

GATE CY 2024 questions

EE25BTECH11010-ARSH DHOKE

General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

1. ΔG_f° and ΔH_f° for Fe(g) are $370.7 \text{ kJ mol}^{-1}$ and $416.3 \text{ kJ mol}^{-1}$ at 298 K, respectively. Assuming ΔH_f° is constant in the interval 250 K to 375 K, ΔG_f° (rounded off to the nearest integer) for Fe(g) at 375 K is:

- (a) 359 kJ mol^{-1} (c) 325 kJ mol^{-1}
(b) 338 kJ mol^{-1} (d) 310 kJ mol^{-1}

(GATE CY 2024)

2. The 15 parts of the given figure are to be painted such that no two adjacent parts with shared boundaries (excluding corners) have the same color. The minimum number of colors required is

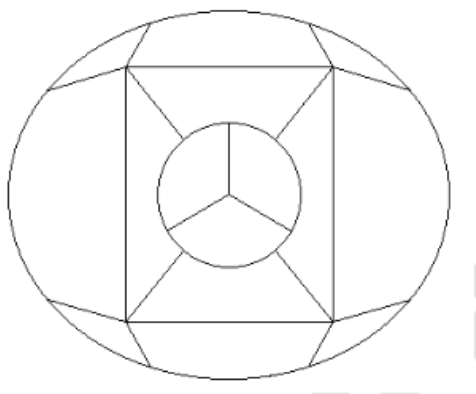


Figure 1: Figure for Q.2

- (a) 4 (c) 5
(b) 3 (d) 6

(GATE CY 2024)

3. How many 4-digit positive integers divisible by 3 can be formed using only the digits {1, 3, 4, 6, 7}, such that no digit appears more than once in a number?

- (a) 24 (c) 72
(b) 48 (d) 12

(GATE CY 2024)

4. The sum of the following infinite series is

$$2 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{8} + \frac{1}{9} + \frac{1}{16} + \frac{1}{27} + \dots$$

- (a) $\frac{11}{3}$ (c) $\frac{13}{4}$
(b) $\frac{7}{2}$ (d) $\frac{9}{2}$

(GATE CY 2024)

5. In an election, the share of valid votes received by the four candidates A, B, C, and D is represented by the pie chart shown. The total number of votes cast in the election were 1,15,000, out of which 5,000 were invalid.

Share of valid votes

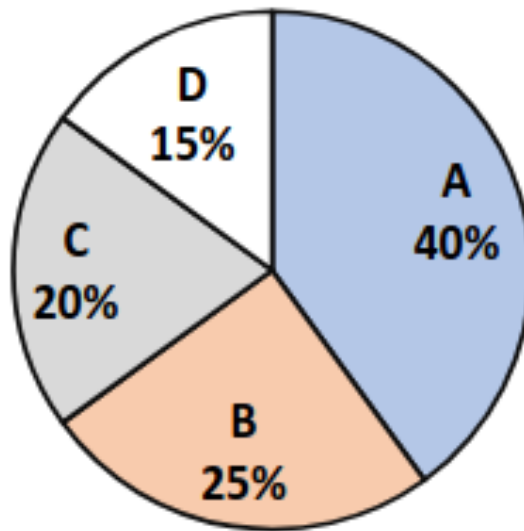


Figure 2: Figure for Q.5

Based on the data provided, the total number of valid votes received by the candidates B and C is

- (a) 45,000

- (b) 49,500
- (c) 51,750
- (d) 54,000

(GATE CY 2024)

6. Thousands of years ago, some people began dairy farming. This coincided with a number of mutations in a particular gene that resulted in these people developing the ability to digest dairy milk.

Based on the given passage, which of the following can be inferred?

- (a) All human beings can digest dairy milk.
- (b) No human being can digest dairy milk.
- (c) Digestion of dairy milk is essential for human beings.
- (d) In human beings, digestion of dairy milk resulted from a mutated gene.

(GATE CY 2024)

7. The probability of a boy or a girl being born is $\frac{1}{2}$. For a family having only three children, what is the probability of having two girls and one boy?

- (a) $\frac{3}{8}$
- (b) $\frac{1}{8}$
- (c) $\frac{1}{4}$
- (d) $\frac{1}{2}$

(GATE CY 2024)

8. Person 1 and Person 2 invest in three mutual funds A, B, and C. The amounts they invest in each of these mutual funds are given in the table.

	Mutual fund A	Mutual fund B	Mutual fund C
Person 1	Rs.10,000	Rs.20,000	Rs.20,000
Person 2	Rs.20,000	Rs.15,000	Rs.15,000

Table 1: Table for Q.8

At the end of one year, the total amount that Person 1 gets is Rs.500 more than Person 2. The annual rate of return for the mutual funds B and C is 15% each. What is the annual rate of return for the mutual fund A?

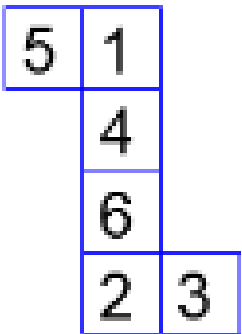
- (a) 7.5%
- (b) 10%
- (c) 15%
- (d) 20%

9. Three different views of a dice are shown in the figure below.



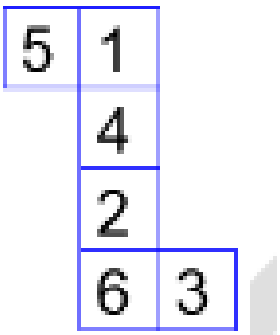
Figure 3: Figure for Q.9

The piece of paper that can be folded to make this dice is



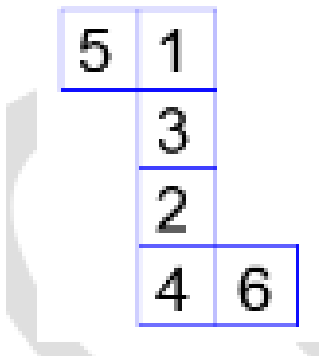
(a)

Figure 4: Option A



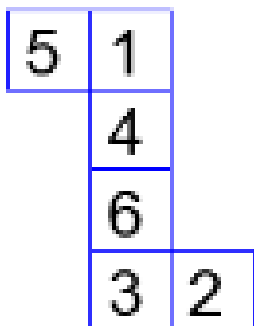
(b)

Figure 5: Option B



(c)

Figure 6: Option C



(d)

Figure 7: Option D

(GATE CY 2024)

10. Visualize two identical right circular cones such that one is inverted over the other and they share a common circular base. If a cutting plane passes through the vertices of the assembled cones, what shape does the outer boundary of the resulting cross-section make?

