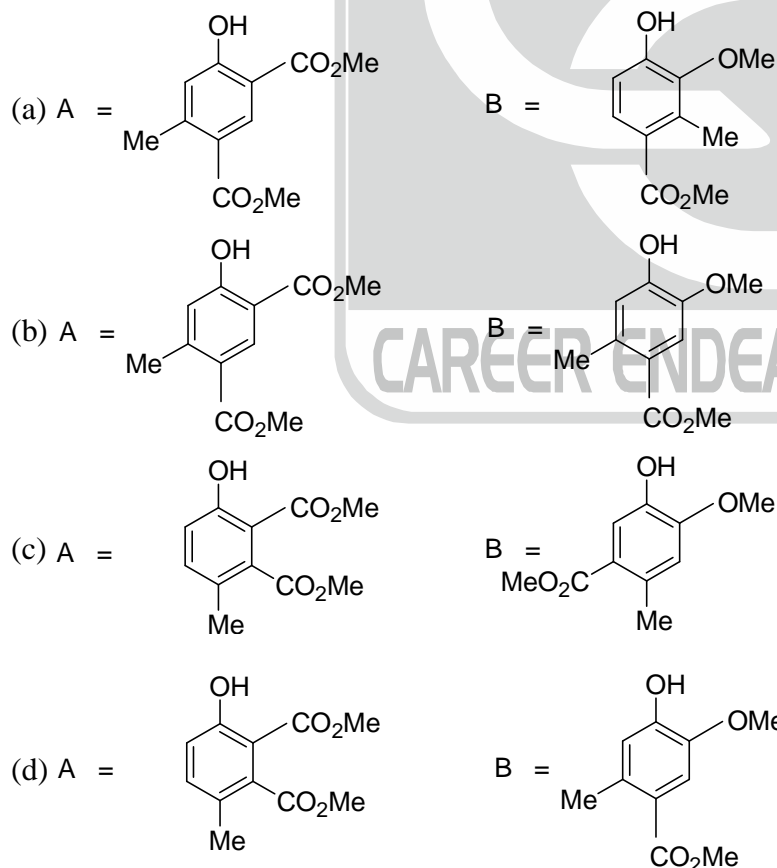
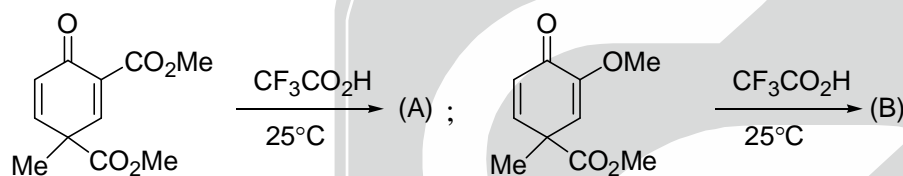
(A) has IR 1640 cm^{-1} ; m/z 138 (100%) and 140 (33%); δ (ppm), 7.68 (2H, d, $J = 7\text{ Hz}$), 7.44 (2H, d, $J = 7\text{ Hz}$), 6.5 (1H, dd, $J=17, 11\text{ Hz}$), 5.5 (1H, dd, $J= 17, 2\text{ Hz}$), and 5.1 (1H, dd, $J=11, 2\text{ Hz}$).

(B) has IR 1700 cm^{-1} ; m/z 111 (45%), 113 (15%), 139 (60%), 140 (100%), 141 (20%), and 142 (33%); δ (ppm) 9.9 (1H, s), 7.75 (2H, d, $J=9\text{ Hz}$), and 7.43 (2H, d, $J=9\text{ Hz}$).

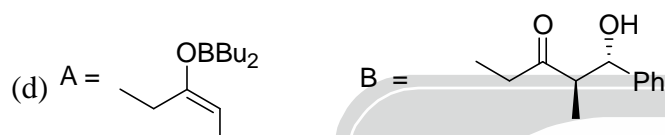
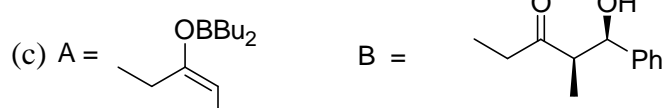
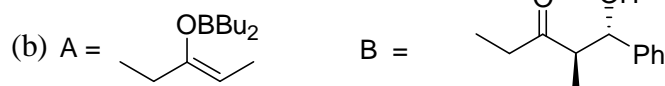
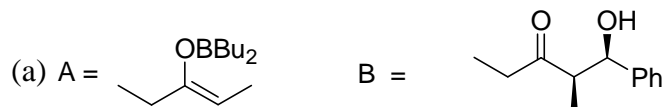
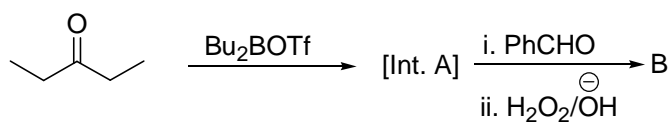
The correct structures of compound A and B are



