ASSIGNMENT 1: GATE 2025
CY: CHEMISTRY

EE25BTECH11039 - Manupati Manideep

Q.1 - Q.5 CARRY ONE MARK EACH

1) Courage: Bravery :: Yearning :
   a) Longing
   b) Yelling
   c) Yawning
   d) Glaring

(GATE CY-2025)

2) We _____ tennis in the lawn when it suddenly started to rain.

   a) have been playing
   b) had been playing
   c) could be playing
   d) would have been playing

(GATE CY-2025)

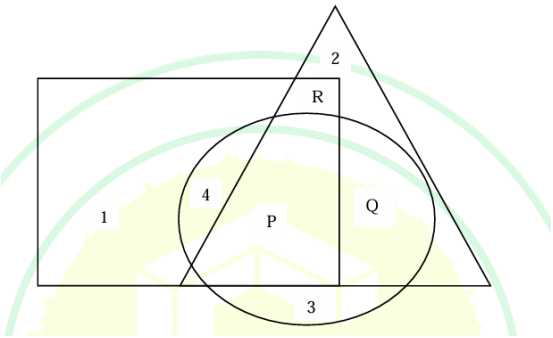
3) A 4×4 digital image has pixel intensities (U) as shown in the figure. The number of pixels with $U \leq 4$ is:

0	1	0	2
4	7	3	3
5	5	4	4
6	7	3	2

   a) 3
   b) 8
   c) 11
   d) 9

(GATE CY-2025)

4) In the given figure, the numbers associated with the rectangle, triangle, and ellipse are 1, 2, and 3, respectively. Which one among the given options is the most appropriate combination of P, Q, and R ?



a) $P = 6$; $Q = 5$; $R = 3$
b) $P = 5$; $Q = 6$ $R = 3$
c) $P = 3$; $Q = 6$; $R = 6$
d) $P = 5$; $Q = 3$; $R = 6$

(GATE CY-2025)

5) A rectangle has a length L and a width W, where $L > W$ If the width, W, is increased by 10%, which one of the following statements is correct for all values of L and W?
   a) Perimeter increases by 10%.
   b) Length of the diagonals increases by 10%.
   c) Area increases by 10%.
   d) The rectangle becomes a square.

(GATE CY-2025)

Q.6 - Q.10 CARRY TWO MARKS EACH

6) Column-I has statements made by Shanthala; and, Column-II has responses given by Kanishk. Identify the option that has the correct match between Column-I and Column-II.
   - P. This house is in a mess.
   - Q. I am not happy with the marks given to me.
   - R. Politics is a subject I avoid talking about.
   - S. I don't know what this word means.
   - 1. Alright, I won't bring it up during our conversations.
   - 2. Well, you can easily look it up.
   - 3. No problem, let me clear it up for you.
   - 4. Don't worry, I will take it up with your teacher.

   a) P-2; Q-3; R-1; S-4
   b) P-3; Q-4; R-1; S-2
   c) P-4; Q-1; R-2; S-3
   d) P-1; Q-2; R-4; S-3

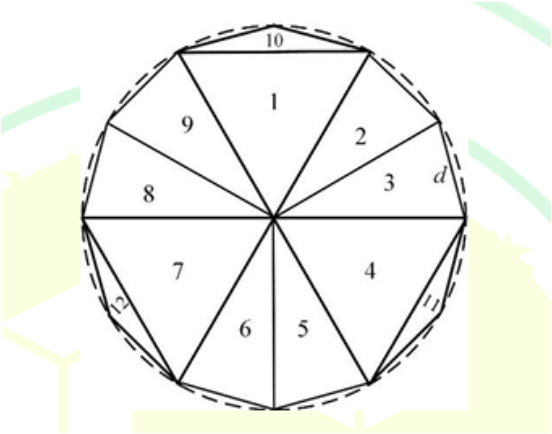
(GATE CY-2025)

7) Weight of a person can be expressed as a function of their age. The function usually varies from person to person. Suppose this function is identical for two brothers, and it monotonically increases till the age of 50 years and then it monotonically decreases. Let a_1 and a_2 (*inyears*) denote the ages of the brothers and $a_1 < a_2$. Which one of the following statements is correct about their age on the day when they attain the same weight?
   a) $a_1 < a_2 < 50$
   b) $a_1 < 50 < a_2$

c) $50 < a_1 < a_2$
d) Either $a_1 = 50$ or $a_2 = 50$

(GATE CY-2025)

8) A regular dodecagon (12-sided regular polygon) is inscribed in a circle of radius r cm as shown in the figure. The side of the dodecagon is d cm. All the triangles (numbered 1 to 12) in the figure are used to form squares of side r cm and each numbered triangle is used only once to form a square. The number of squares that can be formed and the number of triangles required to form each square, respectively, are:



a) 3; 4
b) 4; 3
c) 3; 3
d) 3; 2

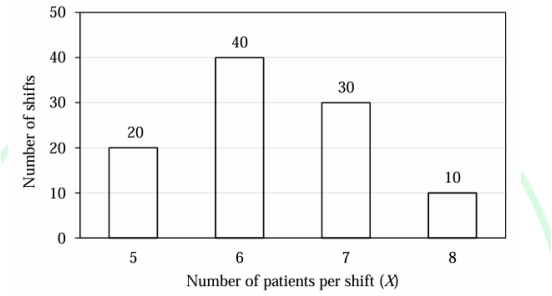
(GATE CY-2025)

