ASSIGNMENT 3: GATE 2015 CY: CHEMISTRY

AI25BTECH11021 - Abhiram Reddy N

August 17, 2025

Graduate Aptitude Test In Engineering

Notations :

1. Options shown in green color and with ✓ icon are correct.

2. Options shown in red color and with ✗ icon are incorrect.

Question Paper Name: CY: CHEMISTRY 31st Jan Shift1 **Number of Questions:** 65 **Total Marks:** 100.0

Wrong answer for MCQ will result in negative marks, (-1/3) for 1 mark Questions and (-2/3) for 2 marks Questions.

General Aptitude
Number of Questions: 10
Section Marks: 15.0

Q.1 to Q.5 carry 1 mark each & Q.6 to Q.10 carry 2 marks each.

1. Choose the most appropriate word from the options given below to complete the following sentence.

   The principal presented the chief guest with a _____, as token of appreciation.

   (**GATE CY 2015**)

   (a) ✗ A momento   (b) ✓ B memento   (c) ✗ C momentum   (d) ✗ D moment

2. Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence:

   Frogs _____

   (**GATE CY 2015**)

(a) ✓ A croak   (b) ✗ B roar   (c) ✗ C hiss   (d) ✗ D patter

3. Choose the word most similar to the given word :

   Educe

   (GATE CY 2015)

   (a) ✓ Exert   (b) ✗ Educate   (c) ✗ Extract   (d) ✗ Extend

4. Operators $\square$, $\diamond$ and $\rightarrow$ are defined by: $a \square b = \frac{a-b}{a+b}$; $a \diamond b = \frac{a+b}{a-b}$; $a \rightarrow b = ab$.

   Find the value of $(66 \square 6) \rightarrow (66 \diamond 6)$.

   (GATE CY 2015)

   (a) ✗ -2   (b) ✗ -1   (c) ✓ 1   (d) ✗ 2

5. If $\log_x(5/7) = -1/3$, then the value of x is

   (GATE CY 2015)

   (a) ✓ 343/125   (b) ✗ 125/343   (c) ✗ -25/49   (d) ✗ -49/25

6. The following question presents a sentence, part of which is underlined. Beneath the sentence you find four ways of phrasing the underlined part. Following the requirements of the standard written English, select the answer that produces the most effective sentence.

   Tuberculosis, together with its effects, **ranks one of the leading causes of death** in India.

   (GATE CY 2015)

   (a) ✓ ranks as one of the leading causes of death   (b) ✗ rank as one of the leading causes of death   (c) ✗ has the rank of one of the leading causes of death   (d) ✗ are one of the leading causes of death

7. Read the following paragraph and choose the correct statement.

   Climate change has reduced human security and threatened human well being. An ignored reality of human progress is that human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security. To keep up both at the required level is a challenge to be addressed by one and all. One of the ways to curb the climate change may be suitable scientific innovations, while the other may be the Gandhian perspective on small scale progress with focus on sustainability.

   (GATE CY 2015)

   (a) ✗ Human progress and security positively associated with environmental security.
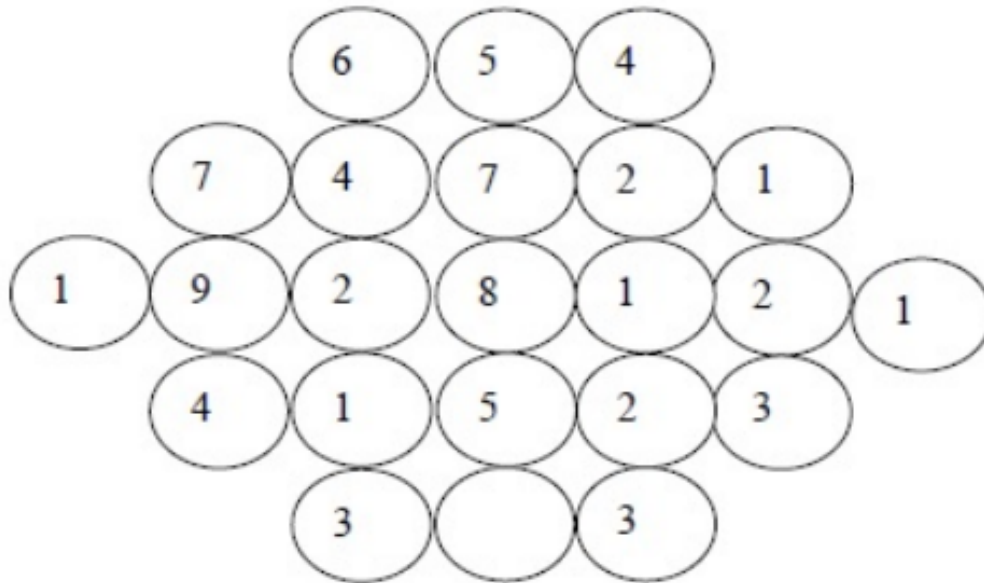
   (b) ✓ Human

Figure 1:

progress is con-   (c) ✗ Human secu-   rity.   pends upon en-
tradictory   to   rity is contra-   vironmental se-
environmental   dictory to envi-   (d) ✗   Human   curity.
security.   ronmental secu-   progress   de-

8. Fill in the missing value

   Correct Answer : 3

9. A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the propor-
   tion of the number of faces of the smaller cubes visible to those which are NOT visible.