- (a) A rhombus
- (b) A triangle
- (c) An ellipse
- (d) A hexagon

(GATE CY 2024)

11. Among the following, the compound with the lowest CO stretching frequency is

- (a) $[\text{Mn}(\text{CO})_6]^+$
- (b) $[\text{V}(\text{CO})_6]^-$
- (c) $[\text{Cr}(\text{CO})_5]$
- (d) $[\text{Cr}(\text{dien})(\text{CO})_3]$ (dien: diethylenetriamine)

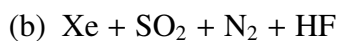
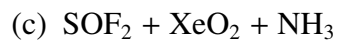
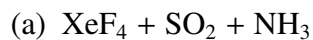
(GATE CY 2024)

12. The ground state of $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ is

- (a) 5E_g
- (b) ${}^5T_{2g}$
- (c) ${}^6A_{1g}$
- (d) ${}^6A_{2g}$

(GATE CY 2024)

13. The reaction of XeF_2 with $\text{HN}(\text{SO}_2\text{F})_2$ at 273 K in CF_2Cl_2 solvent yields



(GATE CY 2024)

14. The major product in the following reaction sequence is

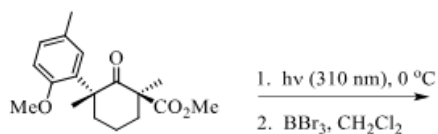


Figure 8: Figure for Q.14

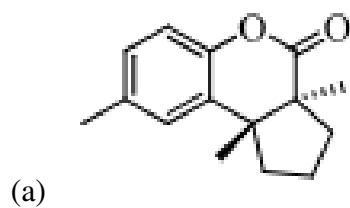


Figure 9: Option A

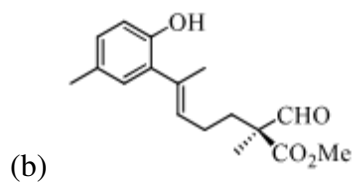


Figure 10: Option B

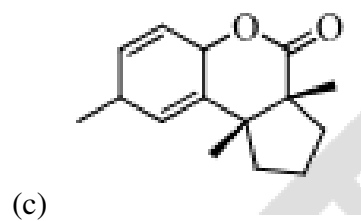


Figure 11: Option C

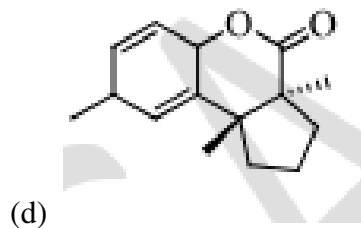


Figure 12: Option D

(GATE CY 2024)

15. Among the following, the chiral compound is

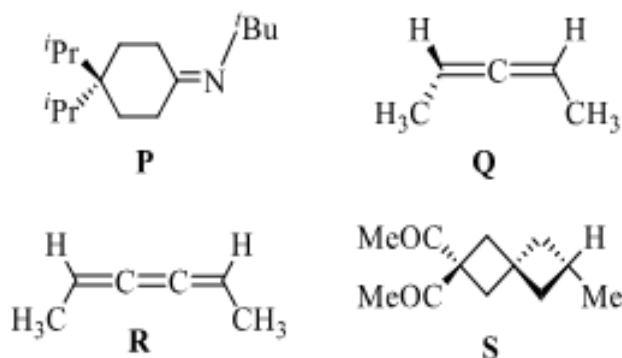


Figure 13: Figure for Q.15

- (a) **P** (c) **R**
(b) **Q** (d) **S**

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16. The major product in the given reaction sequence is **Q**. The mass spectrum of **Q** shows (M = molecular ion peak)

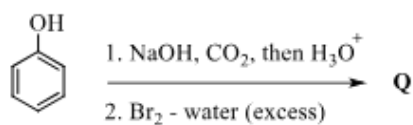


Figure 14: Figure for Q.16

- (a) M, (M+2), (M+4), and (M+6) peaks with relative intensity of 1:1:1:1
(b) M, (M+2), (M+4), and (M+6) peaks with relative intensity of 1:3:3:1
(c) M, (M+2), and (M+4) peaks with relative intensity of 1:2:1
(d) M and (M+2) peaks with relative intensity of 1:1

(GATE CY 2024)

17. The product M in the following reaction is

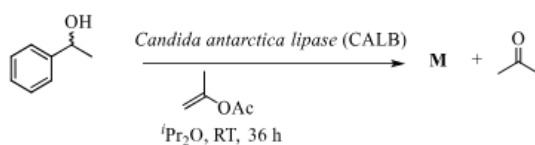


Figure 15: Figure for Q.17

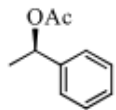


Figure 16: Option A

(a)

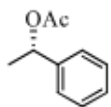


Figure 17: Option B

(b)

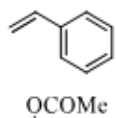


Figure 18: Option C

(c)

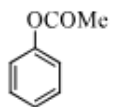


Figure 19: Option D

(d)

(GATE CY 2024)

18. Critical micellar concentration of a surfactant is 0.008 M in water at 25°C. If the aggregation number of the micelles is 80, the concentration of the micelles (in M) present in 0.088 M aqueous solution of the surfactant at 25°C is

- (a) 0.010 (c) 0.008
(b) 0.001 (d) 0.088

(GATE CY 2024)

19. The order and the number of classes present in a group with the irreducible representations A_1 , A_2 , B_1 , B_2 , E_1 , and E_2 are, respectively,

- (a) 6 and 6
(b) 12 and 6
- (c) 6 and 3
(d) 12 and 3

(GATE CY 2024)

20. The molecule XY_2 is microwave active and its vibration-rotation spectrum shows only P and R transitions. In the correct structure,

- (a) X is the central atom in linear XY_2 .
(b) X is the central atom in bent XY_2 .
(c) Y is the central atom in linear XY_2 .
(d) Y is the central atom in bent XY_2 .

