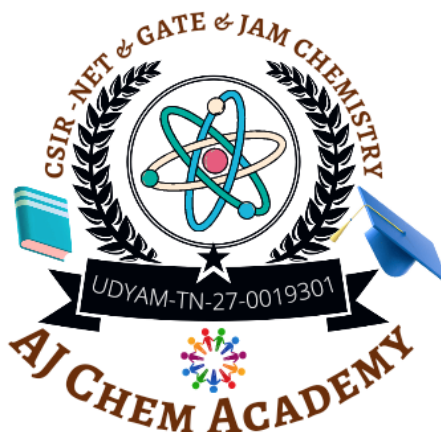


GATE – 2014 – Chemistry



- ✓ CSIR-NET & SLET | SET Chemistry Coaching
- ✓ University Chemistry Entrance (PhD | PG)
- ✓ GATE Chemistry Coaching
- ✓ CUET-PG & JAM Chemistry Coaching
- ✓ PG | Polytechnic | College TRB Chemistry

www.csircoaching.com

Features

- | | |
|-------------------------------|----------------------------------|
| ➤ 300 ++ Live Classes | ➤ A Well-Defined Curriculum |
| ➤ 200 ++ Concept Wise Tests | ➤ A Strong Subject Foundation |
| ➤ 50 ++ Chapter Wise Tests | ➤ A Refined Learning Methodology |
| ➤ 50 ++ Model Tests | ➤ Updated Study materials |
| ➤ 2000 ++ Problem Discussions | ➤ Freshers Can easily understand |
| ➤ Recorded Videos | ➤ Question banks |



Q.1 – Q.25 Multiple Choice Question (MCQ) & NAT, carry ONE mark each (for each wrong answer: – 1/3). (No Negative Marks for NAT)**

- The maximum non-PV work that a system can perform at constant-P is
(a) ΔH (b) ΔG (c) ΔS (d) ΔA
- Consider the reaction : $A + B \rightleftharpoons C$
The unit of the thermodynamic equilibrium constant for the reaction is
(a) mol L^{-1} (b) L mol^{-1} (c) $\text{mol}^2 \text{L}^{-2}$ (d) dimensionless
- The number of IR active vibrational normal modes of CO_2 is _____
- The number of C_2 axes in CCl_4 is _____
- The value of the magnetic quantum number of a p_x orbital is
(a) -1 (b) 0 (c) $+1$ (d) undefined
- The molecular partition function for a system in which the energy levels are equispaced by ϵ , is
(a) $\frac{1}{1+e^{\beta\epsilon}}$ (b) $\frac{1}{1-e^{\beta\epsilon}}$ (c) $\frac{1}{1+e^{-\beta\epsilon}}$ (d) $\frac{1}{1-e^{-\beta\epsilon}}$
- A monoatomic gas-X, adsorbed on a surface, follows Langmuir adsorption isotherm. A plot of the fraction of surface coverage (θ) against the concentration of the gas $[X]$, for very low concentration of the gas, is described by the equation,
(a) $\theta = K[X]$ (b) $1 - \theta = \frac{1}{K[X]}$ (c) $\theta = K^{1/2}[X]^{1/2}$ (d) $\theta = \frac{K[X]}{1-K[X]}$
- At a given temperature and pressure, the ratio of the average speed of hydrogen gas to that of helium gas is approximately _____
- An example of nido-borane from the following is
(a) B_4H_{10} (b) B_6H_{10} (c) B_6H_{12} (d) B_8H_{14}
- The geometries of $\text{Ni}(\text{CO})_4$ and $[\text{NiCl}_4]^{2-}$, respectively, are
(a) tetrahedral and square planar (b) square planar and tetrahedral
(c) tetrahedral and tetrahedral (d) square planar and square planar
- The number of S–S bonds in $\text{H}_2\text{S}_5\text{O}_6$ is _____
- In atomic absorption spectroscopy, the atomization process utilizes
(a) flame (b) electric field (c) magnetic field (d) electron beam
- At room temperature, the number of singlet resonances observed in the ^1H -NMR spectrum of $\text{Me}_3\text{CC}(\text{O})\text{NMe}_2$ {N,N-dimethyl pivalamide} is _____
- Amongst the following, the metal that does NOT form homoleptic polynuclear Metal carbonyl is