   (GATE CY 2015)

   (a) ✗ 1 : 4   (b) ✗ 1 : 3   (c) ✓ 1 : 2   (d) ✗ 2 : 3

10. Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks.
    A person sitting on the wall falls if the wall breaks.

    Which one of the statements below is logically valid and can be inferred from the above
    sentences?

    (GATE CY 2015)

(a) ✗ A) Humpty Dumpty always falls while having lunch

(b) ✓ B) Humpty Dumpty does not fall sometimes while having lunch

(c) ✗ C) Humpty Dumpty never falls during dinner

(d) ✗ D) When Humpty Dumpty does not sit on the wall, the wall does not break
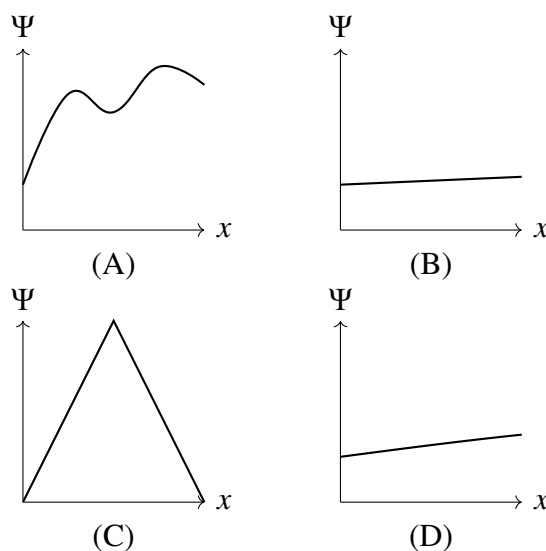
Chemistry
Number of Questions: 55
Section Marks: 85.0

Q.11 to Q.35 carry 1 mark each & Q.36 to Q.65 carry 2 marks each.

11. Which one of the following plots represents an acceptable wavefunction?

(GATE CY 2015)

(a) ✗ A

(b) ✗ B

(c) ✗ C

(d) ✓ D

12. When the operator, $-\hbar^2 \frac{d^2}{dx^2}$, operates on the function e^{-ikx}, the result is

(GATE CY 2015)

(a) ✓ (A) $\hbar^2 k^2 e^{-ikx}$

(b) ✗ (B) $ik\hbar^2 e^{-ikx}$

(c) ✗ (C) $\hbar^2 e^{-ikx}$

(d) ✗ (D) $\hbar^2 e^{-ikx}$

13. From the above Carnot cycle undergone by an ideal gas, identify the processes in which the change in internal energy is **NON-ZERO**.
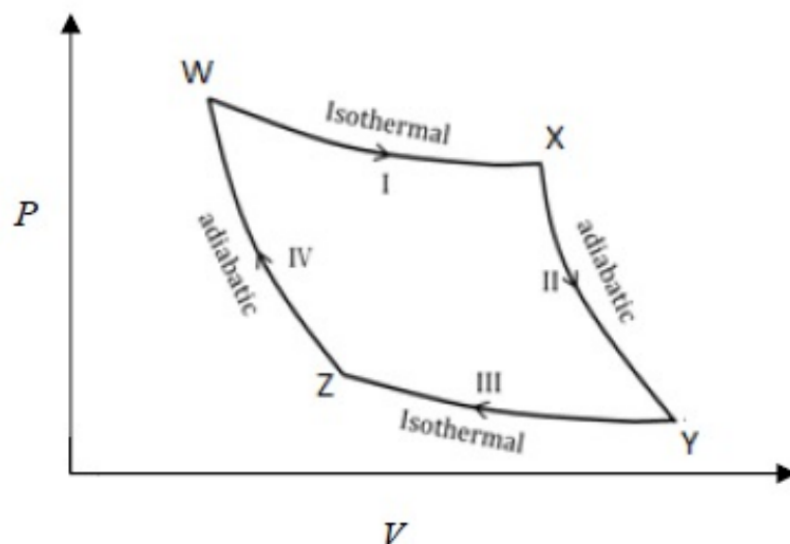
(GATE CY 2015)

Figure 2:

(a) ✗ I and II

(c) ✗ II and III

(b) ✓ II and IV

(d) ✗ I and IV

14. For an ideal gas with molar mass M, the molar translational entropy at a given temperature is proportional to

(GATE CY 2015)

(a) ✗ $M^{3/2}$

(c) ✗ e^M

(b) ✗ $M^{1/2}$

(d) ✓ $\ln(M)$

15. Which one of the following defines the absolute temperature of a system?

(GATE CY 2015)

(a) ✓ $\left(\frac{\partial U}{\partial S}\right)_V$

(c) ✗ $\left(\frac{\partial H}{\partial S}\right)_V$

(b) ✗ $\left(\frac{\partial A}{\partial S}\right)_V$

(d) ✗ $\left(\frac{\partial G}{\partial S}\right)_V$

16. Which of the following properties are characteristic of an ideal solution?

   (i) $\Delta_{\text{mix}}G_{T,P}$ is negative

   (ii) $\Delta_{\text{mix}}S_{T,P}$ is positive

   (iii) $\Delta_{\text{mix}}V_{T,P}$ is positive

(iv) $\Delta_{\text{mix}} H_{T,P}$ is negative

(A) (i) and (iv)   (B) (i) and (ii)   (C) (i) and (iii)   (D) (iii) and (iv)
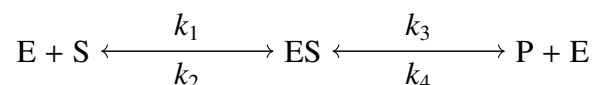
(GATE CY 2015)

(a) ✗ A

(b) ✓ B

(c) ✗ C

(d) ✗ D

17. The expression for the equilibrium constant (K_{eq}) for the enzyme-catalyzed reaction is given below.

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \underset{k_4}{\overset{k_3}{\rightleftharpoons}} P + E$$

(GATE CY 2015)

(a) ✓ $\dfrac{k_1 k_3}{k_2 k_4}$

(b) ✗ $\dfrac{k_1 k_2}{k_3 k_4}$

(c) ✗ $\dfrac{k_3 k_2}{k_1 k_4}$

(d) ✗ $\dfrac{k_1 k_4}{k_2 k_3}$

18. Given the E^0 values for the following reaction sequence,

$$Mn^{6+} \xrightarrow{1.28\ V} Mn^{5+} \xrightarrow{2.9\ V} Mn^{4+} \xrightarrow{0.96\ V} Mn^{3+} \xrightarrow{1.5\ V} Mn^{2+}$$

The computed value of E^0 for $Mn^{6+} \rightarrow Mn^{2+}$ (in volts) is _____

(GATE CY 2015)

Correct answer:
1.6 to 1.7

19. The absorption spectrum of $[Ti(H_2O)_6]^{3+}$ in solution comprises of a maximum with a shoulder. The reason for the shoulder is

(a) ligand-to-metal charge transfer (LMCT)

(b) metal-to-ligand charge transfer (MLCT)

(c) Jahn-Teller distortion

(d) nephelauxetic effect

(GATE CY 2015)

(a) ✗A

(b) ✗B

(c) ✓C

(d) ✗D

20. The ease of formation of the adduct, $NH_3 \cdot BX_3$ (where, X = F, Cl, Br) follows the order

    (a) $BBr_3 ¡ BCl_3 ¡ BF_3$

    (b) $BCl_3 ¡ BF_3 ¡ BBr_3$

    (c) $BF_3 ¡ BCl_3 ¡ BBr_3$

    (d) $BBr_3 ¡ BF_3 ¡ BCl_3$

                                                                              (**GATE CY 2015**)

    (a) ✗A   (c) ✓C

    (b) ✗B   (d) ✗D

21. An efficient catalyst for hydrogenation of alkenes is $[Rh(PPh_3)_3Cl]$. However, $[Ir(PPh_3)_3Cl]$ does not catalyze this reaction, because

    (a) PPh_3 binds stronger to Ir than to Rh

    (b) Cl binds stronger to Ir than to Rh

    (c) PPh_3 binds stronger to Rh than to Ir

    (d) Cl binds stronger to Rh than to Ir

                                                                              (**GATE CY 2015**)

    (a) ✓A   (c) ✗C

    (b) ✗B   (d) ✗D

22. Among the given pH values, the O_2 binding efficiency of heamoglobin is maximum at

    (a) 6.8

    (b) 7.0

    (c) 7.2

    (d) 7.4

                                                                              (**GATE CY 2015**)

    (a) ✗A   (c) ✗C

    (b) ✗B   (d) ✓D

23. The intense red color of $[Fe(bpy)_3]^{2+}$ (bpy = 2,2'-bipyridine) is due to

    (a) metal-to-ligand charge transfer (MLCT)

    (b) ligand-to-metal charge transfer (LMCT)