(GATE CY 2024)

21. The complex(es) with distorted octahedral structure is (are)

- (a) $[VF_6]^{3-}$
(b) $[FeF_6]^{3-}$
- (c) $[MnF_6]^{3-}$
(d) $[Fe(CN)_6]^{4-}$

(GATE CY 2024)

22. The compound(s) which show(s) the perovskite structure in solid state is (are)

- (a) $CaTiO_3$
(b) $NiFe_2O_4$
(c) Fe_3O_4
(d) $CsPbI_3$

(GATE CY 2024)

23. Among the following metalloproteins, the pair(s) of **non-heme** proteins is (are)

- (a) Hemoglobin and Myoglobin
(b) Hemocyanin and Carboxypeptidase
(c) Hemerythrin and Carbonic anhydrase
(d) Cytochrome P-450 and Hemocyanin

(GATE CY 2024)

24. The reaction(s) that yield(s) X as the major product is (are):



Figure 20: Figure for Q.24

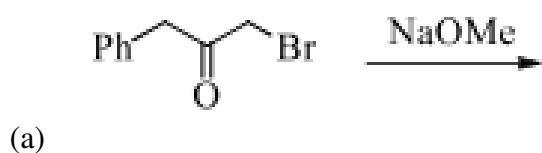


Figure 21: Option A

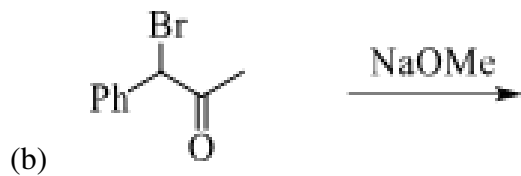


Figure 22: Option B

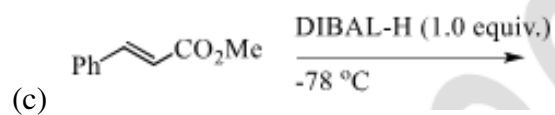


Figure 23: Option C

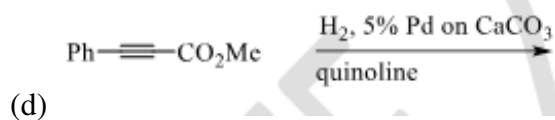


Figure 24: Option D

(GATE CY 2024)

25. The reaction(s) that yield(s) 2-methylquinoline as the major product is (are):

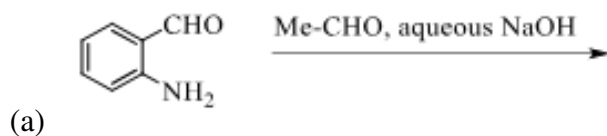


Figure 25: Option A

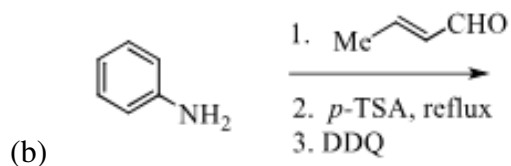


Figure 26: Option B

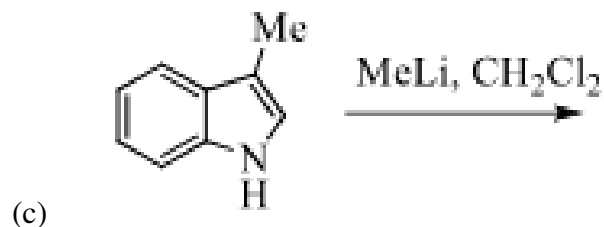


Figure 27: Option C

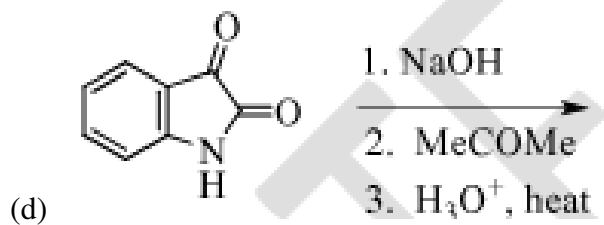


Figure 28: Option D

(GATE CY 2024)

26. The correct statement(s) for decalin is (are):

- (a) cis-Decalin is thermodynamically less stable than trans-decalin.
- (b) cis-Decalin contains plane of symmetry.
- (c) trans-Decalin undergoes ring inversion.
- (d) trans-Decalin belongs to the point group of C_{2h} .

(GATE CY 2024)

27. The correct statement(s) about $^4D_{5/2}$ state of an atom is (are):

- (a) it corresponds to $L = 2$, $S = 1/2$, and $J = 5/2$.
- (b) it can originate from $s^1 p^2$ electronic configuration.
- (c) it splits into five levels in the presence of magnetic field.
- (d) it can show spectral transition to $^4P_{3/2}$ state.

(GATE CY 2024)

28. The correct statement(s) related to an ensemble is (are):

- (a) an ensemble is a collection of an infinite number of imaginary replications of the system of interest.
- (b) all members of an ensemble are macroscopically identical and also have identical microstates.
- (c) an ensemble average of any macroscopic property of the system is equal to the value of the property averaged over a sufficiently long time.
- (d) all systems in a canonical ensemble need NOT have the same composition.

(GATE CY 2024)

29. The non-dissociative adsorption of a gas on a given surface at a fixed temperature follows Langmuir isotherm. The plot(s) which give(s) a straight line is (are) [Given: V = volume of the adsorbed gas, P = pressure of the gas]

- (a) $1/V$ versus $1/P$
- (b) P/V versus P
- (c) V versus P
- (d) V versus $1/P$

(GATE CY 2024)

30. The crystal field stabilization energy of $[\text{Cr}(\text{NH}_3)_6]^{3+}$ with Δ_0 value of 21600 cm^{-1} is $y \text{ cm}^{-1}$. The value of $|y|$ is _____. (rounded off to the nearest integer) (GATE CY 2024)

31. The number of metal-metal bond(s) in the complex $[(\eta^5\text{-Cp})\text{Mo}(\text{CO})_2]_2$ is x and in $[(\eta^5\text{-Cp})_2\text{Fe}_2(\text{CO})_3]$ is y . The value of $x + y$ is _____. (Assume 18 electron rule is followed.) (Answer in integer) (GATE CY 2024)

32. ^1H NMR spectrum of a mixture containing CH_3Br (x mol) and $(\text{CH}_3)_2\text{CBr}$ (y mol) shows two singlets at 2.7 ppm and 1.8 ppm, with the relative ratio of 3:1 (integration value), respectively. The value of x/y is _____. (rounded off to the nearest integer) (GATE CY 2024)

33. The value of $\frac{e^2}{2\pi\epsilon_0 a_0}$ in atomic unit of energy is _____. (e : charge of electron; a_0 : Bohr radius; ϵ_0 : permittivity of vacuum) (rounded off to the nearest integer) (GATE CY 2024)

34. The partial vapor pressure of 0.1 molal solution of **B** in liquid **A** is 60 kPa at 300 K. The partial vapor pressure (in kPa) of a solution containing **B** with mole fraction of 0.1 in liquid **A** at 300 K is _____. (Assume the solute **B** obeys Henry's law. The molar mass of **A** is 80 g mol^{-1} .) (rounded off to three decimal places) (GATE CY 2024)

35. Consider the following two parallel irreversible first-order reactions, where $k_1 = 2k_2$ at 300 K. After complete conversion of **R** at 300 K, the concentration of **P1** in the reaction mixture was 15 mol L^{-1} . The initial concentration of **R** (in mol L^{-1}) was _____.