9) If a real variable x satisfies $3^{x^2} = 27 \times 9^x$ then the value of $\frac{2^{x^2}}{(2^x)^2}$ is:

a) 2^{-1}
b) 2^0
c) 2^3
d) 215

(GATE CY-2025)

10) The number of patients per shift (X) consulting Dr. Gita in her past 100 shifts is shown in the figure. If the amount she earns is $\times 1000\,(X - 0.2)$, what is the average amount (in) she has earned per shift in the past 100 shifts?

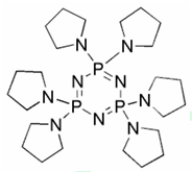


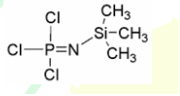
a) 6,100
b) 6,300
c) 6,500
d) 6,700

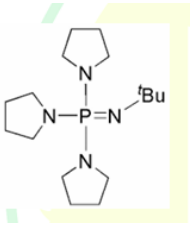
(GATE CY-2025)

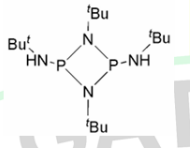
Q.11 - Q.35 CARRY ONE MARK EACH

11) The phosphazene compound that acts as a superbase is

a) 

b) 

c) 

d) 

(GATE CY-2025)

12) The reaction for the synthesis of Me_2SiCl_2 through Rochow-MÃ¼ller process is

a) $SiCl_4 + Me_2Zn \xrightarrow{0\ ^\circ C}$

b) $Si{:}Fe\ (9{:}1) + 2\ MeCl \xrightarrow{300\ ^\circ C}$

c) $Si{:}Cu\ (9{:}1) + 2\ MeCl \xrightarrow{300\ ^\circ C}$

d) $SiCl_4 + 2\ MeMgBr \xrightarrow{0\ ^\circ C}$

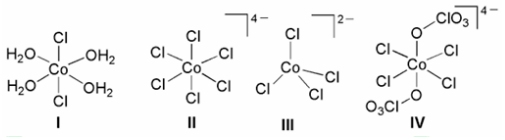
(GATE CY-2025)

13) Upon cooling from room temperature, the magnetic susceptibility of MnO slowly increases until 118 K, and then it decreases. This phenomenon is known as

a) ferromagnetism
b) paramagnetism
c) antiferromagnetism
d) ferrimagnetism

(GATE CY-2025)

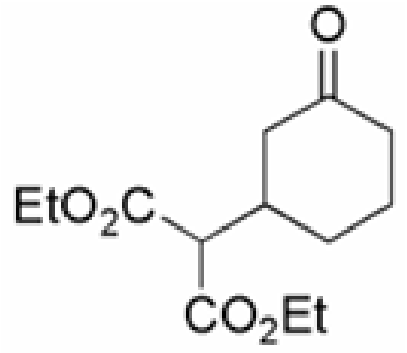
14) An aqueous solution of $Co(ClO_4)_2 \cdot 6H_2O$ is light pink in colour. Addition of conc. HCl results in an intense blue coloured solution due to the formation of a new species. The new species among the following is



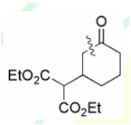
a) 1
b) 2
c) 3
d) 4

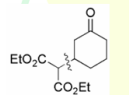
(GATE CY-2025)

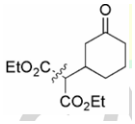
15) For an unambiguous single step synthesis of the following target molecule (TM), the best bond disconnection in its retrosynthetic analysis is

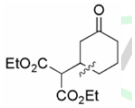


(TM)

a) 

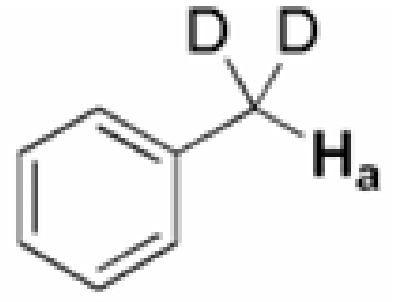
b) 

c) 

d) 

(GATE CY-2025)

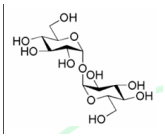
16) In the ^{1}H-NMR spectrum of the following molecule, the signal of proton H_a appears as

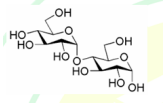


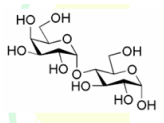
a) singlet
b) triplet
c) quintet
d) quartet

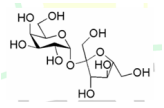
(GATE CY-2025)

17) A disaccharide X does NOT show mutarotation in aqueous solution. Acidic hydrolysis of X affords two different monosaccharides. The disaccharide X is

a) 

b) 

c) 

d) 

(GATE CY-2025)