    (c) d-d transition

    (d) inter-valence charge transfer (IVCT)

                                                                              (**GATE CY 2015**)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

24. The compound with planar geometry is

   (a) N(t-Bu)$_3$

   (b) NPh$_3$

   (c) NF$_3$

   (d) N(SiH$_3$)$_3$

<div align="right">(GATE CY 2015)</div>

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

25. The electrical conductivity of a metal

   (a) increases with increasing temperature

   (b) decreases with increasing temperature

   (c) is independent of temperature

   (d) shows oscillatory behaviour with temperature

<div align="right">(GATE CY 2015)</div>

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

26. Which one of the following statements is **INCORRECT**?

   (a) Frenkel defect is a cation vacancy and a cation interstitial.

   (b) Frenkel defect is an anion vacancy and a cation interstitial.

   (c) Density of a solid remains unchanged in case of Frenkel defects.

   (d) Density of a solid decreases in case of Schottky defects.

<div align="right">(GATE CY 2015)</div>

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

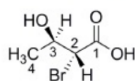27. The absolute configuration of C2 and C3 in the following compound is

Figure 3:

(a) $2R, 3S$

(b) $2S, 3R$

(c) $2S, 3S$

(d) $2R, 3R$

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

28. Among the following compounds, the one that is non-aromatic, is

Figure 4:

(a) A

(b) B

(c) C

(d) D

(GATE CY 2015)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

29. The correct order of reactivity of *p*-halonitrobenzenes in the following reaction is
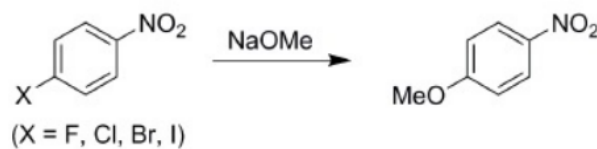
Figure 5:

(a) p-chloronitrobenzene > p-iodonitrobenzene > p-fluoronitrobenzene > p-bromonitrobenzene

(b) p-fluoronitrobenzene > p-chloronitrobenzene > p-bromonitrobenzene > p-iodonitrobenzene

(c) p-iodonitrobenzene > p-bromonitrobenzene > p-chloronitrobenzene > p-fluoronitrobenzene

(d) p-bromonitrobenzene > p-fluoronitrobenzene > p-iodonitrobenzene > p-chloronitrobenzene

(**GATE CY 2015**)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

30. Tollen's test is **NEGATIVE** for

(a) mannose

(b) maltose

(c) glucose

(d) sucrose

(**GATE CY 2015**)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

31. The compound given below is a

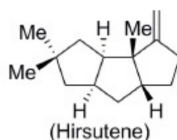Figure 6: Structure of Hirsutene

(a) sesterterpene

(b) monoterpene

(c) sesquiterpene

(d) triterpene

(**GATE CY 2015**)

(a) ✗A   (c) ✓C

(b) ✗B   (d) ✗D

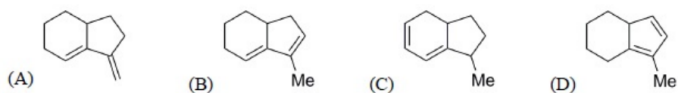32. Amongst the following, the compound that **DOES NOT** act as a diene in Diels-Alder reaction is

Figure 7: Options for DielsâAlder reaction diene

(a) A

(b) B

(c) C

(d) D

(**GATE CY 2015**)

(a) ✗A   (c) ✓C

(b) ✗B   (d) ✗D
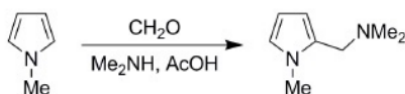
33. The following conversion is an example of

Figure 8: Reaction conversion involving hydrazone and Me_2NH

(a) Arndt-Eistert homologation

(b) Mannich reaction

(c) Michael addition

(d) Chichibabin amination reaction

(**GATE CY 2015**)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

34. The mass spectrum of a dihalo compound shows peaks with relative intensities of 1:2:1 corresponding to M, M+2 and M+4 (M is the mass of the molecular ion), respectively. The compound is
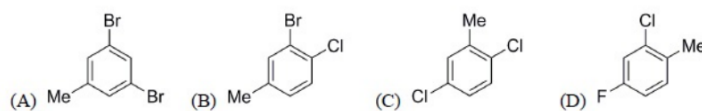
Figure 9: Structures of dihalo compounds

(a) A

(b) B

(c) C

(d) D

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

35. Reaction of benzaldehyde and p-methylbenzaldehyde under McMurry coupling conditions ($TiCl_4$ and $LiAlH_4$) gives a mixture of alkenes. The number of alkenes formed is _____.