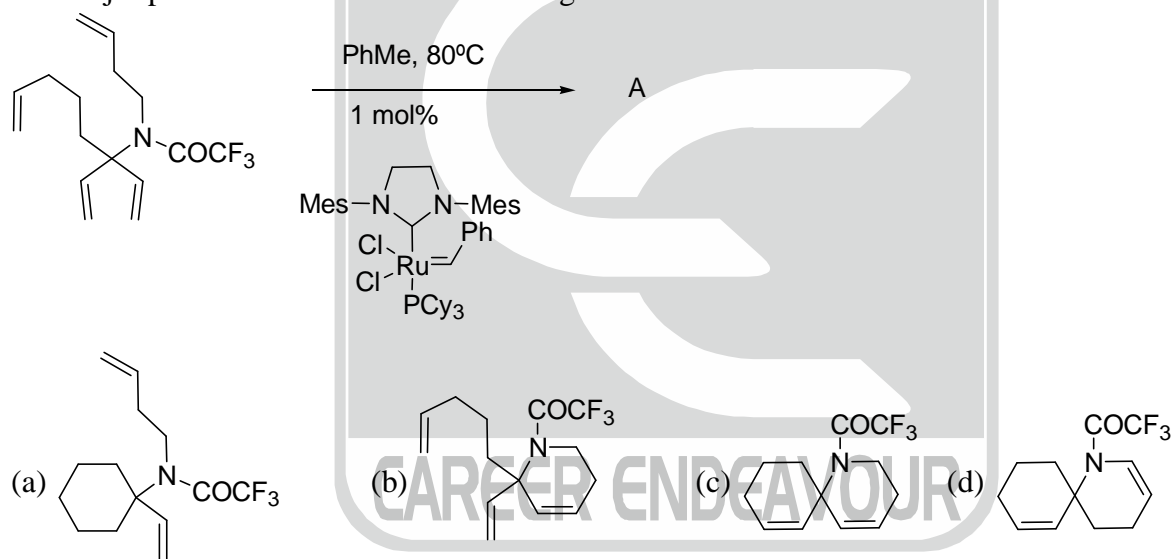
97. The major products A and B formed in the following reactions are



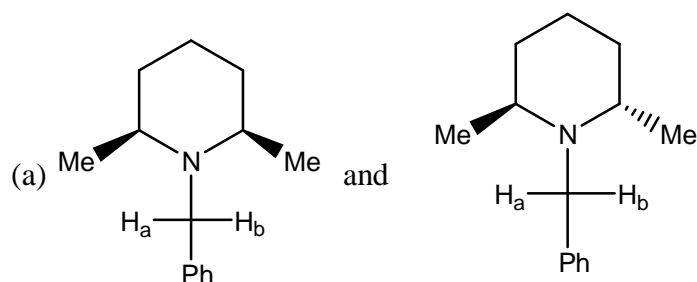
98. The intermediate A and the major product B formed in the following reaction sequence are

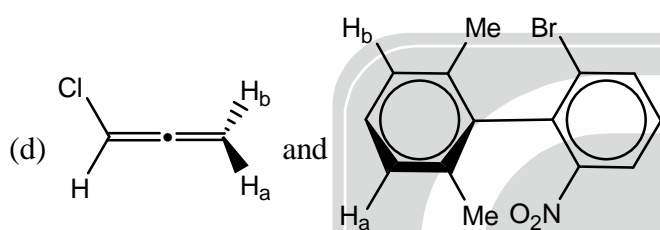
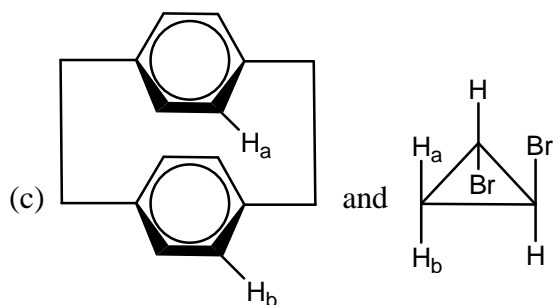
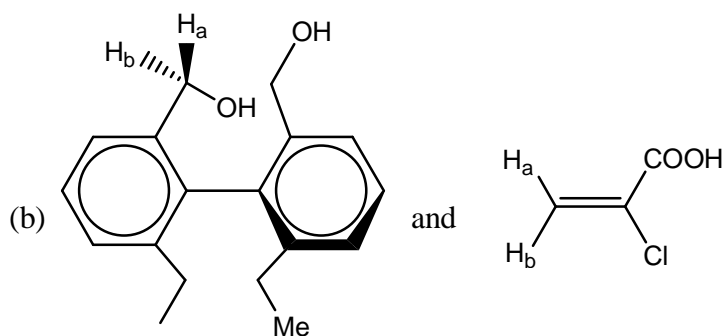