(a) Mn

(b) Fe

(c) Cr

(d) Co

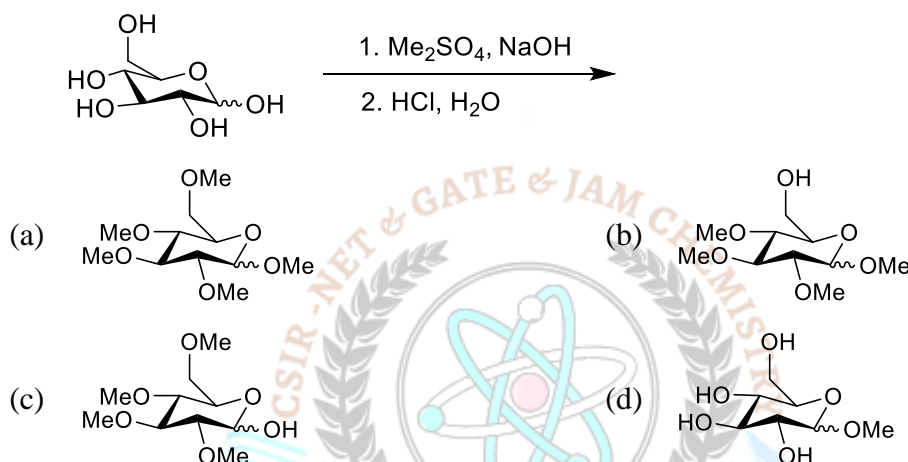
15. The reaction of $[\text{Cp}_2\text{TaMe}_2]\text{I}$ with NaOMe yields,

(a) $[\text{Cp}_2\text{Ta}(\text{OMe})_2]\text{I}$ (b) $[\text{Cp}_2\text{Ta}(\text{Me})(\text{OMe})]\text{I}$ (c) $\text{Cp}_2\text{Ta}(\text{Me})=\text{CH}_2$ (d) $\text{Cp}_2\text{Ta}(\text{OMe})=\text{CH}_2$

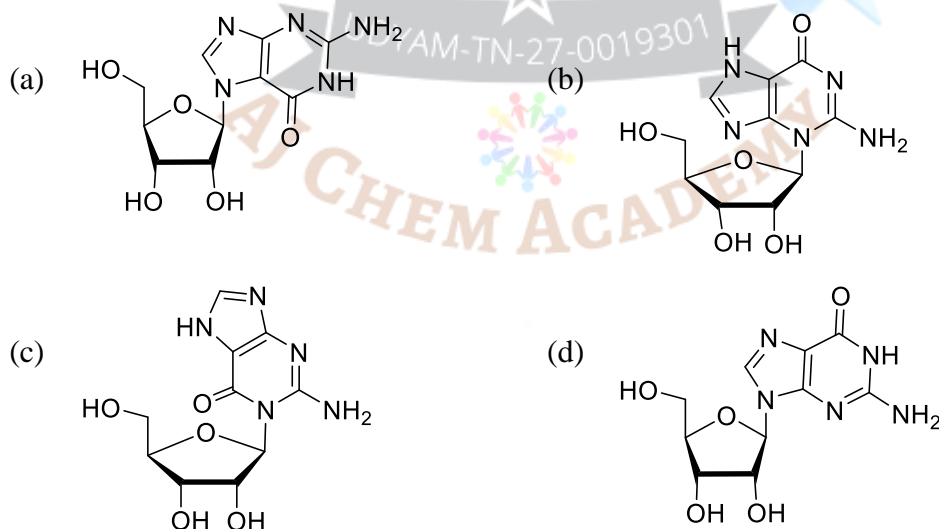
16. The complexes $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{NO}_2$ and $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}(\text{NO}_2)]\text{Cl}$ are

