GATE CY 2020 questions

EE25BTECH11010-ARSH DHOKE

GA - General Aptitude

Q1 - Q5 carry one mark each.

1. While I agree _____ his proposal this time, I do not often agree _____ him.

   (a) to, with
   (b) with, to
   (c) with, with
   (d) to, to

   (GATE CY 2020)

2. The recent measures to improve the output would _____ the level of production to our satisfaction.

   (a) increase
   (b) decrease
   (c) speed
   (d) equalise

   (GATE CY 2020)

3. Select the word that fits the analogy:

   White: Whitening :: Light: _____

   (a) Lightning
   (b) Lightening
   (c) Lighting
   (d) Enlightening

   (GATE CY 2020)

4. In one of the greatest innings ever seen in 142 years of Test history, Ben Stokes upped the tempo in a five-and-a-half hour long stay of 219 balls including 11 fours and 8 sixes that saw him finish on 135 not out as England squared the five-match series.

   Based on their connotations in the given passage, which one of the following meanings DOES NOT match?

(a) upped = increased

(b) squared = lost

(c) tempo = enthusiasm

(d) saw = resulted in

(GATE CY 2020)

5. There are five levels {P, Q, R, S, T} in a linear supply chain before a product reaches customers, as shown in the figure.

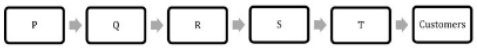


Figure 1: Figure for Q.5

At each of the five levels, the price of the product is increased by 25%. If the product is produced at level P at the cost of Rs. 120 per unit, what is the price paid (in rupees) by the customers?

(a) 187.50

(b) 234.38

(c) 292.96

(d) 366.21

(GATE CY 2020)

Q6 - Q10 carry two marks each.

6. Climate change and resilience deal with two aspects – reduction of sources of non-renewable energy resources and reducing vulnerability of climate change aspects. The terms 'mitigation' and 'adaptation' are used to refer to these aspects, respectively.

Which of the following assertions is best supported by the above information?

(a) Mitigation deals with consequences of climate change.

(b) Adaptation deals with causes of climate change.

(c) Mitigation deals with actions taken to reduce the use of fossil fuels.

(d) Adaptation deals with actions taken to combat green-house gas emissions.

(GATE CY 2020)

7. Find the missing element in the following figure.

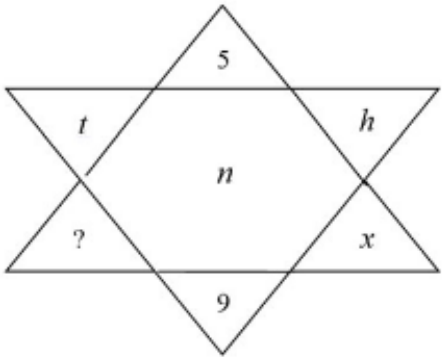


Figure 2: Figure for Q.7

(a) d
(b) e
(c) w
(d) y

(GATE CY 2020)

8. It was estimated that 52 men can complete a strip in a newly constructed highway connecting cities P and Q in 10 days. Due to an emergency, 12 men were sent to another project. How many number of days, more than the original estimate, will be required to complete the strip?

(a) 3 days
(b) 5 days
(c) 10 days
(d) 13 days

(GATE CY 2020)

9. An engineer measures THREE quantities X, Y and Z in an experiment. She finds that they follow a relationship that is represented in the figure below: (the product of X and Y linearly varies with Z)

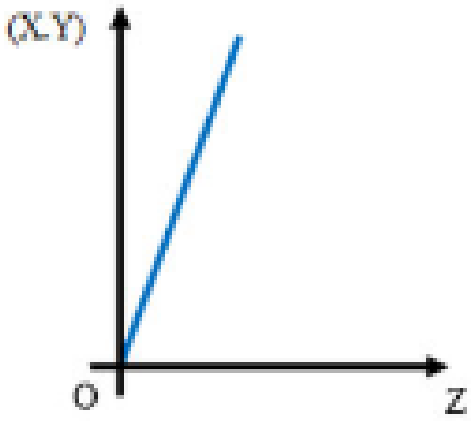


Figure 3: Figure for Q.9

Then, which of the following statements is FALSE?

(a) For fixed Z, X is proportional to Y

(b) For fixed Y, X is proportional to Z

(c) For fixed X, Z is proportional to Y

(d) XY/Z is constant

(GATE CY 2020)

10. The two pie-charts given below show the data of total students and only girls registered in different streams in a university. If the total number of students registered in the university is 5000, and the total number of registered girls is 1500, then, the ratio of boys enrolled in Arts to the girls enrolled in Management is _____.

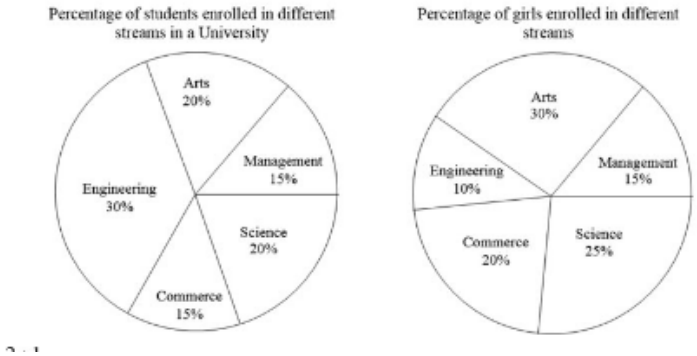


Figure 4: Figure for Q.10

(a) 2 : 1

(b) 9 : 22

(c) 11 : 9

(d) 22 : 9

(GATE CY 2020)

CY: Chemistry

Q1 - Q25 carry one mark each.