99. The major product A formed in the following reaction is

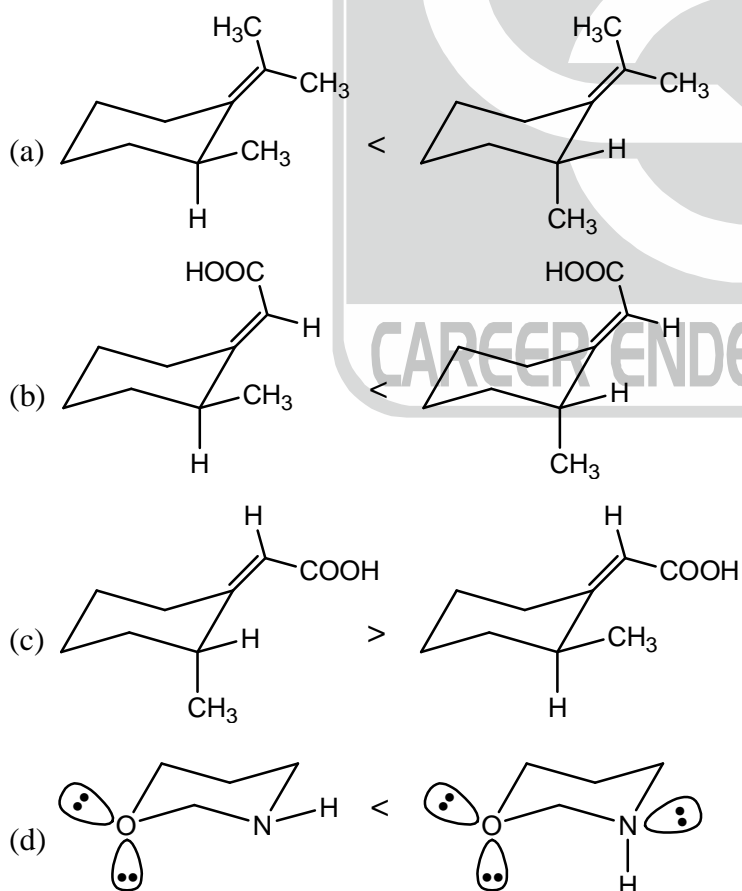


100. Among the following, identify the pair that contains enantiotopic ligand (H_a and H_b)

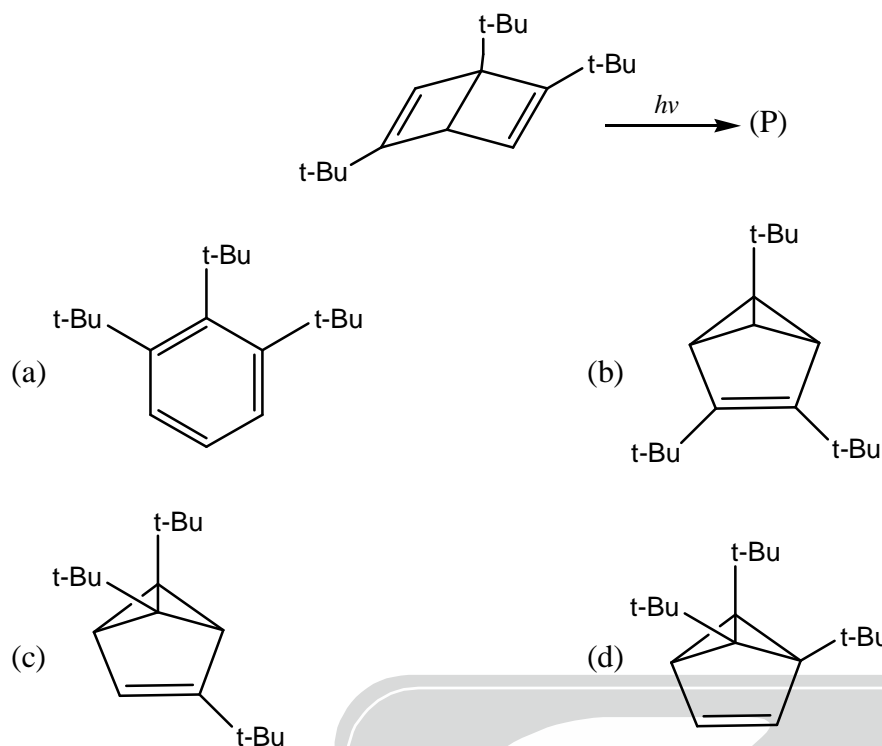




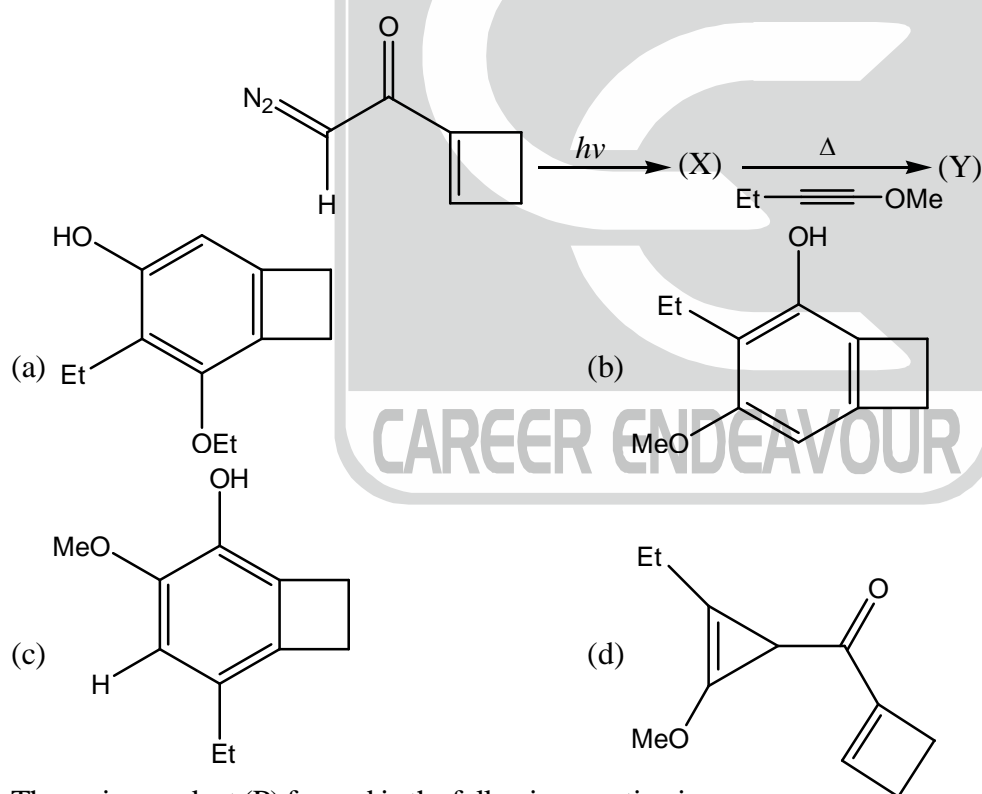
101. Identify the incorrect order of conformational stability