Correct Answer : 6

36. The difference in the ground state energies (kJ/mol) of an electron in one-dimensional boxes of lengths 0.2 nm and 2 nm is _____.

Correct Answer : 880 to 900

37. The mean ionic activity coefficient of 0.001 molal $ZnSO_4$ (aq) at 298 K according to the Debye-Huckel limiting law is (Debye-Huckel constant is 0.509 $mol^{-1/2}$) _____

Correct Answer : 0.73 to 0.75

38. The process given below follows the Langmuir adsorption isotherm.

$$A_2\,(g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2\,A_{ads}$$

Figure 10: Langmuir adsorption equilibrium for $A_2(g)$ on surface

If θ denotes the surface coverage and P denotes the pressure, the slope of the plot of $1/\theta$ versus $1/P$ is

(a) $1/(K_{eq})^2$

(b) $1/K_{eq}$

(c) $-1/K_{eq}$

(d) $1/(K_{eq})^{1/2}$

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

39. For a gas phase unimolecular reaction at temperature 298 K, with a pre-exponential factor of 2.17×10^{13} s^{-1}, the entropy of activation (J K^{-1} mol^{-1}) is _____

(GATE CY 2015)

Correct Answer : 102 to 106

40. A liquid has vapor pressure of 2.02×10^3 N m^{-2} at 293 K and heat of vaporization of 41 kJ mol^{-1}. The boiling point of the liquid (in Kelvin) is _____

(GATE CY 2015)

Correct Answer : 380 to 385

41. The rotational partition function of a diatomic molecule with energy levels corresponding to $J = 0$ and 1, is (where ε is a constant)

(a) $1 + 2e^{-\varepsilon}$

(b) $1 + 3e^{-3\varepsilon}$

(c) $1 + e^{-3\varepsilon}$

(d) $1 + 3e^{-\varepsilon}$

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

42. The internal energy of an ideal gas follows the equation $U = 3.5\,PV + k$, where k is a constant. The gas expands from an initial volume of 0.25 m^3 to a final volume of 0.86 m^3. If the initial pressure is 5 N m^{-2}, the change in internal energy (in Joules) is (given $PV^{1.3}$ = constant) _____

(GATE CY 2015)

Correct Answer : -1.38 to -1.33

43. The solubility product of AgBr(s) is 5×10^{-13} at 298 K. If the standard reduction potential of the half-cell, $E^\circ_{Ag^+|AgBr(s)|Br^-}$ is 0.07 V, the standard reduction potential, $E^\circ_{Ag^+|Ag}$ (in volts) is _____

(GATE CY 2015)

Correct Answer : 0.79 to 0.82

44. One mole of a substance is heated from 300 K to 400 K at constant pressure. The C_P of the substance is given by, C_P (J K^{-1}mol^{-1}) = $5 + 0.1\,T$. The change in entropy, in J K^{-1}mol^{-1}, of the substance is _____

(GATE CY 2015)

Correct Answer : 11.3 to 11.5

45. The potential energy (PE) versus reaction coordinate diagrams for electron transfer reactions with rate constants k_1, k_2, and k_3 are given below. The increasing order of the rate constants is
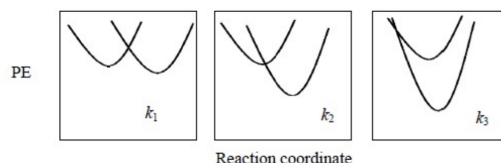

Figure 11: Potential energy diagrams for reactions with rate constants k_1, k_2, and k_3

(a) $k_3 < k_2 < k_1$

(b) $k_2 < k_1 < k_3$

(c) $k_1 < k_3 < k_2$

(d) $k_3 < k_1 < k_2$

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

46. The distance between two successive (110) planes in a simple cubic lattice with lattice parameter a is

(a) $\sqrt{2}\,a$

(b) $\sqrt{3}\,a$

(c) $2\sqrt{2}\,a$

(d) $\dfrac{a}{\sqrt{2}}$

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

47. The percent transmittance of 8×10^{-5} M solution of $KMnO_4$ is 39.8 when measured at 510 nm in a cell of path length of 1 cm. The absorbance and the molar extinction coefficient (in M^{-1} cm^{-1}) of this solution are, respectively

   (a) 0.30 and 4500

   (b) 0.35 and 4800

   (c) 0.4 and 5000

   (d) 0.48 and 5200

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

48. The value of âgâ and the number of signals observed for the reference standard, diphenylpicryl-hydrazyl (DPPH), in the solid state ESR spectrum are, respectively,