(a) linkage isomers (b) positional isomers (c) ionization isomers (d) optical isomers

17. The major product of the following reaction is

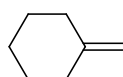


18. Amongst the following, the structure of guanosine is



19. The correct order of IR stretching frequency of the $\text{C}=\text{C}$ in the following olefins is

(I)



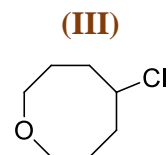
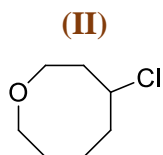
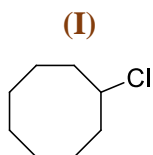
(II)



(III)

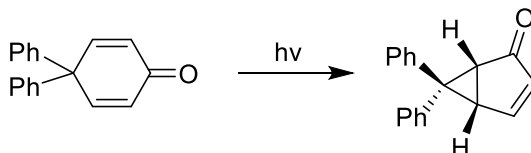
(a) $\text{I} > \text{II} > \text{III}$ (b) $\text{II} > \text{III} > \text{I}$ (c) $\text{III} > \text{II} > \text{I}$ (d) $\text{III} > \text{I} > \text{II}$

20. The correct order of the solvolysis for the following chlorides in acetic acid is



- (a) II > I > III (b) III > II > I (c) III > I > II (d) I > III > II

21. Formation of the product in the following **photochemical reaction** involves



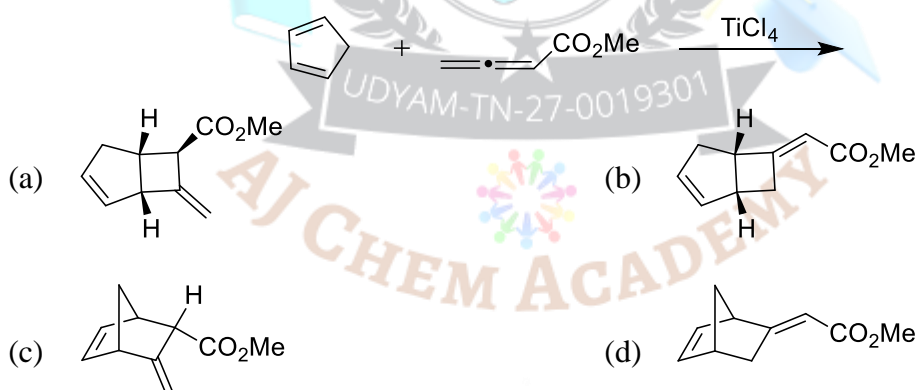
- (a) di- π -methane rearrangement (b) Paterno-Buchi reaction
(c) [2,3]-sigmatropic rearrangement (d) Norrish type-I reaction

22. The **correct order of stability** for the following **conformations of cyclohexane** is

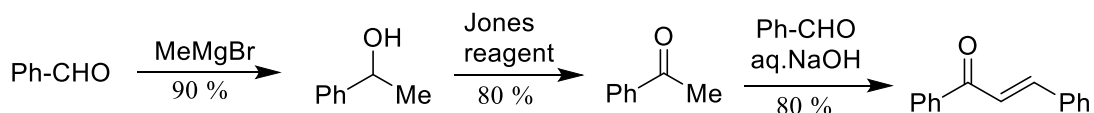


- (a) I > II > III (b) I > III > II (c) II > I > III (d) III > I > II

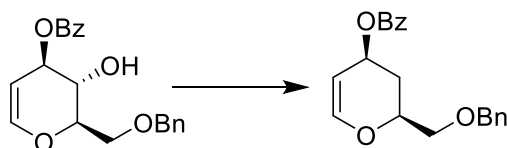
23. The **major product** formed in the following reaction is



24. The **overall yield (in %)** for the following reaction sequence is _____



25. The **most suitable reagent combination** to effect the following conversion is



- (a) (i) NaH, CS₂, then MeI ; (ii) Bu₃SnH, AIBN, C₆H₆, Reflux

- (b) (i) I_2 , PPh_3 , imidazole ; (ii) H_2 , 10% Pd-C, AcOH, high pressure
 (c) (i) Me_3SiCl , pyridine, DMAP ; (ii) Bu_3SnH , AIBN, C_6H_6 , reflux
 (d) (i) $MsCl$, pyridine, DMAP ; (ii) $LiAlH_4$, THF, reflux