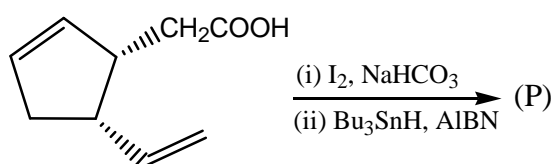
102. The major product (P) formed in the following reaction is

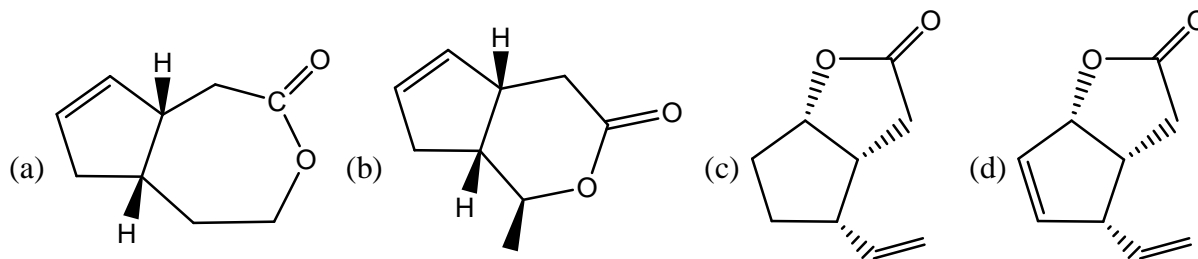


103. The major product (Y) formed in the following reaction sequence is

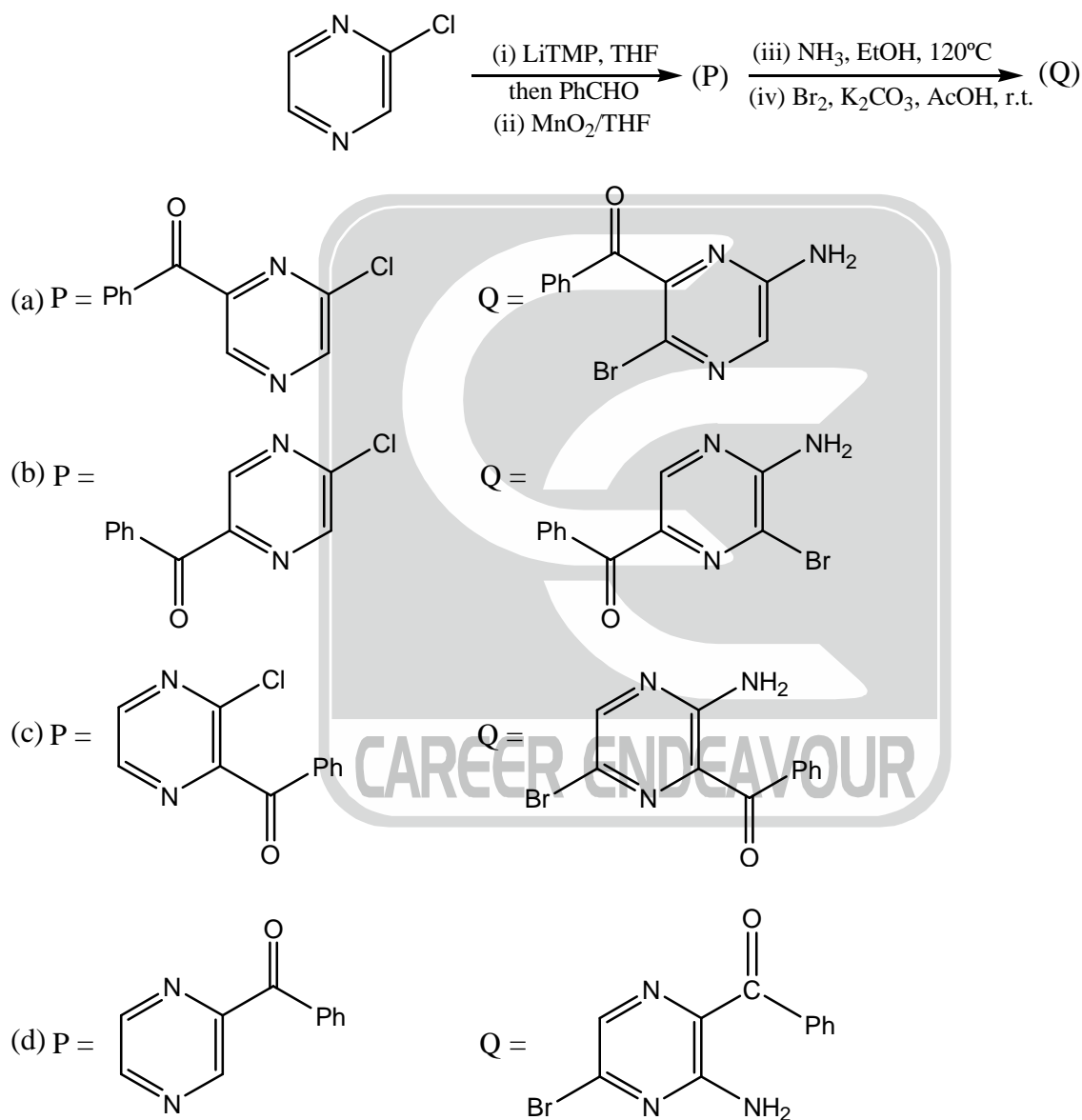


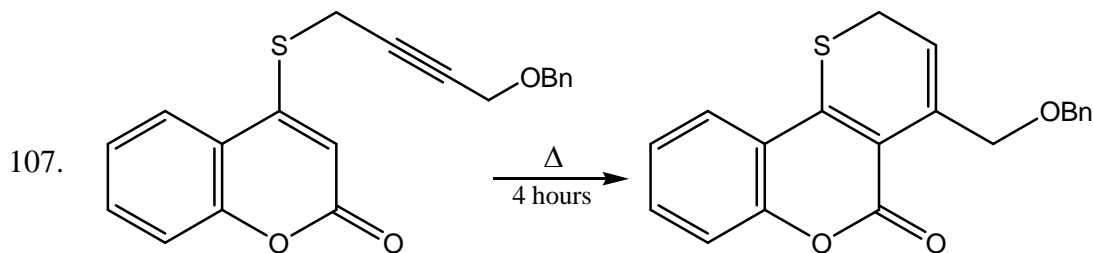
104. The major product (P) formed in the following reaction is