18) The symmetry element that does NOT belong to C_{4v} point group is

a) C_4
b) C_2
c) i
d) σ_v

(GATE CY-2025)

19) Rigid rotor wavefunctions are given by $Y_{l,m}(\theta,\phi)$. The wavefunctions $Y_{1,0}(\theta,\phi)$ and $Y_{2,0}(\theta,\phi)$ are given below

$$Y_{1,0}(\theta,\phi) = \sqrt{\tfrac{3}{4\pi}}cos\theta$$

$$Y_{2,0}(\theta,\phi) = \sqrt{\tfrac{5}{16\pi}}\left(3cos^2\theta - 1\right)$$

For a non-polar diatomic molecule, the value of transition dipole moment integral for transition between $Y_{1,0}(\theta,\phi)$ and $Y_{2,0}(\theta,\phi)$ is equal to

a) $\frac{1}{\sqrt{2\pi}}$
b) 0
c) 2
d) $\frac{1}{\sqrt{4\pi}}$

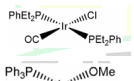
(GATE CY-2025)

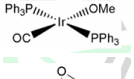
20) The translational, vibrational, and rotational molecular partition functions for a system containing ideal diatomic gas molecules in the canonical ensemble (N,V,T) are written as, q_{trans}, q_{vib}, and q_{rot}, respectively. The option that correctly defines their thermodynamic variable(s) dependency is

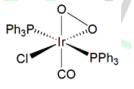
a) $q_{trans}(T,V), q_{vib}(T,V), q_{rot}(T,V)$
b) $q_{trans}(T,V), q_{vib}(T), q_{rot}(T)$
c) $q_{trans}(T), q_{vib}(T,V), q_{rot}(T)$
d) $q_{trans}(T,V), q_{vib}(T), q_{rot}(T,V)$

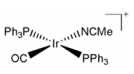
(GATE CY-2025)

21) The Vaska's complex trans-IrCl$(CO)(PPh_3)_2$ shows a band at 1967 cm^{-1} for the ν_{CO} stretching vibration in its infrared spectrum. The complexes that will show an increase in the ν_{CO} stretching vibration from 1967 cm^{-1} is/are

a) 

b) 

c) 

d) 

(GATE CY-2025)

22) Under the conditions mentioned for each reaction, the reaction(s) that would give borazine ($B_3N_3H_6$) as the major product is/are

a) $3\ BCl_3 + 3\ NH_4Cl \xrightarrow{140^\circ C}$

b) $B_2H_6 + 2\ NH_3 \xrightarrow{>250^\circ C}$

c) $3\ B_2H_6 + 6\ NH_4Cl \xrightarrow{\text{ether solvent}}$

d) $3\ LiBH_4 + 3\ NH_4Cl \xrightarrow{\text{THF reflux}}$

(GATE CY-2025)

23) The essential symmetries for a monoclinic crystal system is/are the presence of

a) one C_3 axis

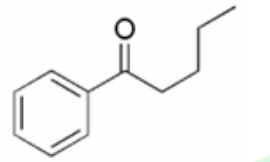
b) one C_2 axis

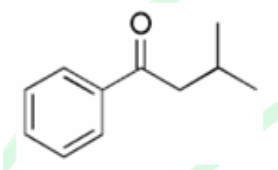
c) one C_4 axis

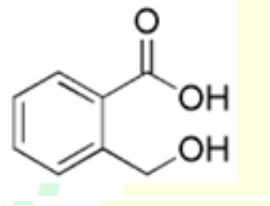
d) one C_6 axis

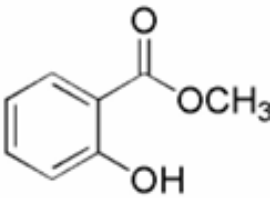
(GATE CY-2025)

24) Compound(*s*) that show(*s*) an intense peak at m/z 120 in the EI mass spectrum is/are

a) 

b) 

c) 

d) 

(GATE CY-2025)

25) The correct option(*s*) of reagents and reaction sequences suitable for carrying out the following transformation is/are

a) (*i*) NBS, $(PhCOO)_2$; (*ii*) aq. NaOH; (*iii*) active MnO_2; (*iv*) Li/liq.NH_3, t-BuOH

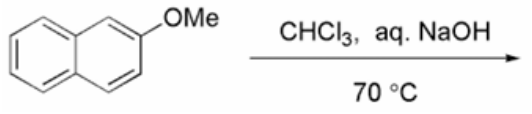
b) (*i*) m-CPBA; (*ii*) $BF_3.Et_2O$

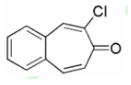
c) (*i*) SeO_2; (*ii*) Dess-Martin periodinane; (*iii*) $K\left[BH\left(s-Bu\right)_3\right]$ $(K-selectride)$

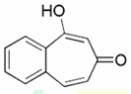
d) (*i*) dil. $KMnO_4$; (*ii*) $NaIO_4$

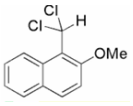
(GATE CY-2025)

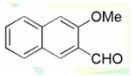
26) Among the given options, the possible product(*s*) that can be obtained from the following reaction is/are



a) 

b) 

c) 

d) 