Q.26 – Q.55 MCQ & NAT, carry TWO marks each (for each wrong answer: – 2/3). (No Negative Marks for NAT)**

26. $\Psi = N r(6 - Z r)e^{-Zr/3} \cos\theta$, is a proposed hydrogenic wavefunction,

Z = Atomic number

θ = Azimuthal angle

r = Radial distance

N = Constant

The INCORRECT statement about Ψ is

- (a) $\Psi = 0$ in the xy-plane
 (b) two radial nodes are present in Ψ
 (c) one angular node is present in Ψ
 (d) the size of the orbital decreases with increase in atomic number
27. The van der Waals constant 'a' and 'b' of CO_2 are $3.64 \text{ L}^2 \text{ bar mol}^{-2}$ and 0.04 L mol^{-1} , respectively. If one mole of CO_2 is confined to a volume of 0.15 L at 300 K, then the pressure (in bar) exerted by the gas, is _____.
- $R = 0.083 \text{ bar dm}^3 \text{ mol}^{-1} \text{ K}^{-1}$**
28. A plot of osmotic pressure against concentration (g L^{-1}) of a polymer is constructed. The slope of the plot
- (a) increases with increase in temperature
 (b) increases with increase in molar mass of the polymer
 (c) decreases with decrease in concentration of the polymer
 (d) decreases with increase in temperature
29. A platinum electrode is immersed in a solution containing 0.1 M Fe^{2+} and 0.1 M Fe^{3+} . Its potential is found to be 0.77 V against SHE. Under standard conditions and considering activity coefficients to be equal to unity, the potential of the electrode, when the concentration of Fe^{3+} is increased to 1 M, is _____
30. Molybdenum crystallizes in a bcc structure with unit cell dimensions of 0.314 nm. Considering the atomic mass of Mo to be 96, its density (Kg m^{-3}) is _____
31. The ratio of molecules distributed between two states is 9.22×10^6 at 300K. The difference in energy (in kJ mol^{-1}) of the two states is _____
32. A Carnot engine operates at 55 % efficiency. If the temperature of reject steam is



- 105 °C, then the absolute temperature of input steam is _____
33. Of the following plots, the correct representation of chemical potential (μ) against absolute temperature (T) for a pure substance is (s, ℓ and g denote solid, liquid and gas phases, respectively)
- (a)

(b)

(c)

(d)
34. The enthalpy of fusion of ice at 273 K is 6.01 kJ mol⁻¹ and the enthalpy of vaporization of water at 273 K is 44.83 kJ mol⁻¹. The enthalpy of sublimation (in kJ mol⁻¹) of ice at 273 K, is _____
35. Suppose Ψ_1 and Ψ_2 , are two hybrid orbitals:
- $$\Psi_1 = 0.12 \Psi_{3s} + 0.63 \Psi_{3p_x} + 0.77 \Psi_{3p_y}$$
- $$\Psi_2 = 0.12 \Psi_{3s} - 0.63 \Psi_{3p_x} - 0.77 \Psi_{3p_y}$$
- The angle (in degrees) between them is _____
36. BCl₃ and NH₄Cl were heated at 140 °C to give compound-X, which when treated with NaBH₄ gave another compound-Y. Compounds X and Y are
- (a) X = B₃N₃H₃Cl₃ and Y = B₃N₃H₆ (b) X = B₃N₃H₉Cl₃ and Y = B₃N₃H₆
- (c) X = B₃N₃H₃Cl₃ and Y = B₃N₃H₁₂ (d) X = B₃N₃Cl₆ and Y = B₃N₃H₆
37. The number of microstates in term ¹G is _____
38. The set of protons (underlined) in CH₃CH₂CH₂OCH₃ that would exhibit different splitting patterns in high (500 MHz) and low (60 MHz) field ¹H-NMR, is
- (a) CH₃CH₂CH₂OCH₃ (b) CH₃CH₂CH₂OCH₃
- (c) CH₃CH₂CH₂OCH₃ (d) CH₃CH₂CH₂OCH₃
39. Amongst the following, the complex ion that would show strong Jahn-Teller distortion is
- (a) [Cr(H₂O)₆]²⁺ (b) [Ti(H₂O)₆]³⁺ (c) [Co(H₂O)₆]²⁺ (d) [Fe(H₂O)₆]²⁺
40. Amongst the following, the metal carbonyl species having the highest ν_{CO} stretching