1. Among the following, the suitable reagents for the given transformation is:

Figure 5: Figure for Q.1

(a) H_2, Pd / C

(b) $H_2N–NH_2$ / KOH, Δ

(c) $NaBH_4$ / $CeCl_3 \cdot 7H_2O$

(d) Li / Liq. NH_3

(GATE CY 2020)

2. Major product formed in the following reaction sequence is:

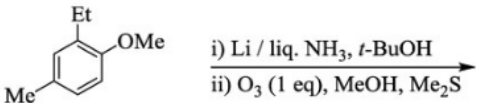


Figure 6: Figure for Q.2

(a)

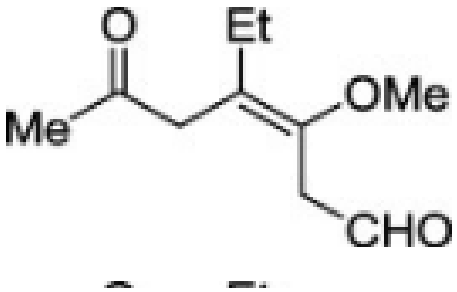


Figure 7: Option A

(b)

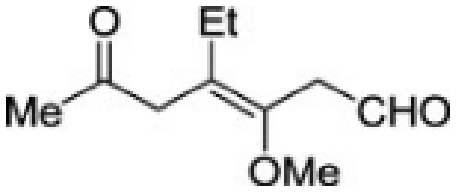


Figure 8: Option B

(c)

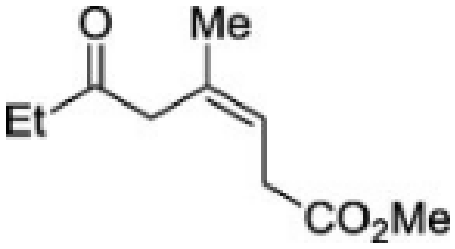


Figure 9: Option C

(d)

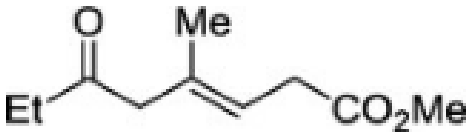


Figure 10: Option D

(GATE CY 2020)

3. Major product formed in the following reaction is:

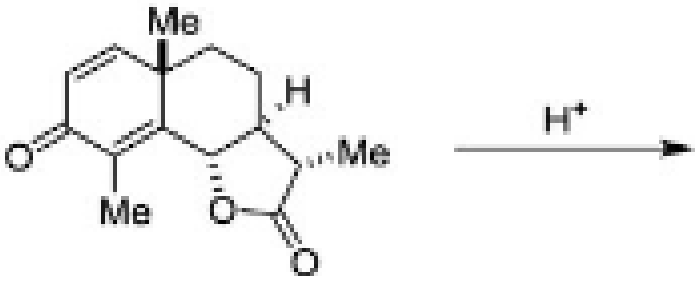
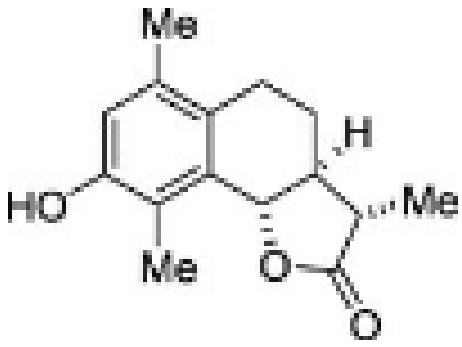
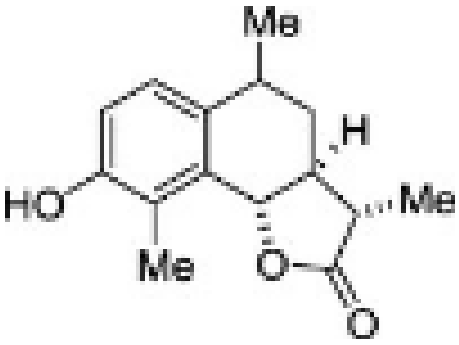


Figure 11: Figure for Q.3



(a)

Figure 12: Option A



(b)

Figure 13: Option B

(c)

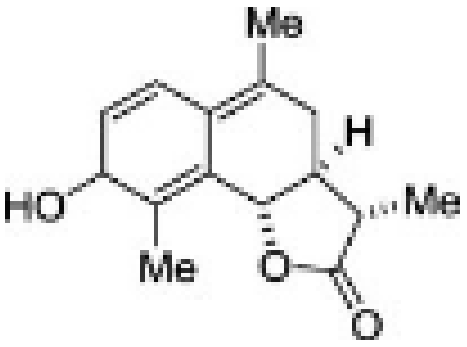


Figure 14: Option C

(d)

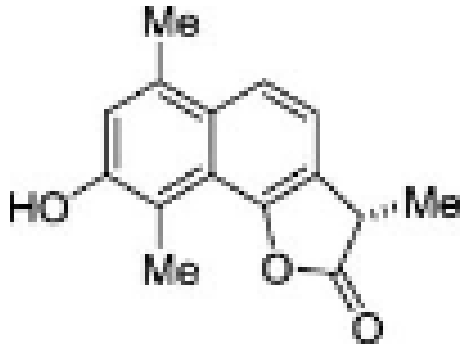


Figure 15: Option D

(GATE CY 2020)

4. Major product formed in the following transformation is:

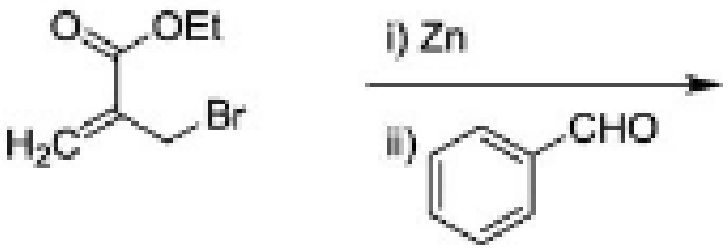


Figure 16: Figure for Q.4

(a)

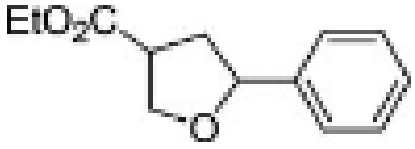


Figure 17: Option A

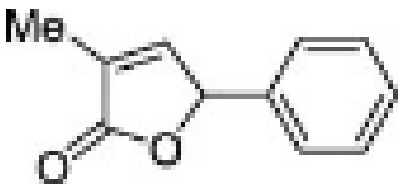
(b) 

Figure 18: Option B

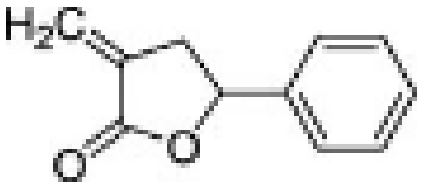
(c) 