(GATE CY-2025)

27) Choose the correct option(*s*) with regard to mechanism of the following transformation.
   a) It proceeds through divinyl cyclopropane rearrangement
   b) It involves a diradical intermediate
   c) It proceeds through di-π-methane rearrangement
   d) It proceeds through [2+2+2] cycloaddition reaction

(GATE CY-2025)

28) Consider two non-interacting particles confined to a one-dimensional box with infinite potential barriers. Their wavefunctions are ψ_1 and ψ_2 and energies are E_1 and E_2, respectively. The INCORRECT statement(*s*) about this system is/are
   a) The total energy is $E_1 + E_2$
   b) The total wavefunction is $\psi_1 + \psi_2$
   c) The total energy is E_1E_2
   d) The total wavefunction is $\psi_1\psi_2$

(GATE CY-2025)

29) The thermodynamic criterion/criteria for a spontaneous process is/are
   a) $\Delta U > 0$ at constant S and V
   b) $\Delta S > 0$ at constant U and V
   c) $\Delta(H - TS) > 0$ at constant T and P
   d) $\Delta(U - TS) < 0$ at constant T and V

(GATE CY-2025)

30) Xe and F_2 in 1:1 molar ratio when mixed in a closed flask and kept in the sunlight for a day, gave white crystals of a compound Q. Two equivalents of Q on reaction with one equivalent of AsF_5 gave an ionic compound X + Y with the cation having two Xe atoms. The total number of lone pairs present on the cation X^+ is _____ (in integer). (GATE CY-2025)

31) The total number of hyperfine lines expected in the EPR spectrum of CH_2OH (*radical*) is _____ (in integer). (GATE CY-2025) [*Note* : *Considerallhydrogenatomsforcalculation*]

32) Partial hydrolysis of a pentapeptide yields all possible tripeptides and dipeptides. The dipeptides that are obtained upon hydrolysis are given below.
Val-Ala, Gln-His, Phe-Val and Ala-Gln (GATE CY-2025)
The total number of tripeptides obtained that contain 'Ala' as one of the amino acids is_____ (in integer) (GATE CY-2025)

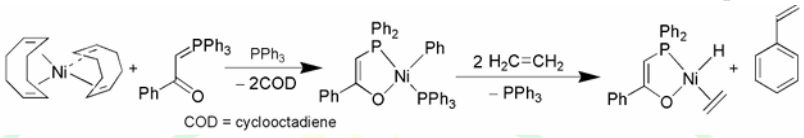
33) The specific rotation of enantiomerically pure (*S*)-2-butanol is +14°. The specific rotation of enantiomeric mixture of 2-butanol obtained from an asymmetric reduction of 2-butanone is found to be +7°. The percentage of (*R*)-2-butanol present in the reaction mixture is _____ (in integer). (GATE CY-2025)

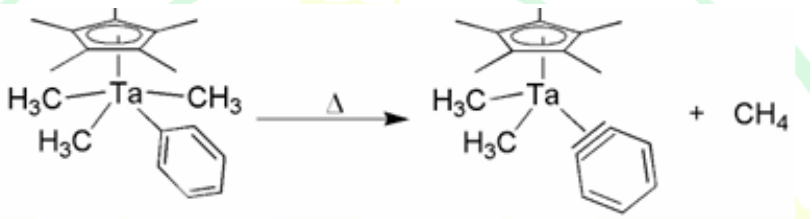
34) The ratio of the fundamental vibrational frequencies $\left(\frac{\nu_{^{13}C^{16}O}}{\nu_{^{12}C^{16}O}}\right)$ of two diatomic molecules $^{13}C^{16}O$ and $^{12}C^{16}O$, considering their force constants to be the same, is _ _ _ _ _ (rounded off to two decimal places) (GATE CY-2025)

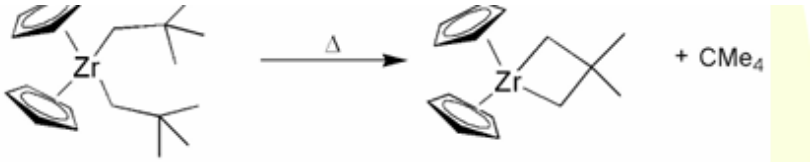
35) The expressions for the vapour pressure of solid (p_1) and vapour pressure of liquid (p_2) phases of a pure substance, respectively, are
$\ln p_1 = -\frac{2000}{T} + 5$ and $\ln p_2 = -\frac{4000}{T} + 10$
The triple point temperature of this substance is _ _ _ _ K (in integer). (GATE CY-2025)

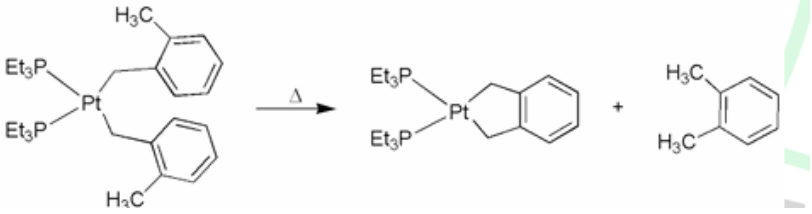
Q.36 - Q.65 CARRY TWO MARKS EACH

36) The reaction that proceeds through an oxidative addition followed by a reductive elimination is
$[given : Atomic numbers Ni = 28, Ta = 73, Zr = 40, Pt = 78]$

a)


b)


c)


d)