   (a) 2.0036 and 1

   (b) 2.0036 and 3

   (c) 2.2416 and 1

   (d) 2.2416 and 3

(GATE CY 2015)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

49. Ammonolysis of S_2Cl_2 in an inert solvent gives

   (a) S_2N_2

   (b) $S_2N_2Cl_2$

   (c) $S_2N_2H_4$

   (d) S_4N_4

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

50. The complexes $K_2[NiF_6]$ and $K_3[CoF_6]$ are

   (a) both paramagnetic

   (b) both diamagnetic

   (c) paramagnetic and diamagnetic, respectively

   (d) diamagnetic and paramagnetic, respectively

                                                                        (**GATE CY 2015**)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

51. The point group of IF_7 is

   (a) D_{6h}

   (b) D_{5h}

   (c) C_{6v}

   (d) C_{5v}

                                                                        (**GATE CY 2015**)

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

52. When one CO group is replaced by PPh_3 in $[Cr(CO)_6]$, which one of the following statements is **TRUE**?

   (a) The Cr-C bond length increases and CO bond length decreases

   (b) The Cr-C bond length decreases and CO bond length decreases

   (c) The Cr-C bond length decreases and CO bond length increases

   (d) The Cr-C bond length increases and CO bond length increases

                                                                        (**GATE CY 2015**)

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

53. Identify X in the reaction, $[Pt(NH_3)_4]^{2+} + 2\,HCl \rightarrow X$

(a) cis-[$PtCl_2(NH_3)_2$]

(b) trans-[$PtCl_2(NH_3)_2$]

$PtCl(NH_3)^+$

$PtCl_2(NH_3)^+$

(GATE CY 2015)

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

54. Identify the function of hemocyanin and the metal responsible for it.

   (a) O_2 transport and Fe

   (b) O_2 transport and Cu

   (c) electron transport and Fe

   (d) electron transport and Cu

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

55. The limiting current (in μA) from the reduction of 3×10^{-4} M Pb^{2+} using a dropping mercury electrode (DME) with characteristics, $m = 3.0$ mg s^{-1} and $t = 3$ s, is (diffusion coefficient of $Pb^{2+} = 1.2 \times 10^{-5}$ cm^2 s^{-1})

(GATE CY 2015)

Correct Answer : 3.5 to 3.8

56. The number of possible stereoisomers obtained in the following reaction is
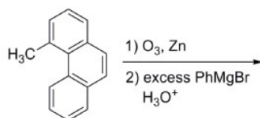
Figure 12: Structure for stereoisomeric product question

(GATE CY 2015)

Correct Answer : 8

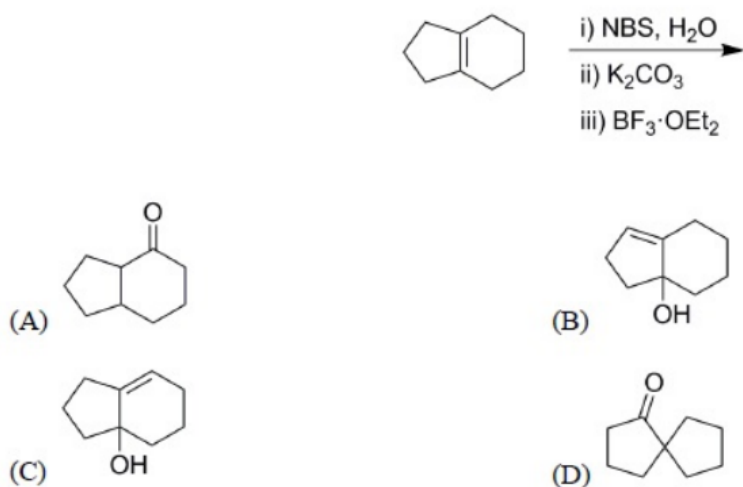57. The major product formed in the following reaction is

i) NBS, H₂O
ii) K₂CO₃
iii) BF₃·OEt₂

(A)

(B)   OH

(C)   OH

(D)

Figure 13: Reaction with NBS, H₂O, K₂CO₃, BF₃.OEt₂

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

58. The most suitable reagent(s) to effect the following transformation is
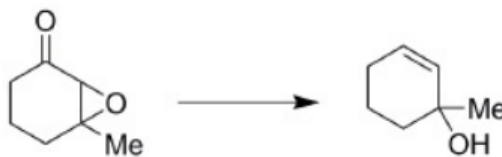
Figure 14: Reduction and transformation of cyclic ketone

(a) N₂H₄, KOH, heat

(b) TsNHNH₂, CF₃COOH

(c) LiAlH₄

(d) Na, liq. NH₃

(GATE CY 2015)