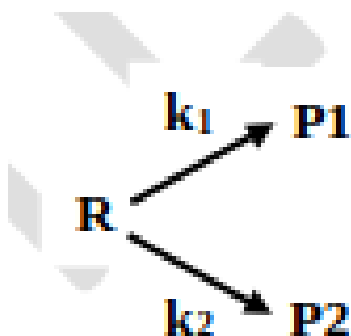


Figure 29: Figure for Q.35

(k_1 and k_2 are the rate constants) (rounded off to one decimal place) (GATE CY 2024)

Q.36 - Q.65 Carry TWO marks each.

36. Borax on treatment with NaOH and H_2O_2 forms X. The compound X on reaction with PhCN at 60°C in methanol–water mixture gives Y as the major product. X and Y, respectively, are

(a) $\text{NaB(O)(OH)}_2 \cdot n\text{H}_2\text{O}$ and PhCONH_2 (c) $\text{Na}_2\text{B}_2(\text{O}_2)(\text{OH})_4 \cdot n\text{H}_2\text{O}$ and PhCONH_2
 (b) $\text{NaB(O)(OH)}_2 \cdot n\text{H}_2\text{O}$ and PhCOOH (d) $\text{Na}_2\text{B}_2(\text{O}_2)(\text{OH})_4 \cdot n\text{H}_2\text{O}$ and PhCOOH

(GATE CY 2024)

37. In the EPR spectrum of an aqueous solution of VOSO_4 at room temperature, the total number of hyperfine splitting signals is

(a) 3 (c) 5
 (b) 7 (d) 8

(GATE CY 2024)

38. The hapticity of allyl and Cp and the ligation mode of NO in the thermodynamically stable complexes $[(\eta^x\text{-allyl})\text{Ru}(\text{CO})_2(\text{NO})]$ and $[(\eta^y\text{-Cp})\text{Ru}(\text{CO})_2(\text{NO})]$, respectively, are (The hapticity of allyl and Cp are denoted by η^x and η^y , respectively.)

(a) $(\eta^3, \text{NO-bent})$ and $(\eta^5, \text{NO-linear})$
 (b) $(\eta^3, \text{NO-linear})$ and $(\eta^5, \text{NO-bent})$
 (c) $(\eta^1, \text{NO-bent})$ and $(\eta^3, \text{NO-bent})$
 (d) $(\eta^1, \text{NO-bent})$ and $(\eta^5, \text{NO-linear})$

(GATE CY 2024)