Figure 19: Option C

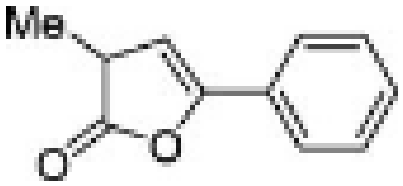
(d) 

Figure 20: Option D

(GATE CY 2020)

5. Absolute stereochemistry of the given compound is:

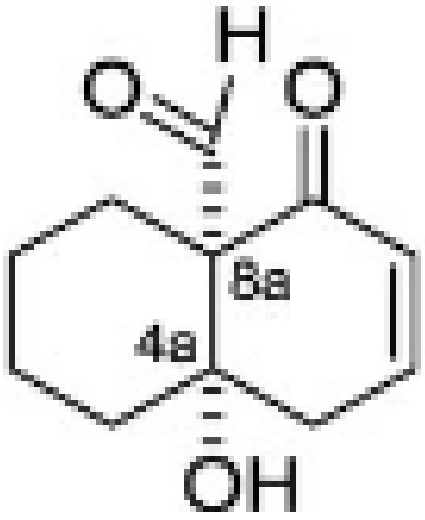


Figure 21: Figure for Q.5

(a) 4aR, 8aS

(b) 4aR, 8aR

(c) 4aS, 8aS

(d) 4aS, 8aR

(GATE CY 2020)

6. In the following reaction sequence:

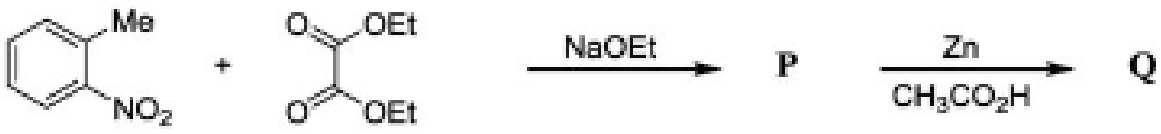


Figure 22: Figure for Q.6

The major products P and Q are:

(a)

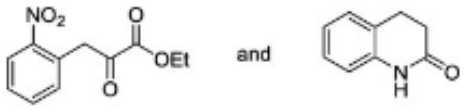


Figure 23: Option A

(b)

Figure 24: Option B

(c)

Figure 25: Option C

(d)

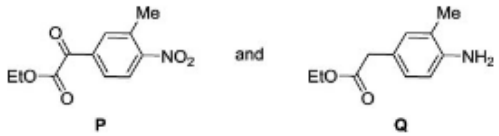


Figure 26: Option D

7. Major product formed in the given reaction is:

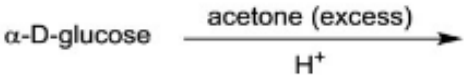
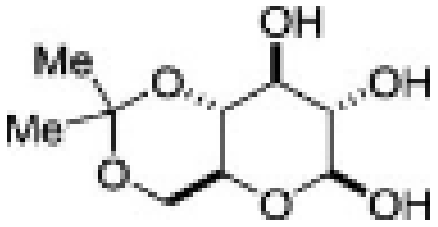
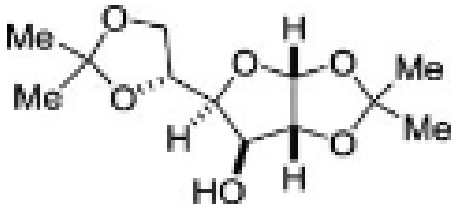


Figure 27: Figure for Q.7



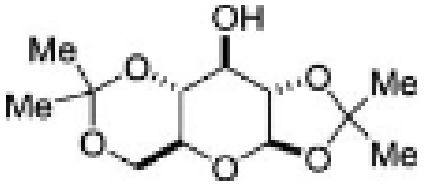
(a)

Figure 28: Option A



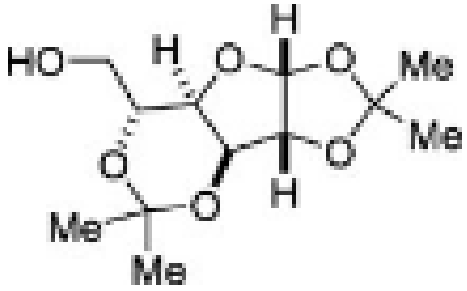
(b)

Figure 29: Option B



(c)

Figure 30: Option C



(d)

Figure 31: Option D

(GATE CY 2020)

8. The **CORRECT** statement regarding the substitution of coordinated ligands in $Ni(CO)_4$ and $Co(NO)(CO)_3$ is:

   (a) $Ni(CO)_4$ and $Co(NO)(CO)_3$ follow associative and dissociative pathways, respectively.

   (b) $Ni(CO)_4$ and $Co(NO)(CO)_3$ follow dissociative and associative pathways, respectively.

   (c) Both $Ni(CO)_4$ and $Co(NO)(CO)_3$ follow associative pathway.

   (d) Both $Ni(CO)_4$ and $Co(NO)(CO)_3$ follow dissociative pathway.

(GATE CY 2020)

9. The **CORRECT** statement about hexagonal boron nitride is:

   (a) It is a good electrical conductor.

   (b) It has same layer stacking as that of graphite.

   (c) It is reactive towards fluorine.

   (d) It has lower thermal stability in air compared to that of graphite.

(GATE CY 2020)

10. In oxyhemocyanin, the coordination number, mode of oxygen binding, color and the net magnetic behavior of copper ions, respectively are:

    (Given: atomic number of Cu is 29)

    (a) Four, μ-$\eta^2 : \eta^1$-O_2^-, colorless and paramagnetic.

    (b) Five, μ-$\eta^2 : \eta^2$-O_2^-, colorless and paramagnetic.

    (c) Five, μ-$\eta^2 : \eta^2$-O_2^-, blue and diamagnetic.

    (d) Four, μ-$\eta^2 : \eta^1$-O_2^-, blue and diamagnetic.

(GATE CY 2020)

11. Among the following species, the one that has pentagonal shape is: (Given: atomic numbers of O, F, S, I and Xe are 8, 9, 16, 53 and 54, respectively.)