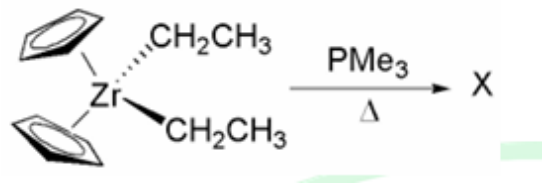
(GATE CY-2025)

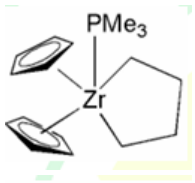
37) The homogeneous catalyst whose metal ion does NOT undergo either oxidation or reduction in any of the steps during the hydrogenation of terminal olefins is

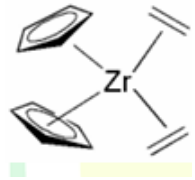
a) $RhCl(PPh_3)_3$ $\quad Ir(COD)(PCy_3)(Py)^+ PF_6^-$ $(COD = cyclooctadiene)$
b) $HRuCl(PPh_3)_3$ $\quad Rh(COD)(PPh_3)_2^+ PF_6^-$ $(COD = cyclooctadiene)$

(GATE CY-2025)

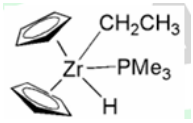
38) The given zirconocene compound, $\left(\eta^5 - Cp\right)_2ZrEt_2$, when heated in the presence of an equimolar amount of PMe_3 results in the formation of a compound X which obeys the 18 electron rule. The reaction also resulted in the release of a saturated hydrocarbon.
$[given : Atomic number of Zr = 40]$
The structure of compound X is



a)


b)


c)


d)


(GATE CY-2025)

39) The ^{1}H NMR spectrum of the given iridium complex at room temperature gave a single signal at 2.6 ppm, and its ^{31}P NMR spectrum gave a single signal at 23.0 ppm. When the spectra were recorded at lower temperatures, both these signals split into a complex pattern. The intra-molecular dynamic processes shown by this molecule are

a) Berry pseudo-rotation and rotation of the ethylene units along the C=C axis
b) Berry pseudo-rotation and propeller type rotation of the ethylene units along the Ir-alkene axis
c) Ray-Dutt twist and rotation of the ethylene units along the C=C axis
d) Ray-Dutt twist and propeller type rotation of the ethylene units along the Ir-alkene axis

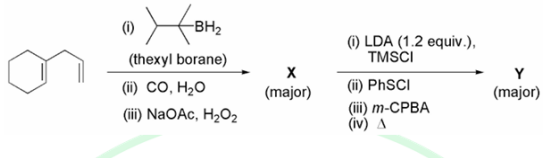
(GATE CY-2025)

40) The effective magnetic moment, μ_{eff} value for $[Cr(H_2O)_6]^{3+}$ taking into account for spin-orbit coupling is closest to
$\left[given: Atomic number of Cr = 24, spin-orbit coupling constant \lambda = 92 cm^{-1}, and \Delta_o = 17400 cm^{-1}\right]$

a) 3.79 μ_B
b) 3.87 μ_B
c) 4.05 μ_B
d) 3.60 μ_B

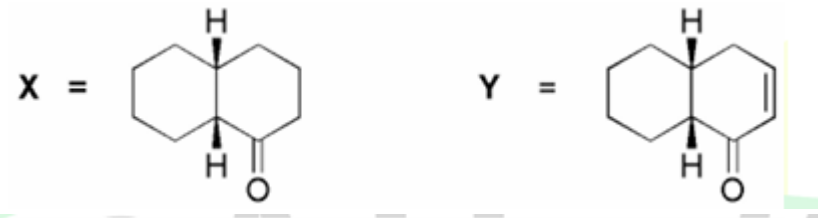
(GATE CY-2025)

41) The major products X and Y formed in the following reaction sequences are



a)

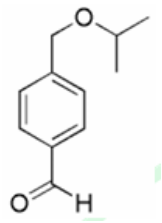

b) 

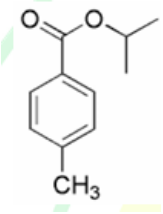
c) 

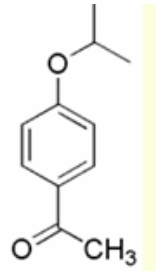
d) 

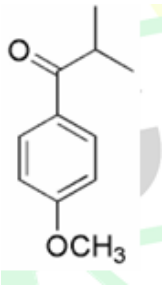
(GATE CY-2025)

42) Compound K displayed a strong band at 1680 cm^{-1} in its IR spectrum. Its ^{1}H-NMR spectral data are as follows: δ (ppm) 7.30 $(d, J = 7.2Hz, 2H)$, 6.8 $(d, J = 7.2Hz, 2H)$, 3.8 $(septet, J = 7.0Hz, 1H)$, 2.2 $(s, 3H)$, 1.9 $(d, J = 7.0Hz, 6H)$. The correct structure of compound K is

a) 