39. In the following reactions, the structures of **I**, **II**, and **III**, respectively, are

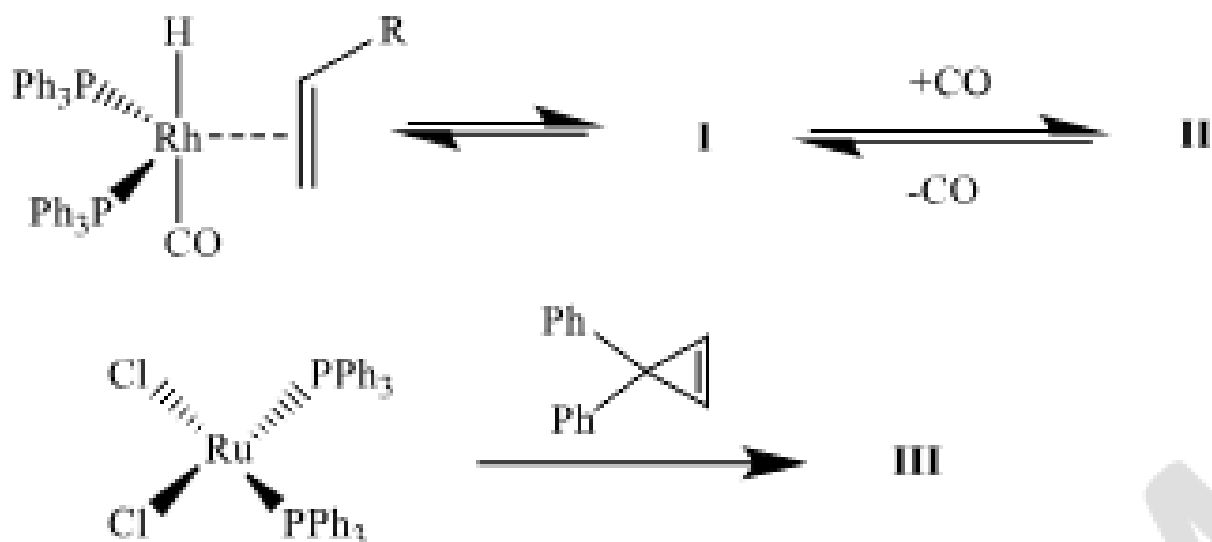


Figure 30: Figure for Q.39

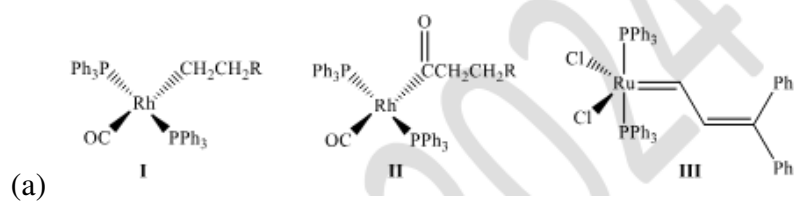


Figure 31: Option A

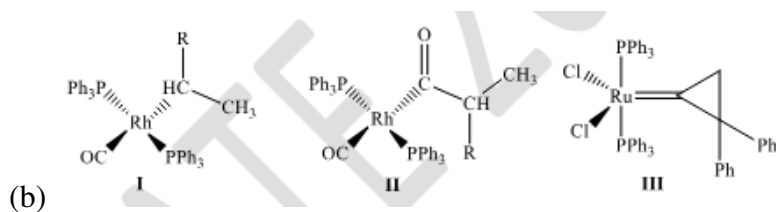


Figure 32: Option B

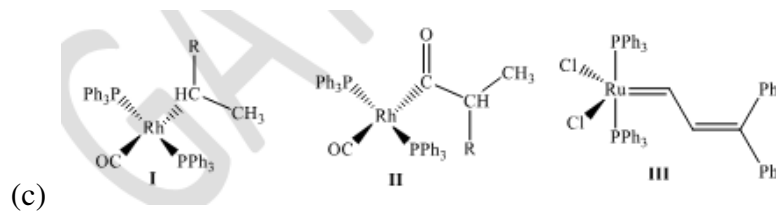


Figure 33: Option C

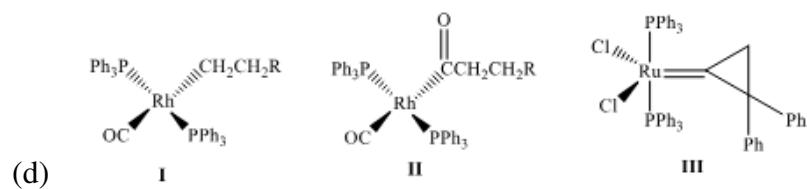


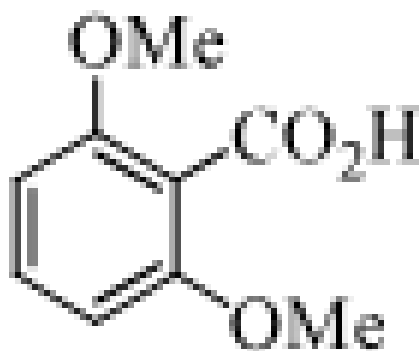
Figure 34: Option D

(GATE CY 2024)

40. Consider the following ^1H NMR (400 MHz, DMSO-d_6) data of a compound:

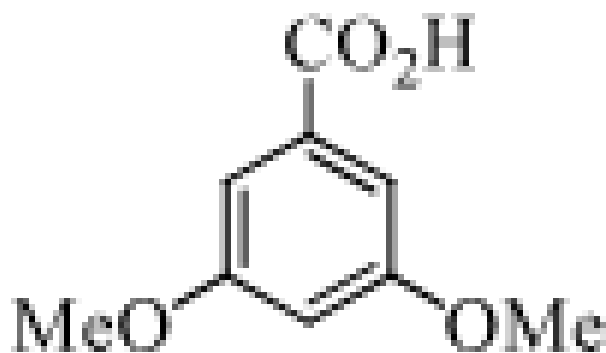
δ in ppm: 3.85 (s, 6H), 6.73 (t, $J = 2.2$ Hz, 1H), 7.1 (d, $J = 2.2$ Hz, 2H), and 13.05 (brs, 1H).

The compound is



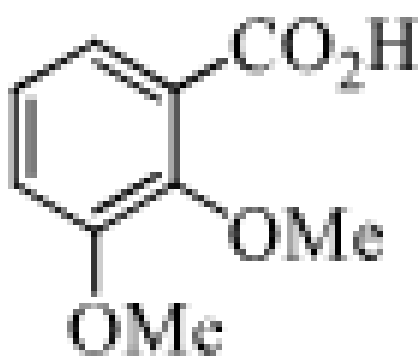
(a)

Figure 35: Option A



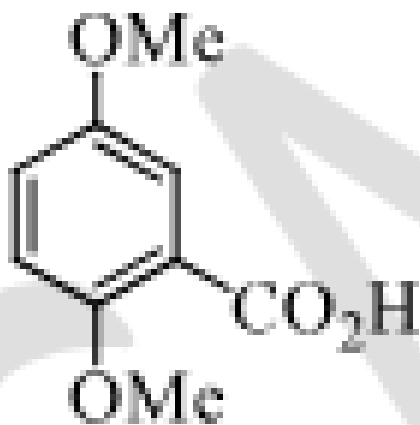
(b)

Figure 36: Option B



(c)

Figure 37: Option C



(d)

Figure 38: Option D

(GATE CY 2024)

41. Fischer presentation of D-(-)-fructose is given below.

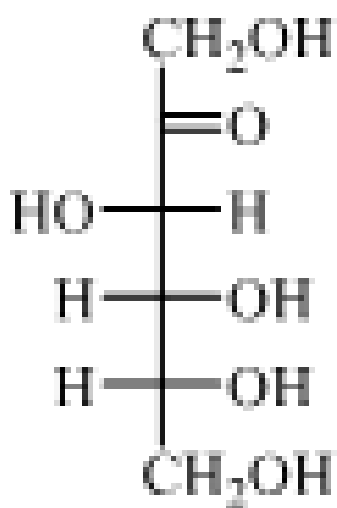


Figure 39: Figure for Q.41

The correct structure of α -L-(+)-fructofuranose is

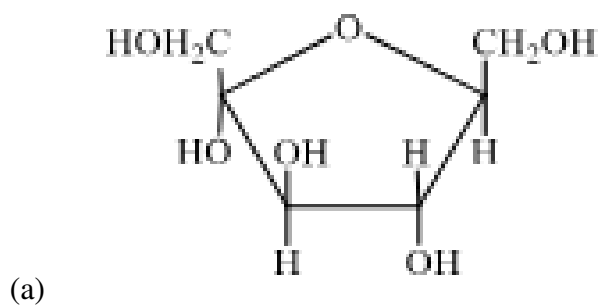


Figure 40: Option A

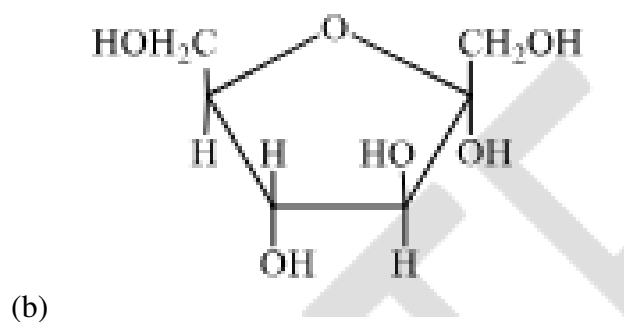


Figure 41: Option B

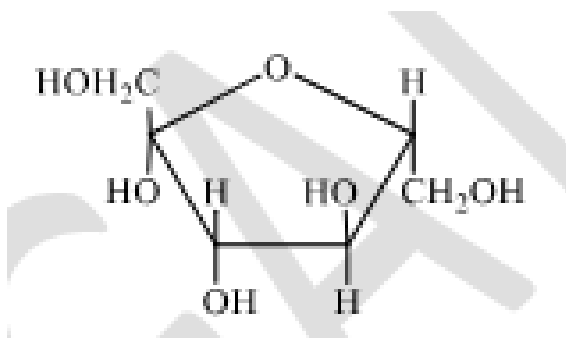


Figure 42: Option C

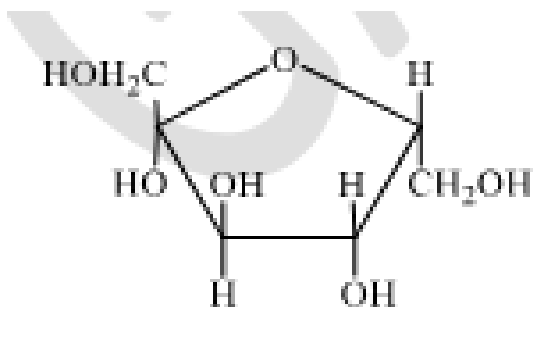


Figure 43: Option D

(GATE CY 2024)