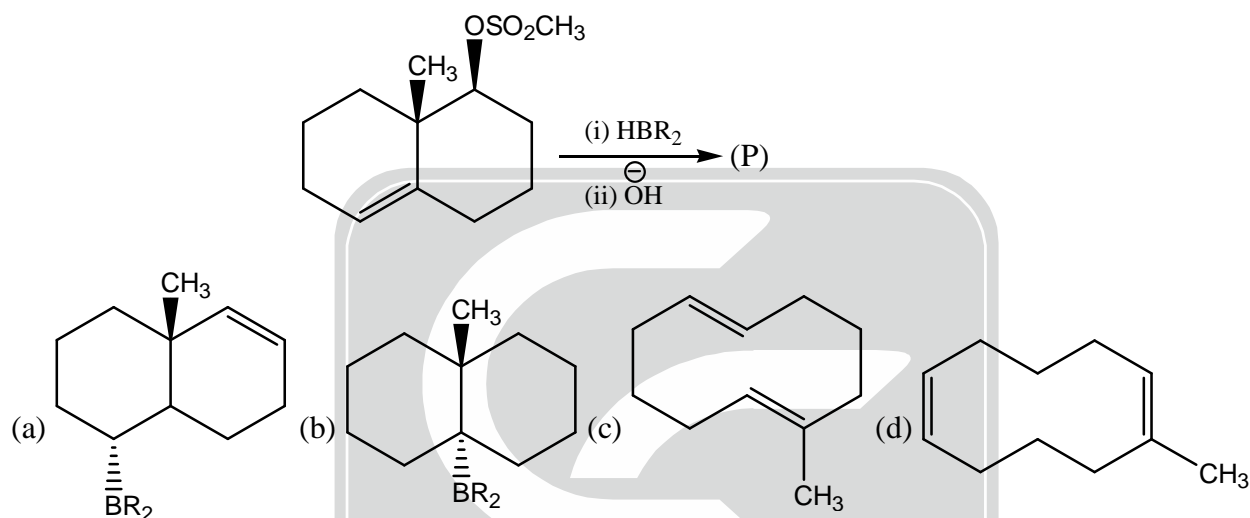
105. A heteronuclear diatomic molecule gives microwave spectrum with approximately equally spaced lines. The spacing between respective line is 40 cm^{-1} . If the same molecule is exposed to 540 nm light then the position of first anti-stoke line in rotational Raman spectrum will be
 (a) 18398 (b) 18638 (c) 16398 (d) 15649
106. In the following reaction sequence, the major product (P) and (Q) formed are





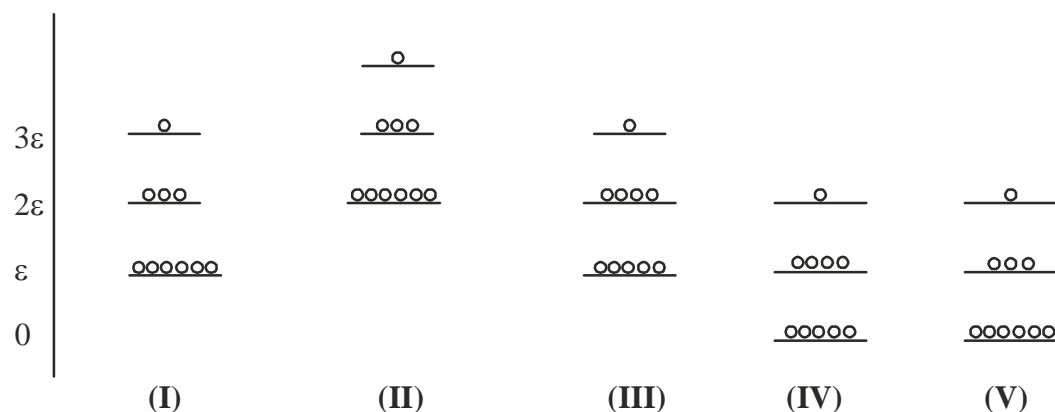
Correct sequence of above pericyclic reactions involved in the following transformation

- (a) (i) Claisen rearrangement (ii) Electrocyclisation (iii) [1, 3] H-shift
 (b) (i) [1, 5]-H shift, (ii) electrocyclisation, (iii) [2, 3] sigmatropic rearrangement
 (c) (i) [3, 3]-sigmatropic rearrangement, (ii) [1, 5] H- shift, (iii) electrocyclisation
 (d) (i) [3, 3]-sigmatropic rearrangement, (ii) electrocyclisation, (iii) [1, 5] H-shift.
108. The major product (P) formed in the following reaction sequence,