    (a) $XeOF_4$

    (b) IF_5

    (c) $[SF_6]^-$

    (d) $[XeF_5]^-$

(GATE CY 2020)

12. A solution containing a metal complex absorbs at 480 nm with molar extinction coefficient of 15,000 $L\,mol^{-1}\,cm^{-1}$. If the path length of the cell is 1.0 cm and transmittance is 20.5%, the concentration (in $mol\,L^{-1}$) of the metal complex is:

(a) 1.37×10^{-5}

(b) 2.29×10^{-5}

(c) 4.59×10^{-5}

(d) 8.75×10^{-5}

(GATE CY 2020)

13. Among the following linear combination of atomic orbitals, the **CORRECT** representation of the lowest unoccupied π-molecular orbital of butadiene is:

(a) $\psi = -0.372\,\phi_1 + 0.602\,\phi_2 - 0.602\,\phi_3 + 0.372\,\phi_4$

(b) $\psi = 0.602\,\phi_1 - 0.372\,\phi_2 - 0.372\,\phi_3 + 0.602\,\phi_4$

(c) $\psi = 0.602\,\phi_1 + 0.372\,\phi_2 - 0.372\,\phi_3 - 0.602\,\phi_4$

(d) $\psi = 0.372\,\phi_1 + 0.602\,\phi_2 + 0.602\,\phi_3 + 0.372\,\phi_4$

(GATE CY 2020)

14. The activity of an m molal $CuSO_4$ solution can be expressed in terms of its mean activity coefficient $\gamma_\pm$ as:

(a) $m^2\gamma_\pm^2$

(b) $4m^3\gamma_\pm^3$

(c) $16m^4\gamma_\pm^4$

(d) $108m^5\gamma_\pm^5$

(GATE CY 2020)

15. The character table for a pyramidal AB_3 molecule of C_{3v} point group is given below:

C_{3v}	E	$2C_3$	$3\sigma_v$	
A_1	1	1	1	z, $x^2 + y^2$, z^2
A_2	1	1	-1	R_z
E	2	-1	0	$(x, y)(R_x, R_y)$, $(x^2 - y^2, xy)(xz, yz)$

Table 1: Table 1 for Q.15

The reducible representation of pyramidal AB_3 is:

C_{3v}	E	$2C_3$	$3\sigma_v$
Γ	12	0	2

Table 2: Table 2 for Q.15

The **CORRECT** option representing all the normal Raman active modes of pyramidal AB_3 is:

(a) $A_1 + A_2 + 2E$

(b) $3E$

(c) $3A_1 + A_2 + E$

(d) $2A_1 + 2E$

(GATE CY 2020)

16. In the following reaction:

Figure 32: Figure for Q.16

the number of peaks exhibited by the major product P in its broadband proton decoupled ^{13}C NMR spectrum is _____. (GATE CY 2020)

17. Among the following:

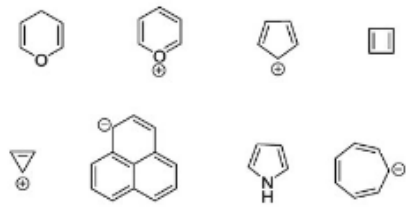


Figure 33: Figure for Q.17

the total number of aromatic species is _____. (GATE CY 2020)

18. The maximum number of microstates for d^2 electronic configuration is _____.

19. In a uranium recovery process, an aqueous solution of uranyl ion is evaporated, dried in air at 400 °C and subsequently reduced with hydrogen at 700 °C to obtain a uranium compound (X). The oxidation state of uranium in X is _____.

    (Given: atomic number of U is 92) (GATE CY 2020)

20. For a cubic crystal system, the powder X-ray diffraction pattern recorded using Cu K_α source (λ = 1.54 Å) shows a peak at 33.60° for (111) plane. The lattice parameter 'a' (in Å, *rounded off to two decimal places*) is _____. (GATE CY 2020)

21. In an NMR spectrometer operating at a magnetic field strength of 16.45 T, the resonance frequency (in MHz, *rounded off to one decimal place*) of ^{19}F nucleus is _____.

    (Given: g factor of ^{19}F = 5.255; $\beta_N = 5.05 \times 10^{-27}$ J T^{-1}; $h = 6.626 \times 10^{-34}$ J s) (GATE CY 2020)

22. When three moles of helium is mixed with one mole of neon at constant temperature and pressure (25 °C, 1 atm), the entropy of mixing (in J K^{-1}, *rounded off to two decimal places*) is _____.

(Given: R = 8.314 J K^{-1} mol^{-1}) (GATE CY 2020)

23. At 25 °C, the emf (*in volts, rounded off to three decimal places*) of the cell,

Ag | AgBr(s) | Br^- (a = 0.20), Cu^{2+} (a = 0.48), Cu^+ (a = 0.24) | Pt is _____.

(Given: The standard emf of the cell is 0.082 V; R = 8.314 J K^{-1} mol^{-1}; F = 96500 C mol^{-1}) (GATE CY 2020)

24. For an enzyme catalyzed reaction, the plot of inverse of initial rate against inverse of initial substrate concentration is linear with slope 0.16 s and intercept 2.12 mol^{-1} L s. The estimated value of Michaelis constant (in mol L^{-1}, *rounded off to two decimal places*) is _____. (GATE CY 2020)

25. Fluorescence quantum yield and fluorescence lifetime of a molecule are 0.4 and 5×10^{-9} s, respectively. If the fluorescence decay rate constant is Y $\times 10^7$ s^{-1}, the value of Y (*rounded off to nearest integer*) is _____. (GATE CY 2020)

Q.26 - Q.55 carry two marks each.