42. The major products X and Y in the following reaction sequence are

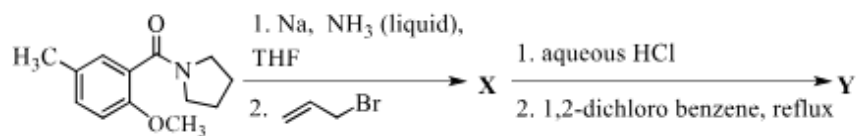


Figure 44: Figure for Q.42

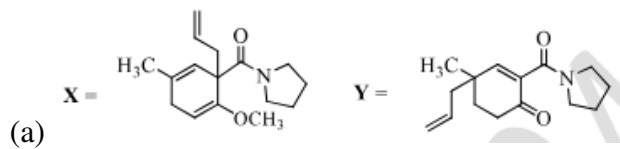


Figure 45: Option A

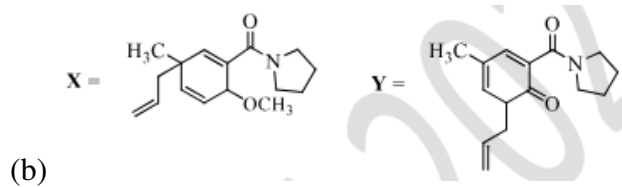


Figure 46: Option B

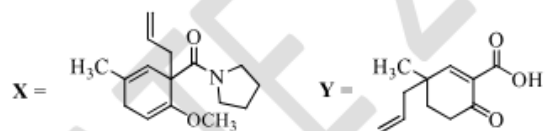


Figure 47: Option C

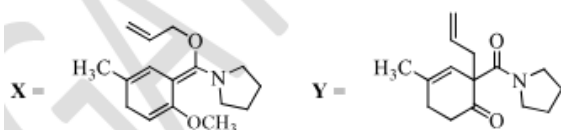


Figure 48: Option D

(GATE CY 2024)

43. The major products **E** and **F** in the following reaction sequence are

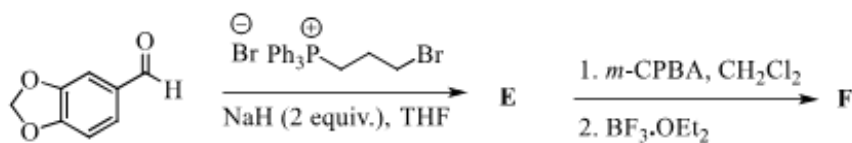


Figure 49: Figure for Q.43



Figure 50: Option A



Figure 51: Option B

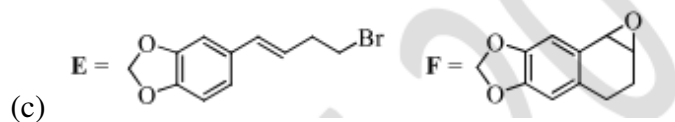


Figure 52: Option C



Figure 53: Option D

(GATE CY 2024)

44. ψ_1, ψ_2, ψ_3 , and ψ_4 are four Hückel molecular orbitals of benzene with orbital energies E_1, E_2, E_3 , and E_4 , respectively.

$$\begin{aligned}\psi_1 &= \frac{1}{2}(\phi_B + \phi_C - \phi_E - \phi_F) \\ \psi_2 &= \frac{1}{6}(\phi_A - \phi_B + \phi_C - \phi_D + \phi_E - \phi_F) \\ \psi_3 &= -\frac{1}{6}(\phi_A + \phi_B + \phi_C + \phi_D + \phi_E + \phi_F) \\ \psi_4 &= \frac{1}{12}(2\phi_A + \phi_B - \phi_C - 2\phi_D - \phi_E + \phi_F)\end{aligned}$$

The correct order of the orbital energies is

(The six carbon atoms of benzene are denoted by A to F and ϕ_J is the $2p_z$ orbital of J^{th} carbon of benzene.)

- | | |
|-----------------------------|-----------------------------|
| (a) $E_1 < E_2 = E_3 < E_4$ | (c) $E_3 < E_1 = E_4 < E_2$ |
| (b) $E_4 < E_1 = E_3 < E_2$ | (d) $E_3 < E_2 < E_1 = E_4$ |

(GATE CY 2024)

45. Consider the following six vibrational modes:

symmetric stretching of CO_2 , O-H symmetric stretching of H_2O , stretching of HCl , stretching of H_2 , N-H symmetric stretching of NH_3 , and bending of CO_2 .

Among these modes, if k number of modes are IR active but Raman inactive, l number of modes are IR inactive but Raman active, and m number of modes are both IR and Raman active.

k , l , and m , respectively, are

- | | |
|-----------------|-----------------|
| (a) 1, 3, and 2 | (c) 1, 2, and 3 |
| (b) 3, 1, and 2 | (d) 2, 1, and 3 |

(GATE CY 2024)

46. The correct statement for a thermally initiated radical polymerization in a solution is:

(Assume: Steady-state and equal reactivity of the propagating radicals, termination reactions are only by combination, and no chain transfer reaction. Given: R_p = rate of polymerization, DP = degree of polymerization, $[I]$ = initiator concentration, and $[M]$ = monomer concentration.)

- (a) with increase in $[I]$, both R_p and DP increase.
- (b) with increase in $[M]$, both R_p and DP increase.
- (c) R_p decreases with increase in $[I]$ but DP increases with increase in $[M]$.
- (d) DP increases with increase in $[I]$ and DP decreases with increase in $[M]$.