109. A student had prepared three ethyl-substituted benzaldehydes, but had neglected to label them. Which should be the appropriate method to identify them if reference standard is not available.
- (a) By brominating a sample of each and determining how many bromo-substituted products were formed.
 (b) By checking melting or boiling point of each of them
 (c) By converting each of them in to Schiff base and checking melting point
 (d) By checking TLC of each of them.
110. The symmetry of the orbital $\psi = \psi_A - \psi_B$ in NO_2 (C_{2v}), where ψ_A is a $2p_x$ orbital on one O-atom and ψ_B that on the other O-atom, belongs to [Hint: character table is not required]
- (a) A_1 symmetry (b) A_2 symmetry (c) B_1 symmetry (d) B_2 symmetry
111. For a system containing H_2 gas in thermodynamics equilibrium fraction of molecules present in ground state is, if molecule is only undergoing rotational motion
- (a) $\frac{kT}{Bhc}$ (b) $\frac{Bhc}{kT}$ (c) $\frac{kT}{2Bhc}$ (d) $\frac{2Bhc}{kT}$

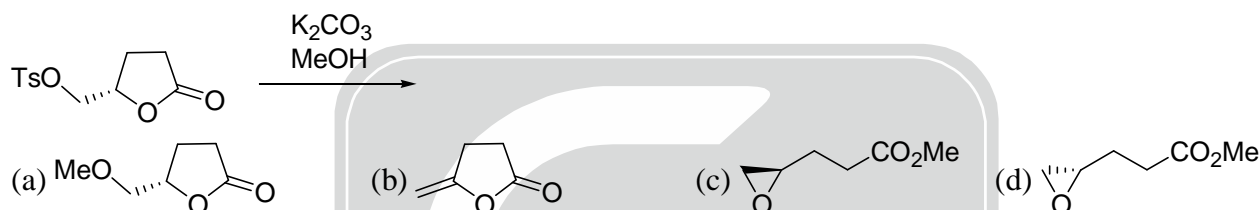
112. Consider the following energy levels, with given number of particles.



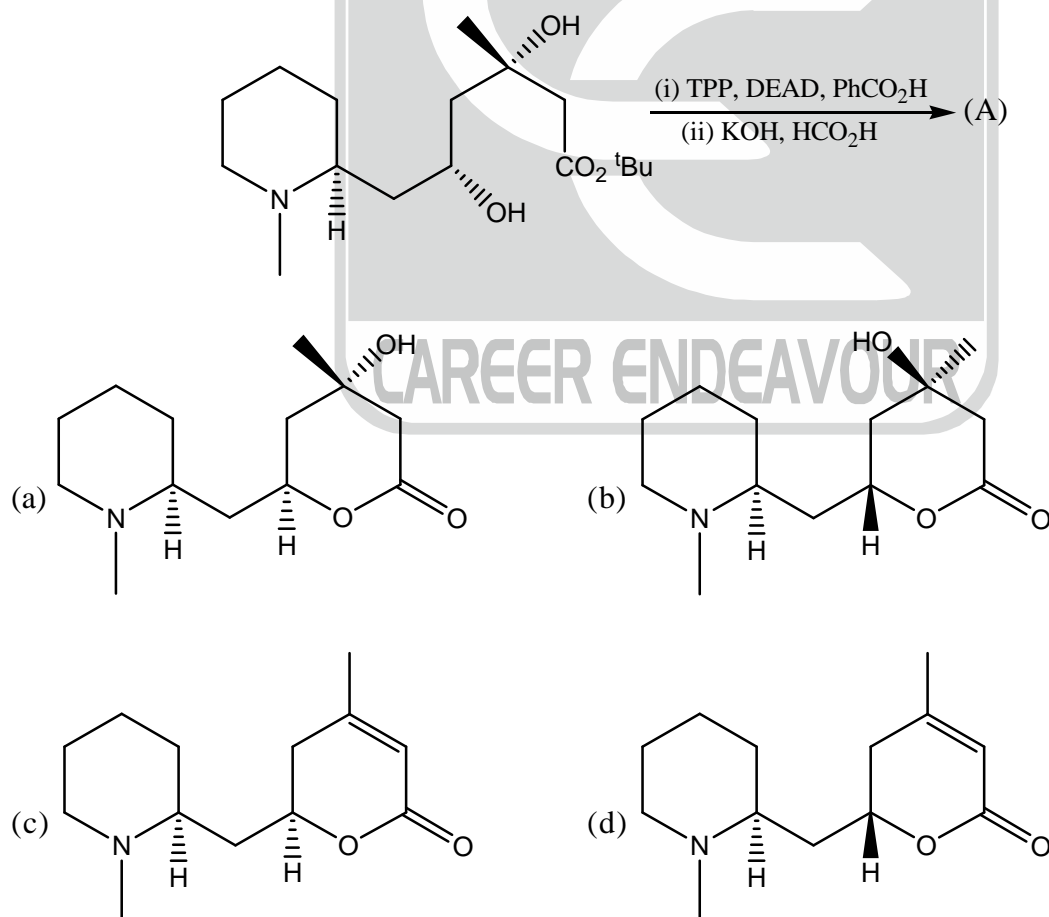
If system (III) is undergoing cooling, change in molar entropy of the system is