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

59. The major product formed in the following reaction is
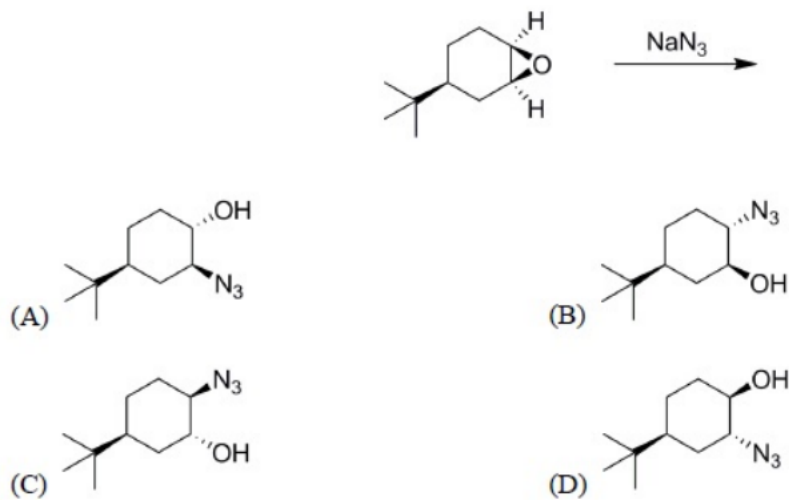
Figure 15: Reaction of cyclohexane derivative with NaN_3

(a) ✗A   (c) ✗C

(b) ✗B   (d) ✓D

60. Solvolysis of the optically active compound **X** gives, mainly
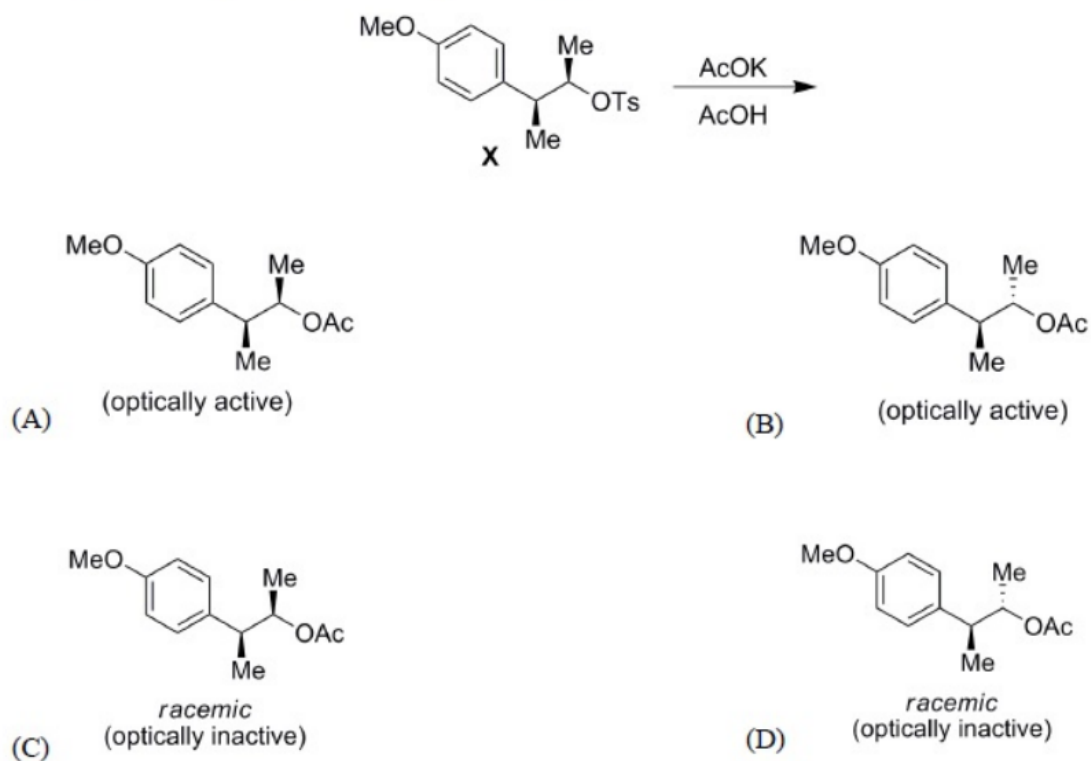
Figure 16: Solvolysis reaction of optically active compound X

(a) ✗A   (c) ✓C

(b) ✗B   (d) ✗D
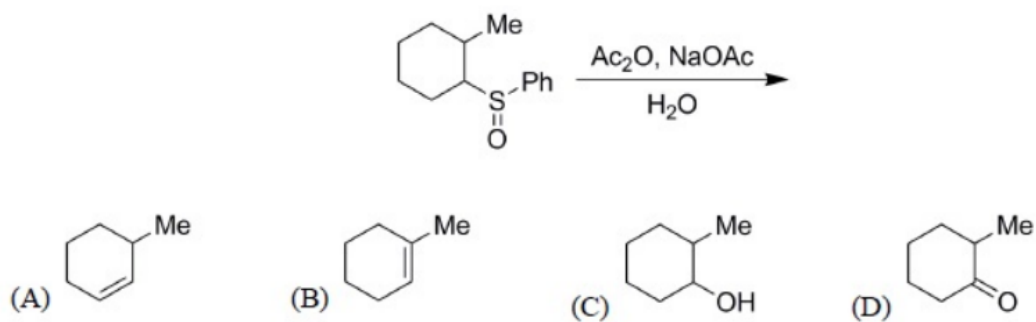
61. The major product formed in the following reaction is