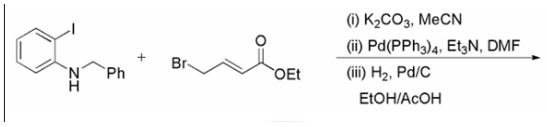
b) 

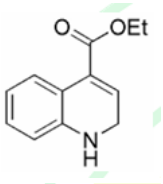
c) 

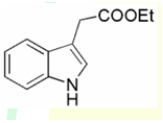
d) 

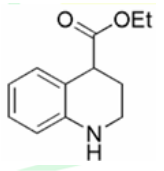
(GATE CY-2025)

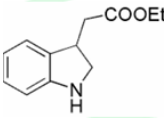
43) The major product formed in the following reaction sequences is



a) 

b) 

c) 

d) 

(GATE CY-2025)

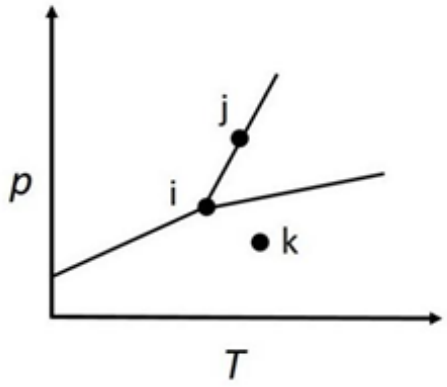
44) In the following asymmetric transformation, the key aldol reaction involves the attack of
   a) Si face of enolate on to the Re face of aldehyde
   b) Si face of enolate on to the Si face of aldehyde
   c) Re face of enolate on to the Re face of aldehyde
   d) Re face of enolate on to the Si face of aldehyde

(GATE CY-2025)

45) The correct option with regard to the following statements is
   a) (*a*) Time-independent SchrÃ¶dinger equation can be exactly solved for Be^{2+}.
   b) (*b*) For a particle confined in a one-dimensional box of length l with infinite potential barriers, the trial variation function $\phi = [\frac{3}{l^3}]^{1/2}x$ is not an acceptable trial wavefunction for $0 \leq x \leq l$.
   c) (*c*) Wavefunctions for system of Fermions must be anti-symmetric with respect to exchange of any two Fermions in the system.
   d) (*d*) Born-Oppenheimer approximation can be used to separate the vibrational and rotational motion of a molecule.

(GATE CY-2025)

46) The phase diagram of a single component system is given below. The option with the correct number of degrees of freedom corresponding to the labelled points i, j, and k, respectively, is



   a) 0, 1, 2
   b) 3, 2, 1
   c) 2, 0, 1
   d) 0, 2, 1

(GATE CY-2025)

47) An approximate partition function $Q(N, V, T)$ of a gas is given below. $Q(N, V, T) = \frac{1}{N!}\left(\frac{2\pi m k_B T}{h^2}\right)^{3N/2}(V - Nb)^N$ The equation of state(*s*) for this gas is/are [Note: b is a parameter independent of volume.]

a) $P(V - Nb) = Nk_BT$
b) $PV^{(N-b)} = k_BT$
c) $PV = Nk_BT$
d) $P(V - Nb) = Nk_B$

(GATE CY-2025)

48) The compound(s) having structure similar to that of B_2H_6 is/are
a) I_2Cl_6
b) Si_2Cl_6
c) Al_2Cl_6
d) Cl_2O_6

(GATE CY-2025)

49) The UV-visible spectrum of $[Ni(en)_3]^{2+}$ (en = ethylenediamine) shows absorbance maxima at 11200 cm^{-1}, 18350 cm^{-1}, and 29000 cm^{-1}. Absorbance maximum Electronic transition (a) 11200 cm^{-1} (i) $^3A_{2g} \rightarrow {}^3T_{1g}$ (F) (b) 18350 cm^{-1} (ii) $^3A_{2g} \rightarrow {}^3T_{2g}$ (c) 29000 cm^{-1} (iii) $^3A_{2g} \rightarrow {}^3T_{1g}$ (P) [$given$: $Atomicnumberof N$
The correct match(es) between absorbance maximum and electronic transition is/are
a) $(a) \rightarrow (ii)$
b) $(b) \rightarrow (i)$
c) $(a) \rightarrow (iii)$
d) $(c) \rightarrow (iii)$

(GATE CY-2025)

50) Cytochrome P450 (CYP) enzymes catalyze stereoselective C–H hydroxylation of hydrocarbons in the presence of O_2. The correct statement(s) about the structure and activity of CYP is/are
a) A thiolate group is coordinated to the Fe center at one of the axial positions around Fe.
b) While one of the oxygen atoms of O_2 is inserted into a C–H bond of a hydrocarbon, the other oxygen atom gets reduced to water.
c) An imidazole group is coordinated to the Fe center at one of the axial positions around Fe.
d) An iron-oxo species acts as a key oxidant in the catalytic cycle of CYP.