26. Major product formed in the following reaction sequence is:

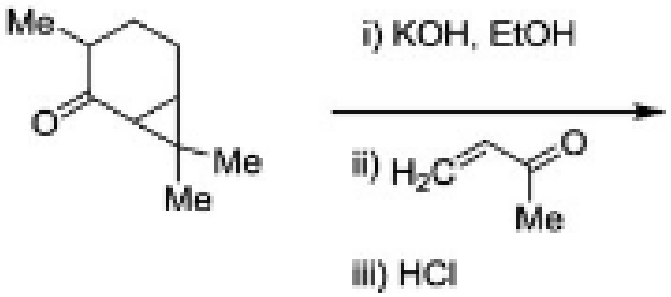


Figure 34: Figure for Q.26

(a)

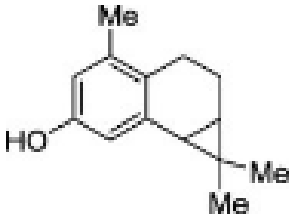


Figure 35: Option A

(b)

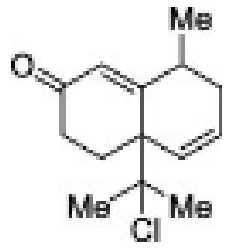


Figure 36: Option B

(c)

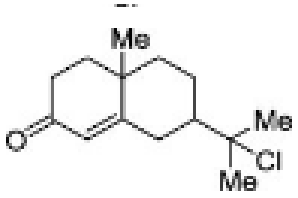


Figure 37: Option C

(d)

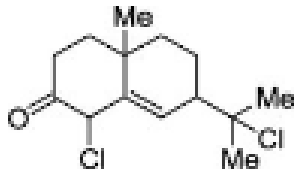


Figure 38: Option D

(GATE CY 2020)

27. Major products **P** and **Q**, in the given reaction sequence, are:

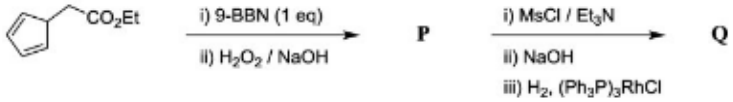


Figure 39: Figure for Q.27

(a)

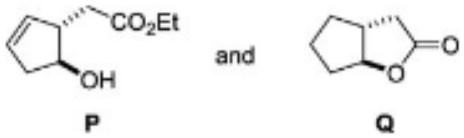


Figure 40: Option A

(b)

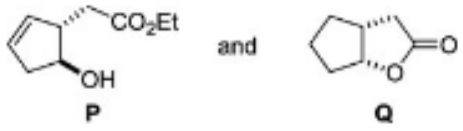


Figure 41: Option B

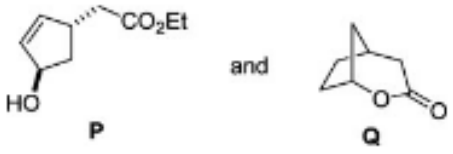
(c) 

Figure 42: Option C

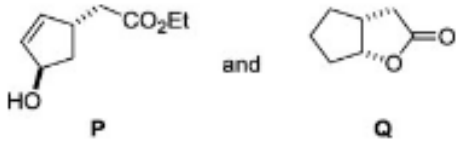
(d) 

Figure 43: Option D

(GATE CY 2020)

28. Major products **P** and **Q**, formed in the reactions given below, are:

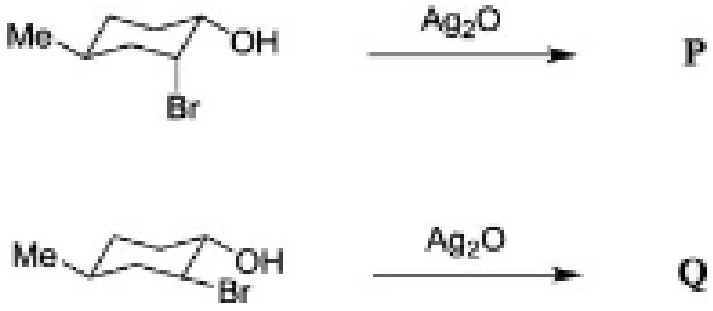


Figure 44: Figure for Q.28

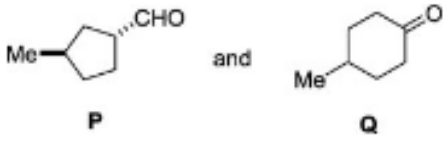
(a) 

Figure 45: Option A

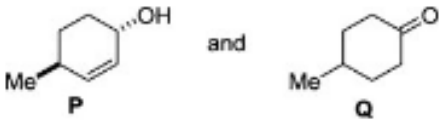
(b) 

Figure 46: Option B

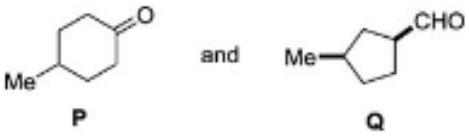
(c) 

Figure 47: Option C

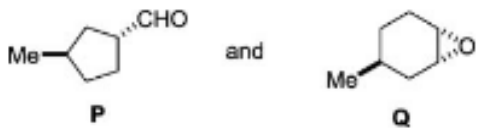
(d) 

Figure 48: Option D

(GATE CY 2020)

29. A compound with molecular formula $C_{10}H_{12}O_2$ showed a strong IR band at ~ 1720 cm^{-1}, a peak at m/z 122 in the mass spectrum and the following ^1H NMR signals: δ 8.1–8.0 (2H, m), 7.6–7.5 (1H, m), 7.5–7.3 (2H, m), 4.3 (2H, t), 1.8 (2H, sextet) and 1.0 (3H, t). The structure of the compound is:

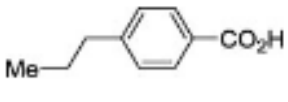
(a) 

Figure 49: Option A

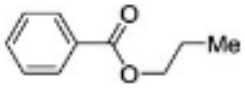
(b) 

Figure 50: Option B

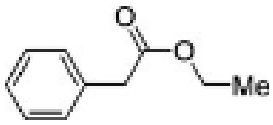
(c) 

Figure 51: Option C

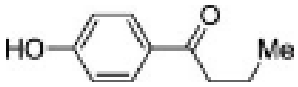
(d) 

Figure 52: Option D

(GATE CY 2020)

30. Major product formed in the following synthetic sequence is:

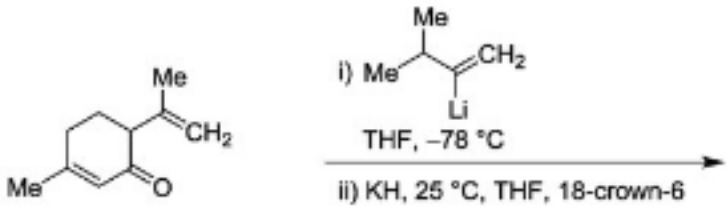


Figure 53: Figure for Q.30

(a)