frequency is

- (a) $[\text{Mn}(\text{CO})_6]^+$ (b) $\text{Cr}(\text{CO})_6$ (c) $[\text{V}(\text{CO})_6]^-$ (d) $[\text{Fe}(\text{CO})_4]^{2-}$

41. The correct order of thermal stability for the given compounds is

- (a) $\text{TiMe}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiEt}_4$
 (b) $\text{TiEt}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiMe}_4$
 (c) $\text{TiMe}_4 > \text{TiEt}_4 > \text{Ti}(\text{CH}_2\text{CMe}_3)_4$
 (d) $\text{Ti}(\text{CH}_2\text{CMe}_3)_4 > \text{TiMe}_4 > \text{TiEt}_4$

42. Amongst the following, the complex ion that is expected to show the highest magnetic moment at room temperature is

- (a) $[\text{Ni}(\text{CN})_4]^{2-}$ (b) $[\text{Fe}(\text{CN})_6]^{3-}$ (c) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ (d) $[\text{Co}(\text{CN})_6]^{3-}$

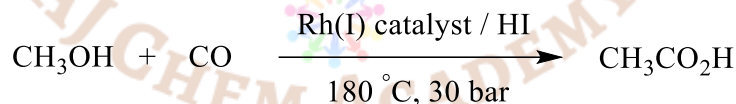
43. MnCr_2O_4 is

- (a) normal spinel with total CFSE of -15.5 Dq
 (b) inverse spinel with total CFSE of -15.5 Dq
 (c) normal spinel with total CFSE of -24 Dq
 (d) inverse spinel with total CFSE of -24 Dq

44. Mg^{2+} is preferred in photosynthesis by chlorophyll because

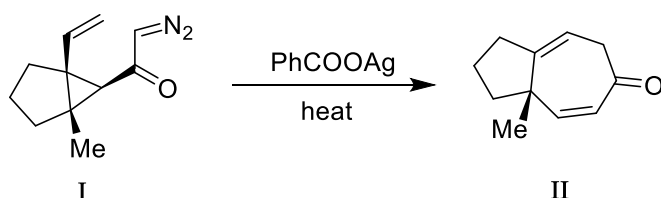
- (a) it has strong spin-orbit coupling (b) it has weak spin-orbit coupling
 (c) it is a heavy metal (d) it binds strongly with chlorophyll

45. In Monsanto acetic acid process shown below, the role of HI is



- (a) to convert CH_3OH to a stronger nucleophile (CH_3O^-)
 (b) to reduce the Rh(I) catalyst to a Rh(0) species
 (c) to reduce a Rh(III) active species to a Rh(I) species in the catalytic cycle
 (d) to convert CH_3OH to CH_3I

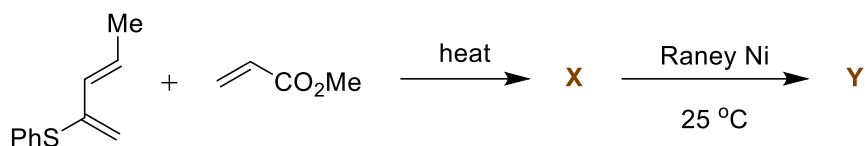
46. Formation of the ketone-II from the diazoketone-I involves



- (a) generation of carbene and a [2,3]-sigmatropic rearrangement
 (b) generation of carbene and an electrocyclic ring closing reaction