(GATE CY-2025)

51) The complex(es) having metal-metal bond order ≥3.5 is/are
[$given$: $Theatomicnumbersof Mo, Cr, Mn, and Reare 42, 24, 25, and 75, respectively.$]
a) $[Ti(H_2O)_6]^{3+} < [Mn(H_2O)_6]^{2+} < [CrO_4]^{2-}$
b) $[Mn(H_2O)_6]^{2+} < [Ti(H_2O)_6]^{3+} < [CrO_4]^{2-}$
c) $[NiCl_4]^{2-} < [Ti(H_2O)_6]^{3+} < [Mn(H_2O)_6]^{2+}$
d) $[NiCl_4]^{2-} < [Mn(H_2O)_6]^{2+} < [Ti(H_2O)_6]^{3+}$

(GATE CY-2025)

52) Consider the following two reactions and their corresponding Hammett plots
Choose the option(s) that correctly match(es) the points on the graph given in Column-I with substituents X given in Column-II in accordance with their substituents constant σ

Column-I (points on the graph)	Column-II (substituent X)
p	NH_2
q	NO_2
r	OMe
s	Cl
t	Me
u	CN

a) s $\rightarrow$ $\sigma(X = Cl)$; t $\rightarrow$ $\sigma(X = OMe)$; u $\rightarrow$ $\sigma(X = NH_2)$; r $\rightarrow$ $\sigma(X = NO_2)$
b) s $\rightarrow$ $\sigma(X = Me)$; u $\rightarrow$ $\sigma(X = NH_2)$; t $\rightarrow$ $\sigma(X = OMe)$; r $\rightarrow$ $\sigma(X = Br)$

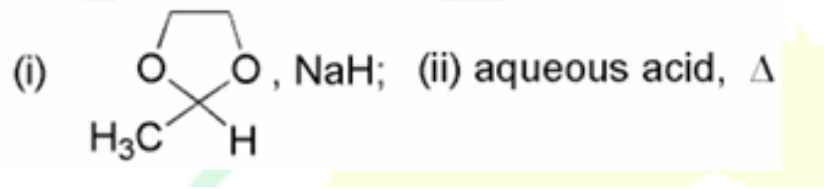
c) p $\rightarrow$ $\sigma(X = Me)$; q $\rightarrow$ $\sigma(X = CN)$; r $\rightarrow$ $\sigma(X = NO_2)$; t $\rightarrow$ $\sigma(X = OMe)$

d) p $\rightarrow$ $\sigma(X = Cl)$; q $\rightarrow$ $\sigma(X = NO_2)$; r $\rightarrow$ $\sigma(X = CN)$; t $\rightarrow$ $\sigma(X = Me)$

(GATE CY-2025)

53) The correct option(*s*) of reagents and reaction sequences suitable for carrying out the following transformation is/are

a) (i) Li—C≡C—H, THF, –70 °C; (ii) cat. $HgSO_4$, H_2SO_4, H_2O; (iii) aqueous acid, Δ

b) 

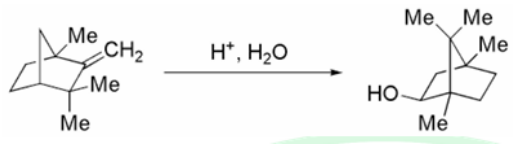
c) (i) LDA, $TfNPh_2$; (ii) cat. [(dppe)Pd(0)], 

; (iii) aqueous acid, Δ
(dppe = diphenylphosphinoethane)

d) (i) $H_3C\text{-}NO_2$, $NaOCH_3$; (ii) sat. NaCl; (iii) $TiCl_3$, H_2O; (iv) aqueous acid, Δ

(GATE CY-2025)

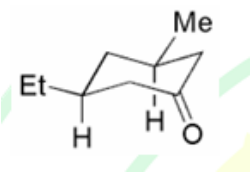
54) The process(*es*) and/or intermediate(*s*) through which the following transformation proceeds is/are

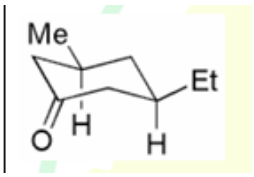


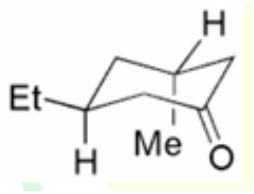
a) 1,2-methide shift
b) 1,3-methide shift
c) non-classical carbocation
d) tertiary carbocation

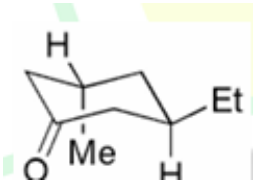
(GATE CY-2025)

55) For the following reaction, the possible product(*s*) is/are

a) 

b) 

c) 

d) 

(GATE CY-2025)

56) Wavefunctions and energies for a particle confined in a cubic box are ψ_{n_x,n_y,n_z} and E_{n_x,n_y,n_z}, respectively. The functions ϕ_1, ϕ_2, ϕ_3, and ϕ_4 are written as linear combinations of ψ_{n_x,n_y,n_z}. Among these functions, the eigenfunction(s) of the Hamiltonian operator for this particle is/are