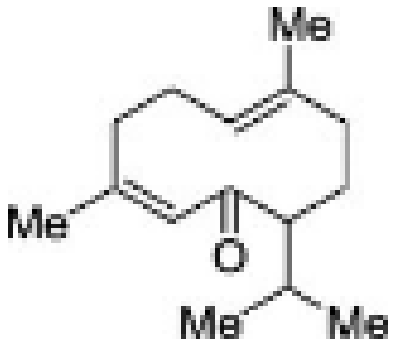


Figure 54: Option A

(b)

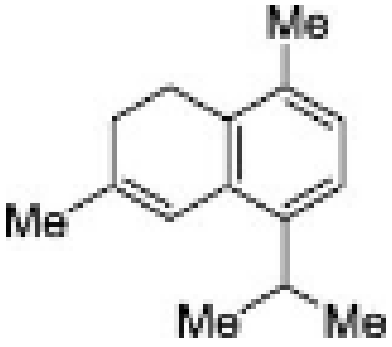


Figure 55: Option B

(c)

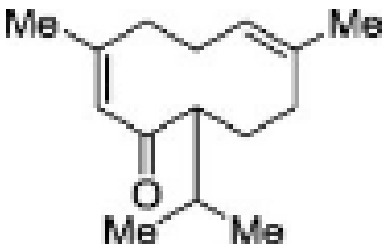


Figure 56: Option C

(d)

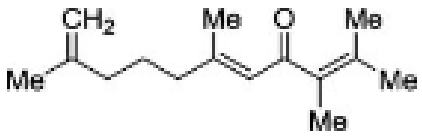


Figure 57: Option D

(GATE CY 2020)

31. The **CORRECT** statement with respect to the stereochemistry of α-hydroxy acids **P** and **Q** formed in the following reactions is:

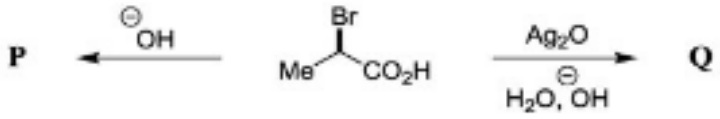


Figure 58: Figure for Q.31

(a) Both P and Q are formed with retention of configuration.

(b) Both P and Q are formed with inversion of configuration.

(c) P is formed with retention of configuration and Q with inversion of configuration.

(d) P is formed with inversion of configuration and Q with retention of configuration.

(GATE CY 2020)

32. The rate of solvolysis of the given compounds is in the order:

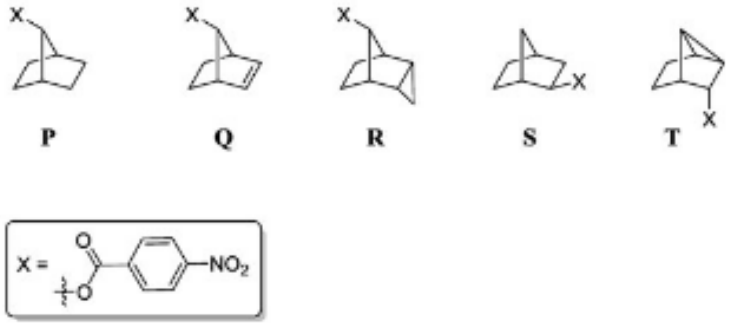


Figure 59: Figure for Q.32

(a) T > R > O > S > P

(b) O > T > R > P > S

(c) R > T > O > S > P

(d) T > O > T > R > S

(GATE CY 2020)

33. In the following reaction sequence, the major products Q and R are:

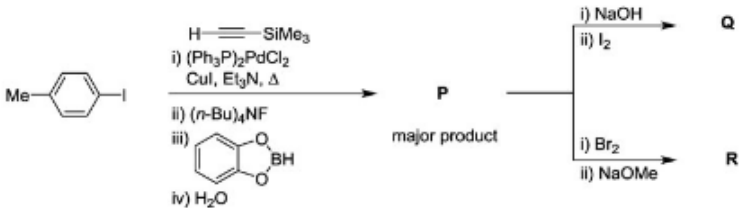


Figure 60: Figure for Q.33

(a)


Figure 61: Option A

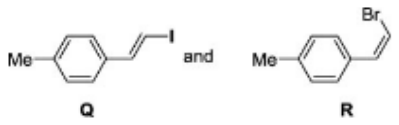
(b) 

Figure 62: Option B

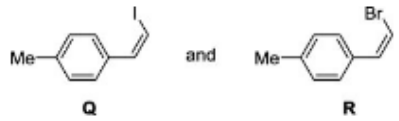
(c) 

Figure 63: Option C

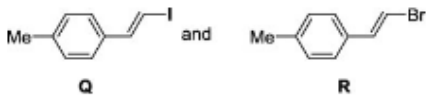
(d) 

Figure 64: Option D

(GATE CY 2020)

34. In the electronic absorption spectrum of an aqueous solution of $[Ni(NH_3)_6]^{2+}$, a very weak band is observed between the bands due to the transitions $^3A_{2g} \rightarrow {}^3T_{2g}$ and $^3A_{2g} \rightarrow {}^3T_{1g}(F)$. The transition responsible for the very weak band is:

    (Given: atomic number of Ni is 28)

    (a) $^3A_{2g} \rightarrow {}^1T_{1g}$
    (b) $^3A_{2g} \rightarrow {}^1T_{2g}$
    (c) $^3A_{2g} \rightarrow {}^1E_g$
    (d) $^3A_{2g} \rightarrow {}^1A_{1g}$

(GATE CY 2020)

35. The experimental magnetic moment (3.4 BM) of a hydrated salt of Eu^{2+} at 27 °C is significantly different from the calculated value. The difference is due to:

    (Given: atomic number of Eu is 63)

    (a) population of electrons at higher J level(s) via thermal excitation.
    (b) strong ligand field splitting of f-orbitals.
    (c) strong spin–orbit coupling.
    (d) pairing of electrons in f-orbitals.