- (a) 12.5 J/mol-K (b) 10.5 J/mol-K (c) 9.2 J/mol-K (d) None of these

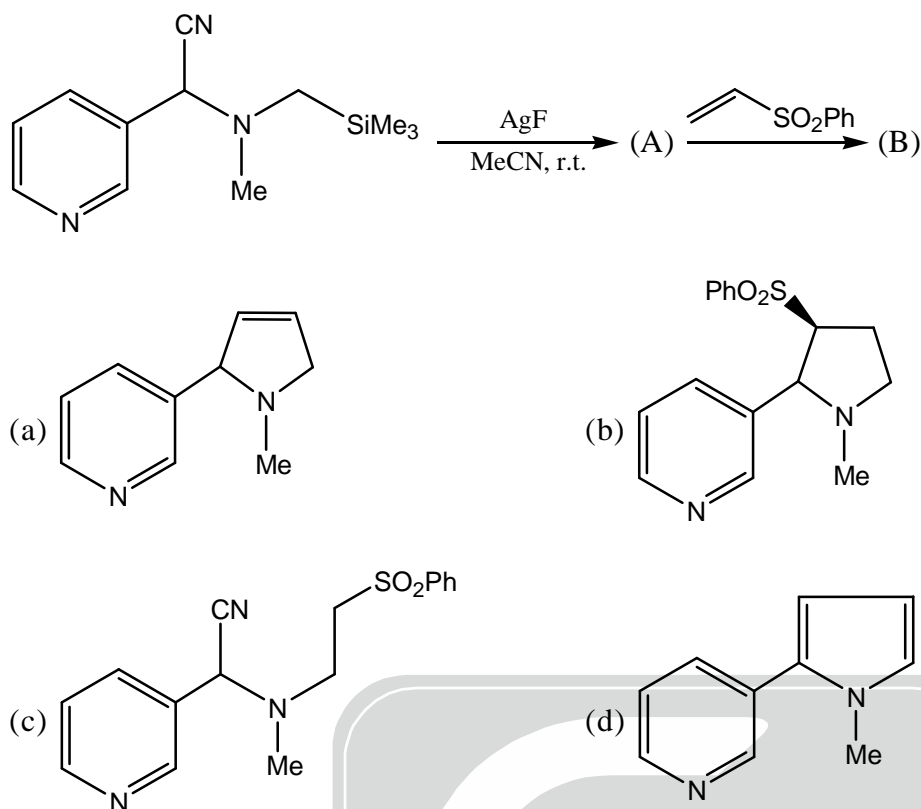
113. The major product formed in the following reaction is



114. The major product A formed in the following reaction sequence is

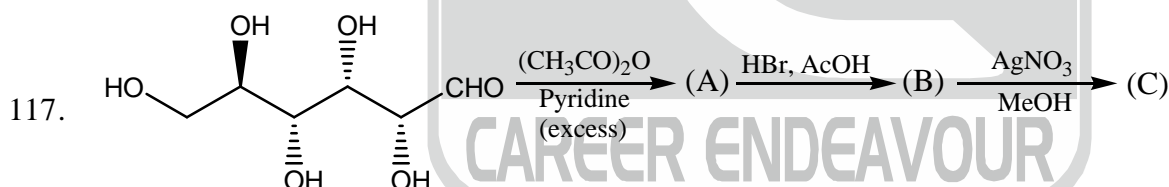


115. The major product (B) formed in the following in the reaction



116. Choose the incorrect statement(s) among the following

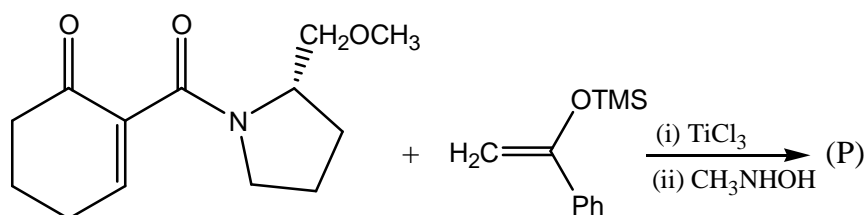
- (I) Nucleoside may be reducing or non-reducing
 (II) Base pairing will be always among purine-pyrimidine or pyrimidine-purine and will be never possible between two purines or pyrimidine
 (III) DNA is genetic material carrier in organisms and RNA will never perform this function
 (IV) Ribonucleoprotein are absent inside the nucleus
- (a) II, III and IV (b) I, II and III (c) I, II and IV (d) All are incorrect.