$\phi_1 = \frac{1}{\sqrt{2}}\psi_{1,4,1} - \frac{1}{\sqrt{2}}\psi_{2,2,3}$
$\phi_2 = \frac{1}{\sqrt{2}}\psi_{1,5,1} + \frac{1}{\sqrt{2}}\psi_{3,3,3}$
$\phi_3 = \frac{1}{\sqrt{2}}\psi_{1,3,8} + \frac{1}{\sqrt{2}}\psi_{3,8,1}$
$\phi_4 = \frac{1}{2}\psi_{3,3,1} + \frac{\sqrt{3}}{2}\psi_{2,4,1}$

a) ϕ_2
b) ϕ_4
c) ϕ_3
d) ϕ_1

(GATE CY-2025)

57) If a particle's state function is an eigenfunction of the operator $\hat{L}^2$ with eigenvalue $30\hbar^2$, then the possible eigenvalue(s) of the operator $\hat{L}_z^2$ for the same state function is/are

a) $10\hbar^2$
b) $16\hbar^2$
c) $25\hbar^2$
d) 0

(GATE CY-2025)

58) An archaeological specimen containing ^{14}C gives 45 counts per gram of carbon in 5 minutes. A specimen of freshly cut wood gives 20 counts per gram of carbon per minute. The counter used recorded a background count of 5 counts per minute in the absence of any ^{14}C containing sample. The age of the specimen is _____ years (in integer). [Note: $t_{1/2}$ of ^{14}C = 5730 years] (GATE CY-2025)

59) In the following reaction, 13.4 grams of aldehyde P gave a diastereomeric mixture of alcohols Q and R in a ratio of 2:1. If the yield of the reaction is 80, then the amount of Q (*ingrams*) obtained is _____ (in integer). (GATE CY-2025)

60) The kinetic energies of an electron (e) and a proton (p) are E and $3E$, respectively. Given that mass of a proton is 1836 times that of an electron, the ratio of their de Broglie wavelengths $\left(\frac{\lambda_e}{\lambda_p}\right)$ is _____ (rounded off to two decimal places). (GATE CY-2025)

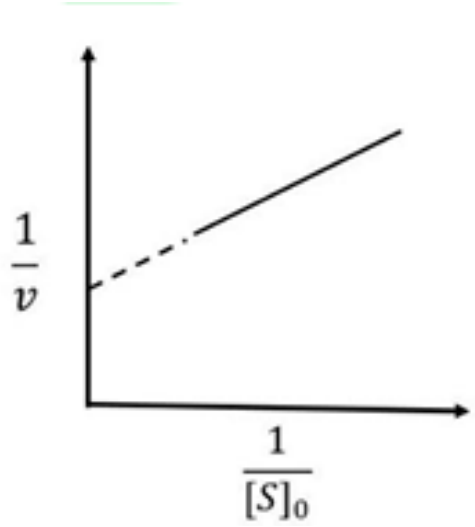
61) If a molecule emitting a radiation of frequency 3.100×10^9 Hz approaches an observer with a relative speed of 5.000×10^6 m s^{-1}, then the observer detects a frequency of _____ $\times 10^9$ Hz (rounded off to three decimal places) (GATE CY-2025)
$\left[given : Speedoflightc = 3.000 \times 10^8 ms^{-1}\right]$

62) The mean energy of a molecule having two available energy states at $\epsilon = 0$ J and $\epsilon = 4.14 \times 10^{-21}$ J at 300 K is _____$\times 10^{-21}$ J (rounded off to two decimal places).
$[given : Boltzmannconstant]$ $(k_B) = 1.38 \times 10^{-23}$ J K^{-1}] (GATE CY-2025)

63) For the cell reaction, Hg_2Cl_2 (s) + H_2 ($1atm$) → 2Hg (l) + $2H^+(a = 1)$ + $2Cl^-(a = 1)$ The standard cell potential is $\mathcal{E}^0 = 0.2676$ V, and $\left(\frac{\partial \mathcal{E}^0}{\partial T}\right)_P = -3.19 \times 10^{-4}$ V K^{-1}. The standard enthalpy change of the reaction $\left(\Delta_r H^0\right)$ at 298 K is –x kJ mol^{-1}. The value of x is _____ (rounded off to two decimal places).
$\left[given : FaradayconstantF = 96500Cmol^{-1}\right]$ (GATE CY-2025)

64) Consider a Carnot engine with a hot source kept at 500 K. From the hot source, 100 J of energy (heat) is withdrawn at 500 K. The cold sink is kept at 300 K. The efficiency of the Carnot engine is _____ (rounded off to one decimal place). (GATE CY-2025)

65) The Lineweaver-Burk plot for an enzyme obeying the Michaelis-Menten mechanism is given below. The slope of the line is 0.36×10^{-2}s, and the y-intercept is 1.20 mol^{-1} L s. The value of the Michaelis constant (K_M) is____$\times 10^{-3}$ mol L^{-1} (in integer).



[Note: v is the initial rate, and $[S]_0$ is the substrate concentration]

(GATE CY-2025)

END OF THE QUESTION PAPER