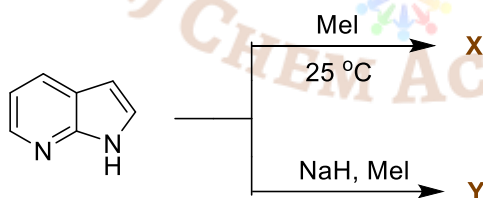
- (c) generation of ketene and a [2+2] cycloaddition
 (d) generation of ketene and a [3,3]-sigmatropic rearrangement

47. The major products **X** and **Y** formed in the following reaction sequence are



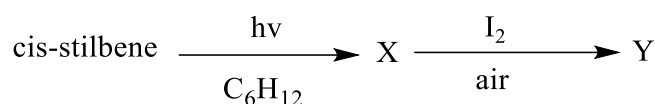
- (a) $X =$; $Y =$
- (b) $X =$; $Y =$
- (c) $X =$; $Y =$
- (d) $X =$; $Y =$

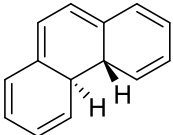
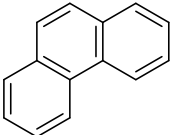
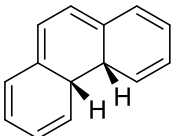
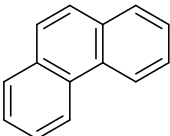
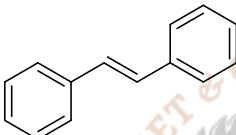
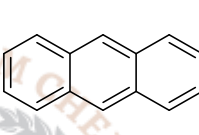
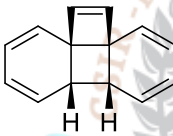
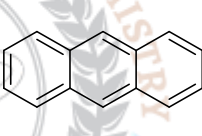
48. The major products **X** and **Y** formed in the following reactions are



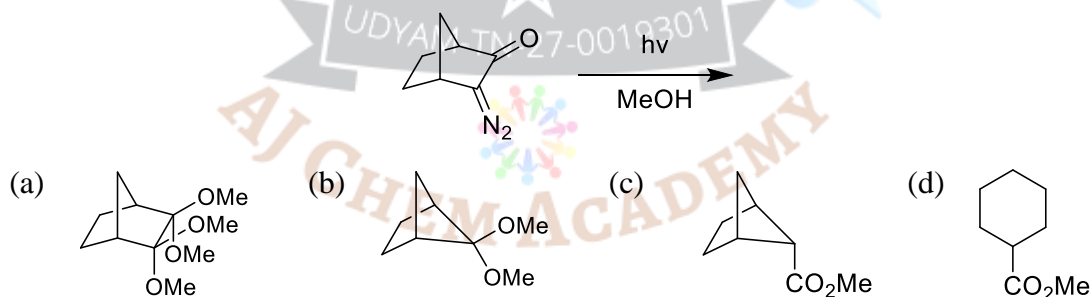
- | | X | Y | | X | Y |
|-----|----------|----------|-----|----------|----------|
| (a) | | | (b) | | |
| (c) | | | (d) | | |

49. The major products **X** and **Y** formed in the following reaction sequence are

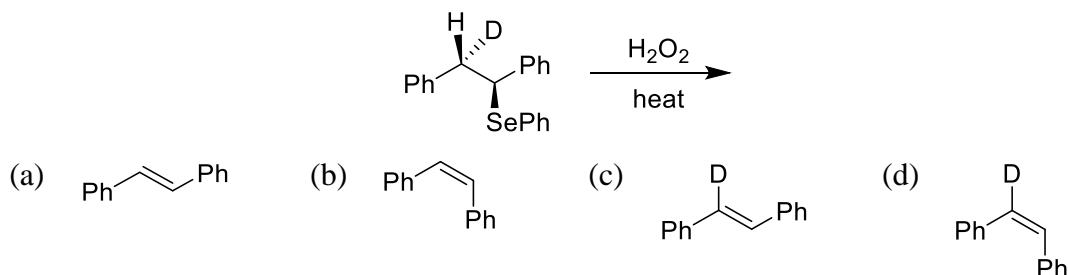


- (a) **X** =  ; **Y** = 
- (b) **X** =  ; **Y** = 
- (c) **X** =  ; **Y** = 
- (d) **X** =  ; **Y** = 