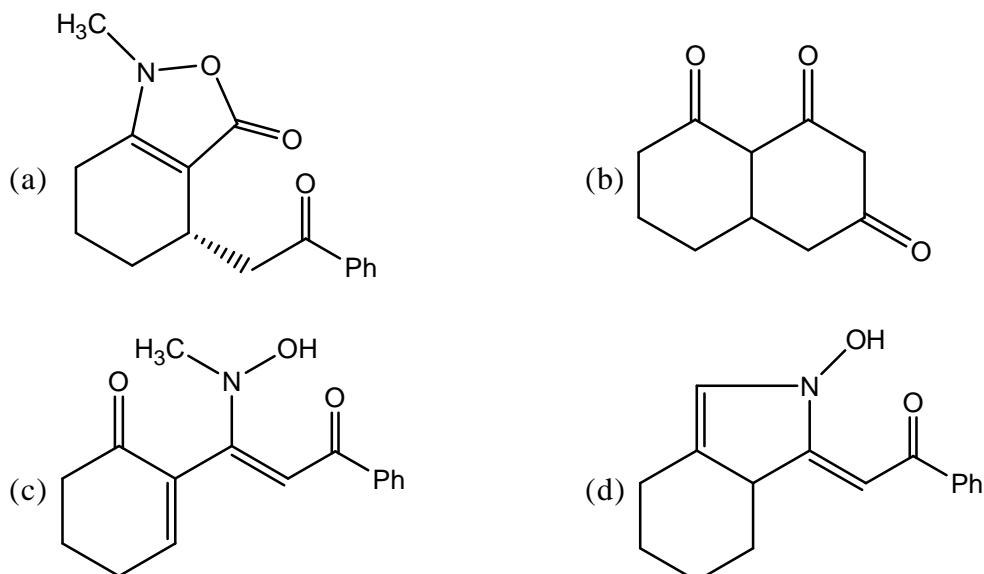


Which of the following statement is correct regarding aforementioned reaction

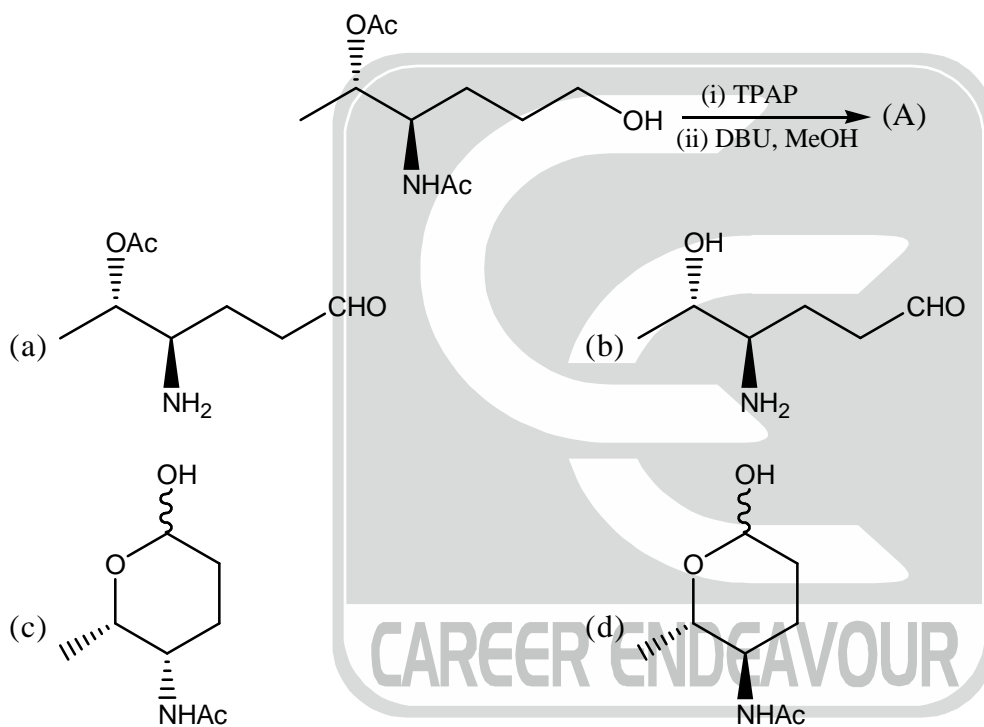
- (a) A is a reducing sugar
 (b) A is a non-reducing sugar, while C is a reducing sugar
 (c) Both A and C are non-reducing sugar
 (d) C is a reducing sugar.

118. The major product (P) formed in the following reaction is





119. The major product (A) formed in the following reaction sequence is



120. $Zn | Zn^{2+} (10^{-1} M) || Cu^{2+} (10^{-3} M) | Cu$

The value of E_{cell} is (Given: $E_{Zn^{2+}|Zn}^0 = -0.76$; $E_{Cu^{2+}|Cu}^0 = 0.34$)

- (a) 1.1 (b) 2.17 (c) 1.17 (d) None of these

Space for rough work





CHEMICAL SCIENCES

Date : 06-06-2019

TEST SERIES-D

ANSWER KEY [FULL LENGTH TEST - 1]

PART-A

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 2. (b) | 3. (a) | 4. (b) | 5. (b) | 6. (d) | 7. (d) |
| 8. (d) | 9. (a) | 10. (d) | 11. (b) | 12. (c) | 13. (d) | 14. (a) |
| 15. (a) | 16. (b) | 17. (a) | 18. (d) | 19. (b) | 20. (a) | |

PART-B

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 21. (c) | 22. (d) | 23. (b) | 24. (b) | 25. (d) | 26. (d) | 27. (d) |
| 28. (d) | 29. (c) | 30. (b) | 31. (b) | 32. (b) | 33. (d) | 34. (c) |
| 35. (a) | 36. (b) | 37. (b) | 38. (a) | 39. (d) | 40. (c) | 41. (b) |
| 42. (a) | 43. (b) | 44. (d) | 45. (b) | 46. (c) | 47. (d) | 48. (a) |
| 49. (c) | 50. (c) | 51. (b) | 52. (c) | 53. (b) | 54. (b) | 55. (c) |
| 56. (a) | 57. (b) | 58. (a) | 59. (b) | 60. (d) | | |

PART-C

- | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|
| 61. (c) | 62. (b) | 63. (b) | 64. (d) | 65. (c) | 66. (c) | 67. (a) |
| 68. (c) | 69. (b) | 70. (a) | 71. (d) | 72. (a) | 73. (c) | 74. (b) |
| 75. (b) | 76. (c) | 77. (b) | 78. (d) | 79. (a) | 80. (b) | 81. (c) |
| 82. (c) | 83. (c) | 84. (b) | 85. (a) | 86. (b) | 87. (c) | 88. (b) |
| 89. (c) | 90. (b) | 91. (d) | 92. (c) | 93. (a) | 94. (b) | 95. (a) |
| 96. (b) | 97. (c) | 98. (a) | 99. (c) | 100. (d) | 101. (b) | 102. (c) |
| 103. (b) | 104. (c) | 105. (b) | 106. (c) | 107. (c) | 108. (c) | 109. (a) |
| 110. (b) | 111. (d) | 112. (a) | 113. (d) | 114. (c) | 115. (b) | 116. (d) |
| 117. (c) | 118. (a) | 119. (d) | 120. (d) | | | |