Figure 17: Reaction showing formation of major product

(a) ✗A (c) ✗C

(b) ✗B (d) ✓D

62. The tetrapeptide, Ala-Val-Phe-Met, on reaction with Sanger's reagent, followed by hydrolysis gives

Figure 18: Tetrapeptide reaction with Sanger's reagent and hydrolysis

(a) ✗A (c) ✓C

(b) ✗B (d) ✗D

63. The major product formed in the following reaction is

Figure 19: Reaction showing formation of major product

(a) ✗A   (c) ✗C

(b) ✓B   (d) ✗D

64. The Beckmann rearrangement of a bromoacetophenone oxime (C_8H_8BrNO) gives a major product having the following ^1H NMR (δ, ppm): 9.89 (s, 1H), 7.88 (s, 1H), 7.45 (d, 1H, J = 7.2 Hz), 7.17 (m, 1H), 7.12 (d, 1H, J = 7.0 Hz), 2.06 (s, 3H). The structure of the product is
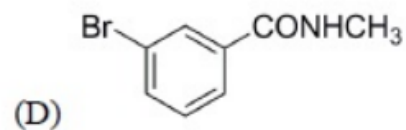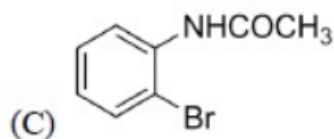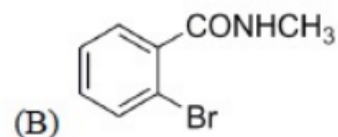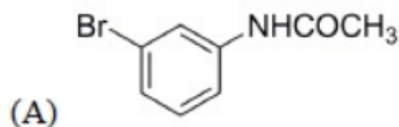

Figure 20: Beckmann rearrangement product

(a) ✓A   (c) ✗C

(b) ✗B   (d) ✗D

65. The major products, **K** and **L** formed in the following reactions are

Figure 21: Major products K and L

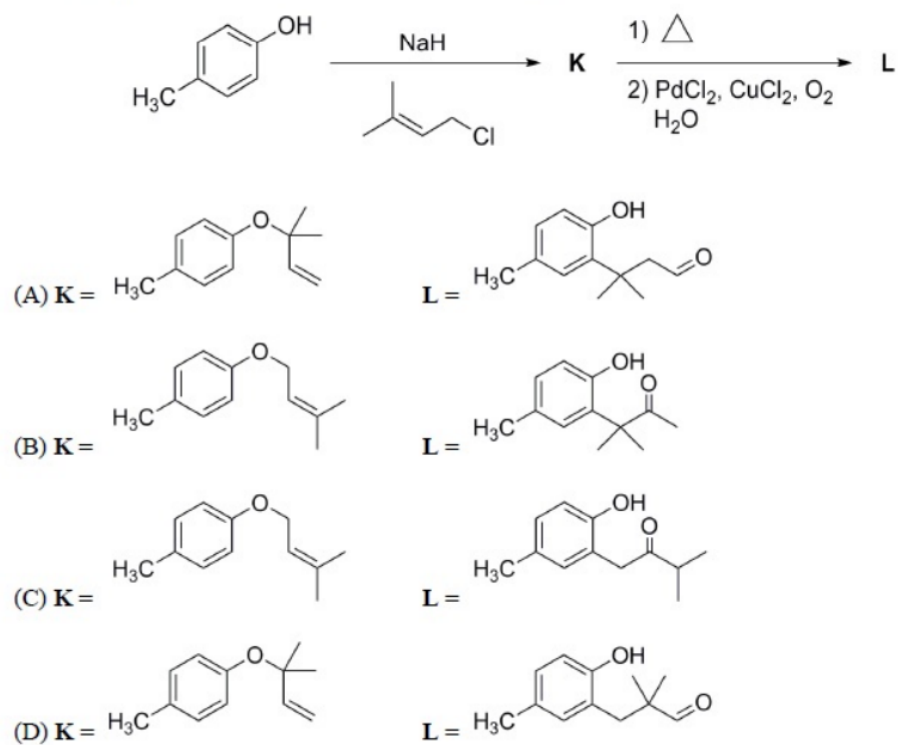(a) ✗A   (c) ✗C
(b) ✓B   (d) ✗D

END OF THE QUESTION PAPER