(GATE CY 2024)

47. If q_t and $Q_{t,m}$ are the molecular and molar translational partition functions of X_2 , respectively, then $\ln(Q_{t,m}) =$

(N is the Avogadro number)

- (a) $N \ln q_t - N \ln N$
- (b) $N \ln q_t - \ln N$
- (c) $N \ln q_t + \ln N + N$
- (d) $N \ln q_t - \ln N + N$

(GATE CY 2024)

48. Among the following, the NMR active nucleus(nuclei) is (are)

- (a) ^{12}C
- (b) ^{19}F
- (c) ^2H
- (d) ^{16}O

(GATE CY 2024)

49. The complex(es) that exhibit(s) optical isomerism is (are)

- (a) $[\text{Fe}(\text{acac})]_3$
- (b) $\text{cis-}[\text{Co}(\text{en})_2\text{Cl}_2]^+$
- (c) $\text{trans-}[\text{Co}(\text{en})_2\text{Cl}_2]^+$
- (d) $[\text{Co}(\text{en})_3]^{3+}$

(GATE CY 2024)

50. In aqueous solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$, the allowed transition(s) is (are)

- (a) t^5T_{2g} to 3E_g
- (b) $^1A_{1g}$ to $^1T_{1g}$
- (c) $^1A_{1g}$ to $^1T_{2g}$
- (d) $^5T_{2g}$ to 5E_g

(GATE CY 2024)

51. The correct option(s) that give(s) **P** as the major product is (are)

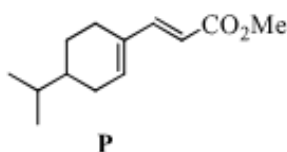


Figure 54: Figure for Q.51

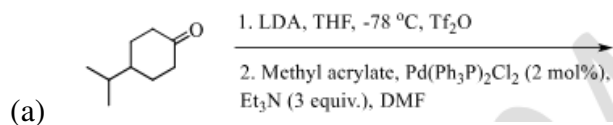


Figure 55: Option A

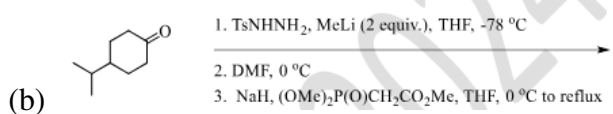


Figure 56: Option B

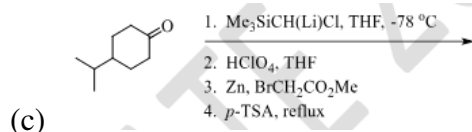


Figure 57: Option C

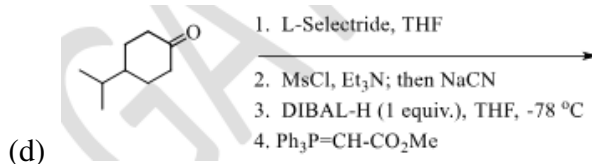


Figure 58: Option D

(GATE CY 2024)

52. The correct statement(s) regarding **P**, **Q**, **R**, and **S** is (are):

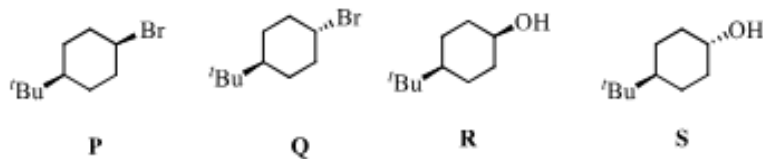


Figure 59: Figure for Q.52

- (a) **P** reacts faster than **Q** with PhSNa in DMF as a solvent.
- (b) **Q** reacts faster than **P** with NaN_3 in DMF as a solvent.
- (c) **R** reacts faster than **S** when treated with $\text{TsCl}/\text{Et}_3\text{N}$ in DCM as a solvent.
- (d) **R** gets oxidized faster than **S** when reacted with CrO_3 in DCM as a solvent.

(GATE CY 2024)

53. Consider the following reaction sequence. The correct option(s) is (are):

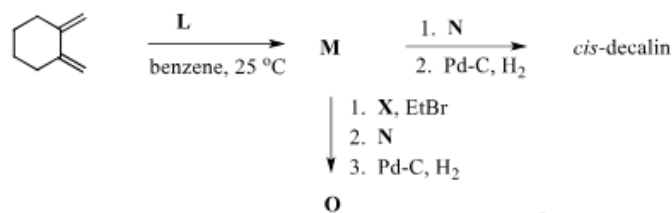


Figure 60: Figure for Q.53

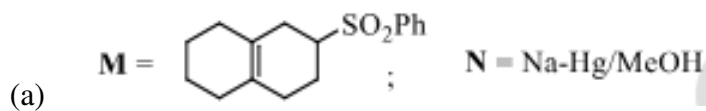


Figure 61: Option A

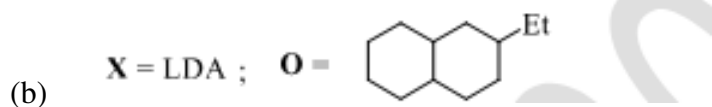


Figure 62: Option B

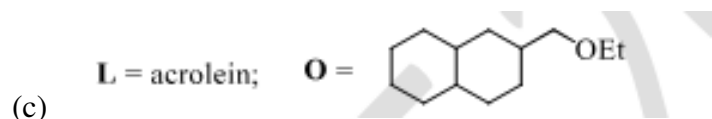
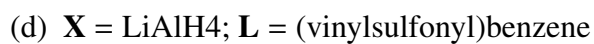


Figure 63: Option C



(GATE CY 2024)

54. Consider the following reaction sequence where **M** and **N** are the major products.

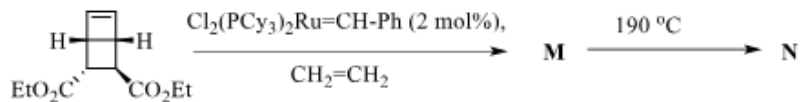
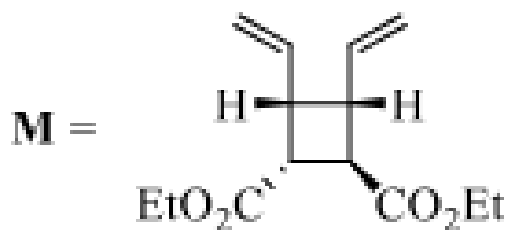


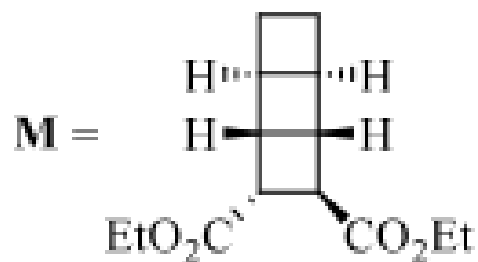
Figure 64: Figure for Q.54

The correct option(s) is (are):



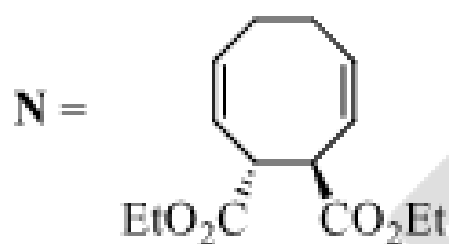
(a)