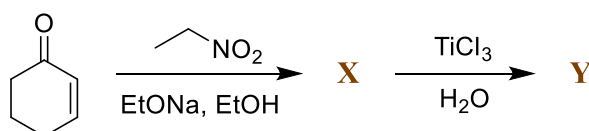
50. The product of the following reaction gave 6 line ^{13}C -NMR spectrum with peaks at δ 175, 52, 50, 46, 37, 33 ppm. The structure of the product is

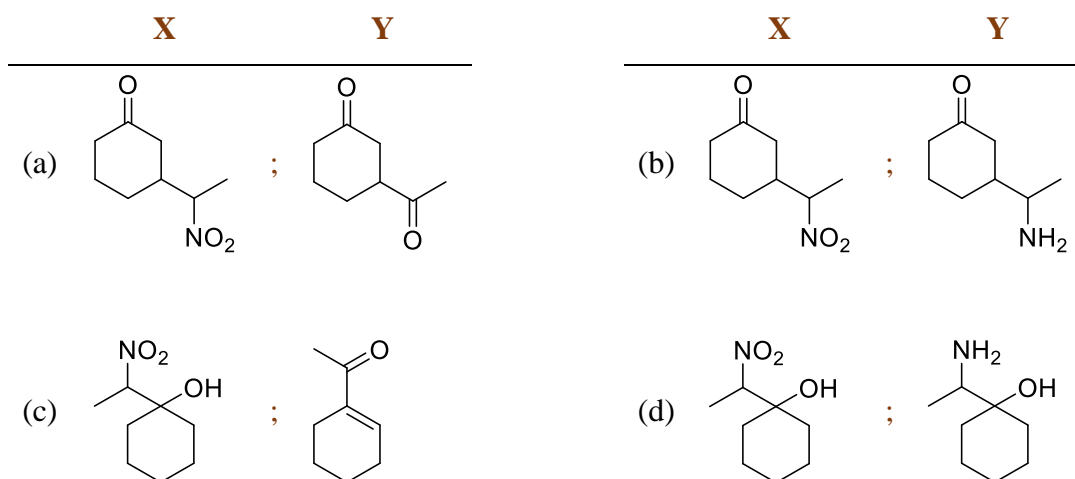


51. The major product formed in the following reaction is

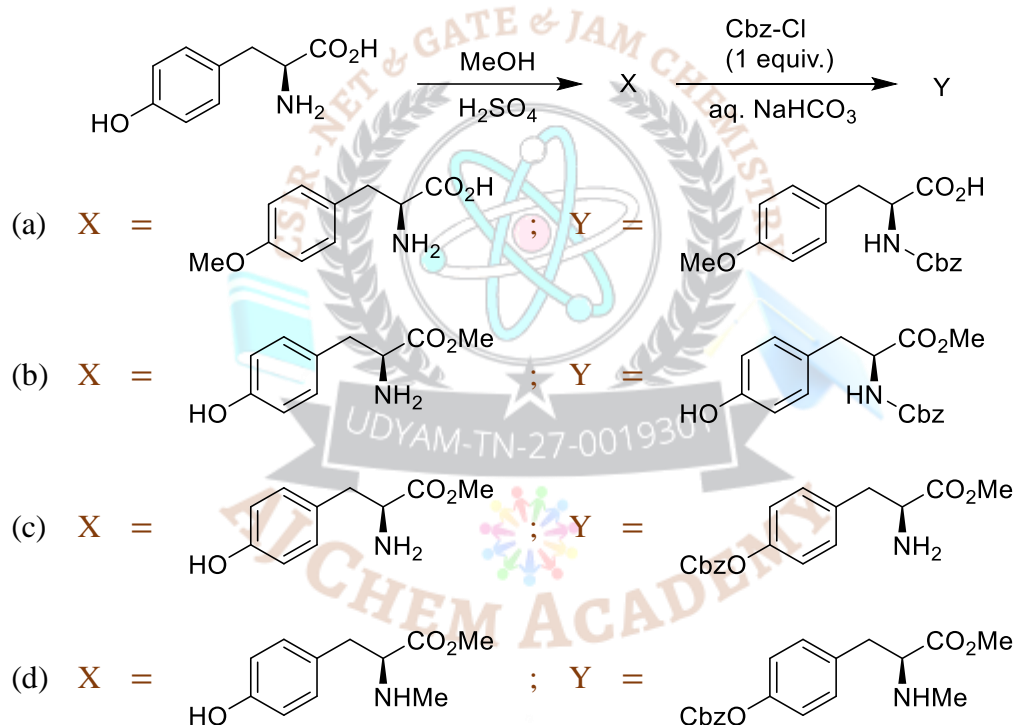


52. The major products **X** and **Y** formed in the following reaction sequence are

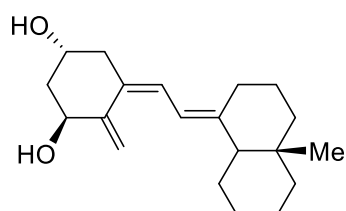




53. The **major products X and Y** formed in the following reaction sequence are



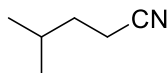
54. Given the fact that **1,3-butadiene** has a UV absorption of 217 nm, the absorption wavelength (in nm) for the conjugated system shown below is _____



Use these absorption values

Alkyl	: +5
Exo-cyclic double bond	: +5
Every additional conjugated C=C	: +30

55. The **m/z value** of the detectable fragment formed by **McLafferty like rearrangement** of the following compound in mass spectrometer is _____



Answer Key

Q.No	Ans		Q.No	Ans		Q.No	Ans		Q.No	Ans
1.	b		16.	c		31.	38 to 42		46.	d
2.	d		17.	c		32.	830 to 850		47.	a
3.	3		18.	d		33.	a		48.	b
4.	3		19.	c		34.	50 to 52		49.	a