(GATE CY 2020)

36. The **CORRECT** combination of L1 and L2 among H^-, NO^-, $MeCH_2^-$, $MeCH^-$, and CO, that will satisfy the 18-electron rule for both metal centers in the following neutral molecule, is:

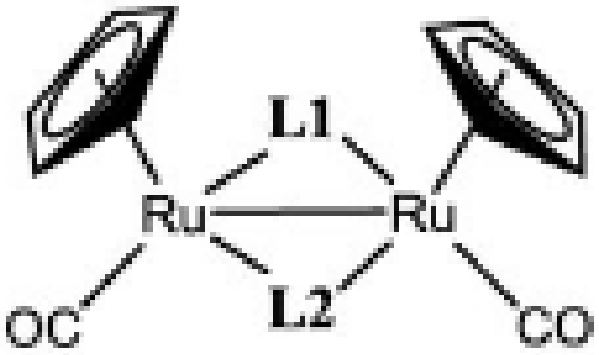


Figure 65: Figure for Q.36

(Given: atomic number of Ru is 44)

(a) H^-, NO^-

(b) $MeCH_2^-$, NO^-

(c) $MeCH_2^-$, CO

(d) H^-, CO

(GATE CY 2020)

37. In the following reaction sequence,

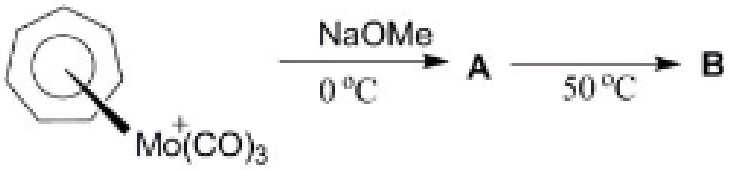
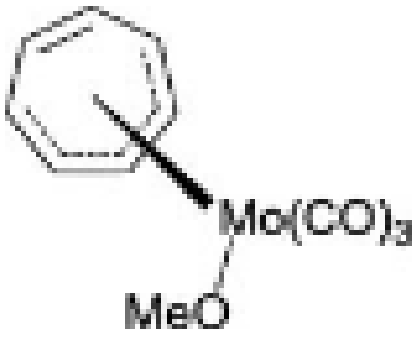


Figure 66: Figure for Q.37

the structure of B is

(Given: atomic number of Mo is 42)



(a)

Figure 67: Option A

(b)

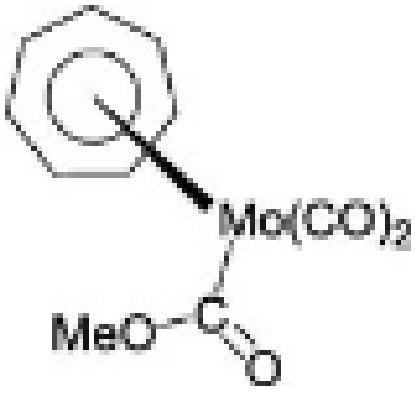


Figure 68: Option B

(c)

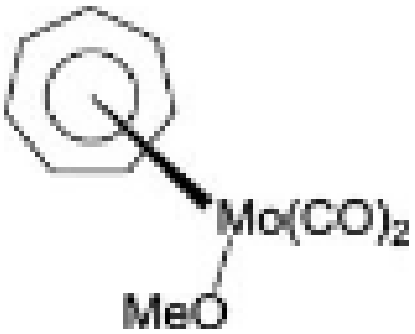


Figure 69: Option C

(d)

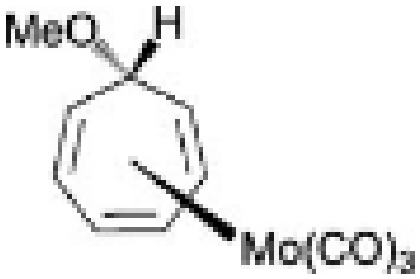


Figure 70: Option D

(GATE CY 2020)

38. The following table lists the reaction/conversion catalyzed by metalloenzymes.

	Reaction / conversion	Metalloenzyme
P	$R\text{-}H + O_2 + 2H^+ + 2e^- \rightarrow R\text{-}OH + H_2O$	I Coenzyme B_{12}
Q	$O_2 + 4e^- + 4H^+ \rightarrow 2H_2O + 4H^+$	II Cytochrome P-450
R	$2H_2O \rightarrow 2H_2O + O_2$	III Cytochrome c oxidase
S	$NH_2–CH_2–COOH \rightarrow NH_2–CH(CH_2OH)–COOH$	IV Catalase

Table 3: Table for Q.38

The CORRECT combination is

(a) P-II; Q-I; R-III; S-IV
(b) P-IV; Q-II; R-I; S-I
(c) P-I; Q-II; R-IV; S-III
(d) P-I; Q-IV; R-III; S-II

(GATE CY 2020)

39. The fission reaction of $^{235}_{92}U$ with thermal neutron is represented below.

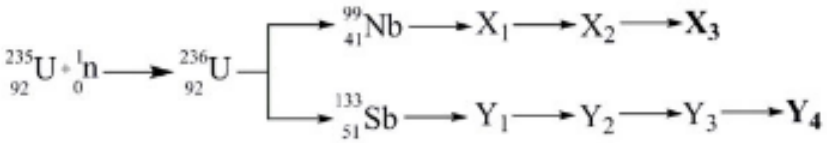


Figure 71: Figure for Q.39

^{99}Nb and ^{135}Sb are the primary fission fragment pair, which undergo series of radioactive decay to form stable nuclei X_3 and Y_4 (chain enders). The X_3 and Y_4, respectively are:

(a) ^{96}Mo and ^{133}Cs
(b) ^{99}Ru and ^{138}Cs
(c) ^{97}Sr and ^{142}Ba
(d) ^{87}Br and ^{143}Ce

(GATE CY 2020)

40. The CORRECT 'voltage (E) *versus* time' excitation signal used in cyclic voltammetry is

(a)