Figure 65: Option A



(b)

Figure 66: Option B



(c)

Figure 67: Option C



(d)

Figure 68: Option D

(GATE CY 2024)

55. The correct statement(s) about the relationship for the H-atoms in the following compounds is (are):

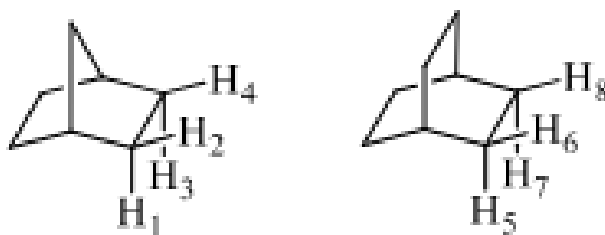


Figure 69: Figure for Q.55

- (a) H_1 and H_3 are enantiotopic; H_2 and H_3 are diastereotopic.
- (b) H_1 and H_3 are diastereotopic; H_2 and H_3 are enantiotopic.
- (c) H_5 and H_7 are enantiotopic; H_6 and H_7 are homotopic.
- (d) H_5 and H_7 are homotopic; H_6 and H_7 are enantiotopic.

(GATE CY 2024)

56. Among the following, the correct statement(s) is (are):

- (a) the normalization factor of a Slater determinant for a 3-electron atom is $\sqrt{\frac{1}{3}}$.
- (b) the number of nodes in the radial wave function of 3s orbital of a hydrogen atom is the same as the number of nodes in the angular wave function of a 4d orbital of hydrogen atom.
- (c) the energy separation between any two adjacent states is same for a harmonic oscillator, while it is different for a rigid rotor.
- (d) the magnitude of the total spin angular momentum of an α electron is the negative of that of a β electron.

(GATE CY 2024)

57. Among the following, the correct statement(s) is (are):

- (a) C_2 symmetry element is present in H_2O and H_2O_2 but NOT in PCl_5 .
- (b) both C_2 and C_3 symmetry elements are present in CCl_4 and SF_6 .
- (c) one σ_h and three σ_d symmetry elements are present in benzene.
- (d) σ_v symmetry element is present in NH_3 but NOT in BF_3 .

(GATE CY 2024)

58. ΔS° (in $J\ mol^{-1}\ K^{-1}$) for the given reaction at 298 K is _____.



(Given: $\log K_1 = 10.6$, where K_1 is the equilibrium constant. $\Delta H^\circ = -54\ kJ\ mol^{-1}$ and $R = 8.314\ J\ mol^{-1}\ K^{-1}$) (rounded off to two decimal places)

(GATE CY 2024)

59. The turnover frequency (in h^{-1}) of a reaction where 5 mol% of a catalyst is required for 90% conversion in 3 h is _____. (rounded off to the nearest integer) (GATE CY 2024)
60. In thermogravimetric analysis, 12.45 mg of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ was subjected to heating under N_2 atmosphere. At a particular temperature, there was a weight loss of 3.6 mg. The number of water molecule(s) lost per formula unit is _____.
(Given: molar mass (in g mol^{-1}) of H = 1.0, O = 16.0, S = 32.0, and Cu = 63.5) (rounded off to the nearest integer) (GATE CY 2024)
61. In the given reaction sequence, the amount of **R** produced (in g) is _____.

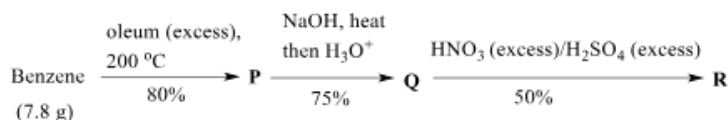


Figure 70: Figure for Q.61

- (Given: molar mass (in g mol^{-1}) of H = 1, C = 12, N = 14, O = 16, and S = 32) (rounded off to two decimal places) (GATE CY 2024)
62. The wave function of a particle in a cubic box (of side L) is given by

$$\psi(x, y, z) = \sqrt{32}/L^3 \sin\left(\frac{\pi x}{L}\right) \cos\left(\frac{\pi x}{L}\right) \sin\left(\frac{2\pi y}{L}\right) \sin\left(\frac{\pi z}{L}\right)$$

The ratio of the energy of the state corresponding to the above wave function to the ground state energy is _____.

(rounded off to the nearest integer)

(GATE CY 2024)

63. ϕ_1 and ϕ_2 are normalized eigenfunctions of a Hermitian operator.

$$|\psi\rangle = 3i|\phi_1\rangle + 2|\phi_2\rangle \text{ and } |x\rangle = -2i|\phi_1\rangle + 5|\phi_2\rangle.$$

The value of $\langle\psi|x\rangle + \langle x|\psi\rangle$ is _____.

(rounded off to the nearest integer)

(GATE CY 2024)

64. 2 mol of a monoatomic ideal gas with initial volume of 5 L and pressure 10 bar undergoes an irreversible adiabatic expansion against a constant final pressure of 1 bar. The final volume (in L) is _____.

(Given: $R = 8.314 \times 10^2 \text{ L bar mol}^{-1} \text{ K}^{-1}$)

(rounded off to one decimal place)

(GATE CY 2024)

65. The following figure shows an experimental liquid-liquid phase diagram of phenol and water at the vapor pressure of the system. The total amount of phenol and water (in mol) present in the phenol-rich phase when 5 mol of water was shaken with 5 mol of phenol at 40°C is _____.

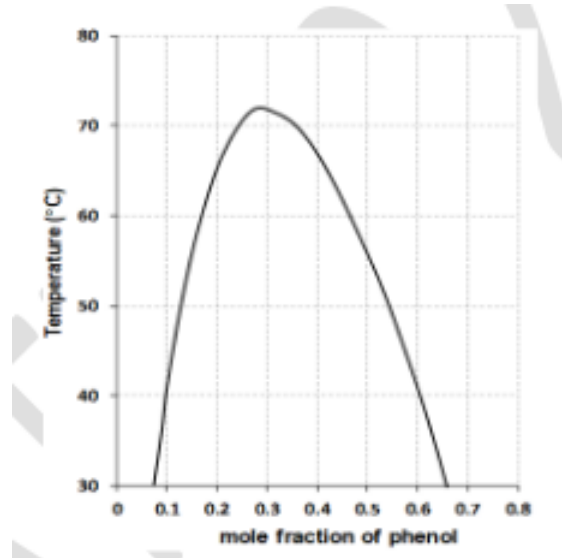


Figure 71: Phase diagram for Q.65

(rounded off to one decimal place)

(GATE CY 2024)