5.	d		20.	b		35.	175 to 185		50.	c
6.	d		21.	a		36.	a		51.	c
7.	a		22.	b		37.	9		52.	a
8.	1.4 to 1.5		23.	c		38.	b		53.	b
9.	b		24.	56 to 58		39.	a		54.	282
10.	c		25.	a		40.	a		55.	41
11.	4		26.	b		41.	d			
12.	a		27.	60 to 66		42.	b			
13.	3		28.	a		43.	c			
14.	c		29.	0.81 to 0.85		44.	b			
15.	c		30.	10000 to 10500		45.	d			

- © No Part of this Question Paper shall be reproduced, reprinted or Translated for any purpose whatsoever without prior permission of AJ Chem Academy.
- © In spite of best efforts taken to present this Work without mistakes, some mistakes may have inadvertently crept in. So, we do not take any legal responsibility for them. If they are brought to our notice, corrections will be done in next edition.

- © இந்த வினாத்தாளின் எந்தப் பகுதியும் ஏஜே கெம் அகாடமியின் முன் அனுமதியின்றி எந்த நோக்கத்திற்காகவும் மீண்டும் உருவாக்கப்படவோ, மறுபதிப்பு செய்யவோ அல்லது மொழிபெயர்க்கவோ கூடாது.
- © இந்த படைப்பை பிழையின்றி வழங்குவதற்கு சிறந்த முயற்சிகள் எடுக்கப்பட்டாலும், சில தவறுகள் கவனக்குறைவாக ஊடுருவியிருக்கலாம். எனவே அவற்றிற்கு நாங்கள் எந்த சட்டப் பொறுப்பையும் ஏற்கவில்லை. அவற்றை எங்கள் கவனத்திற்கு கொண்டு வந்தால், அடுத்த பதிப்பில் திருத்தங்கள் செய்யப்படும்.