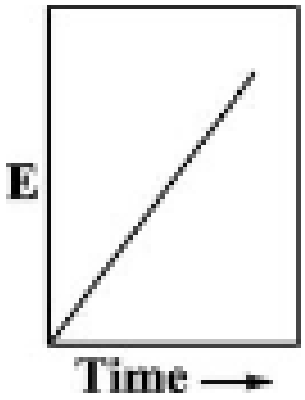


Figure 72: Option A

(b)

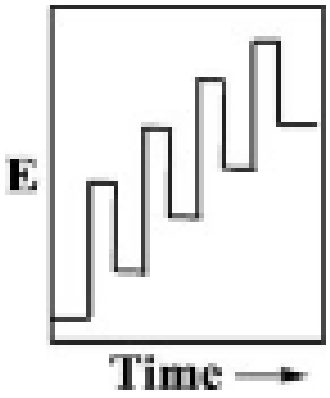


Figure 73: Option B

(c)

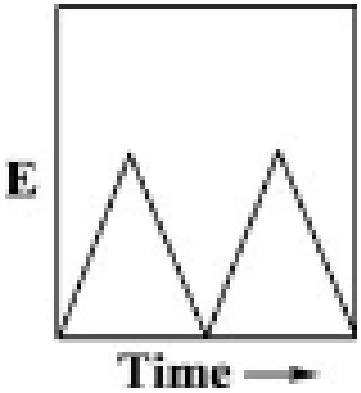


Figure 74: Option C

(d)

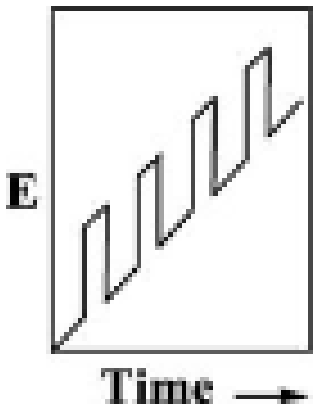


Figure 75: Option D

(GATE CY 2020)

41. The hydrogen-like radial wave function of the $3s$ orbital is given as

$$R_{30} = \frac{1}{9\sqrt{3}}\left(\left(\frac{Z}{a_0}\right)^{3/2}\right)\left(6 - 2\rho + \frac{\rho^2}{6}\right)e^{-\rho/6}$$

where $\rho = 2Zr/a_0$; Z = atomic number; r = distance from the nucleus; and a_0 = Bohr radius. Positions of the radial nodes (in units of a_0) of the $3s$ orbital are at

(a) $\frac{3+\sqrt{3}}{2Z}, \frac{3-\sqrt{3}}{2Z}$

(b) $\frac{6+3\sqrt{3}}{2Z}, \frac{6-3\sqrt{3}}{2Z}$

(c) $\frac{9+3\sqrt{3}}{2Z}, \frac{9-3\sqrt{3}}{2Z}$

(d) $\frac{3+3\sqrt{3}}{2Z}, \frac{3-3\sqrt{3}}{2Z}$

(GATE CY 2020)

42. ΔG_f° and ΔH_f° for Fe(g) are 370.7 kJ mol^{-1} and 416.3 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}

(b) 338 kJ mol^{-1}

(c) 325 kJ mol^{-1}

(d) 310 kJ mol^{-1}

(GATE CY 2020)

43. Adsorption of N_2 on TiO_2 was carried out at 75 K. A plot of $\frac{z}{(1-z)p}$ versus z ($z = p/p^0$) gives a straight line with an intercept, 4.0×10^{-6} mm^3 and slope, 1.0×10^{-3} mm^3. The volume (rounded off to the nearest integer) corresponding to the monolayer coverage is:

(a) 996 mm^3

(b) 785 mm^3

(c) 690 mm^3

(d) 555 mm^3

(GATE CY 2020)

44. Among the following sets,

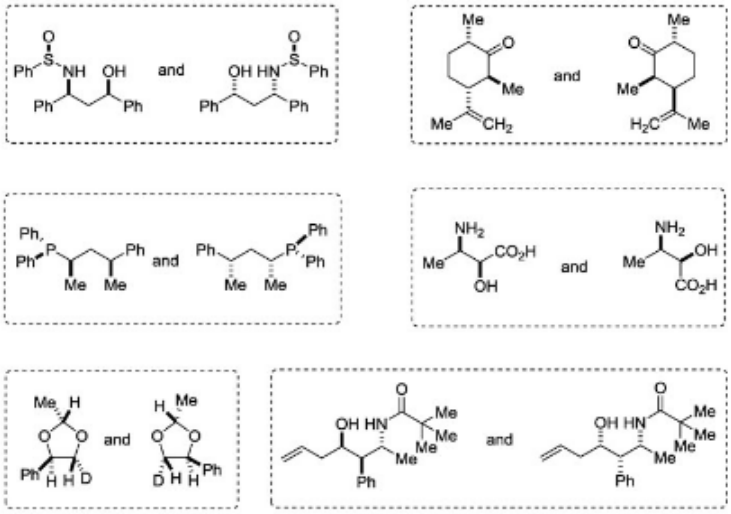


Figure 76: Figure for Q.44

the total number of set(s) of diastereomeric pair(s) is _____ (GATE CY 2020)

45. Among the following,

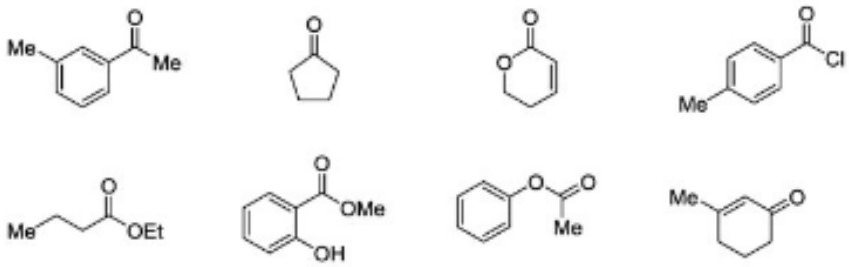


Figure 77: Figure for Q.45

the total number of compounds showing characteristic carbonyl stretching frequency less than 1700 cm^{-1} in their IR spectra is _____ (GATE CY 2020)

46. Consider that AgX crystallizes in rock salt structure. The density of AgX is 6477 kg/m^3 and unit cell length is 577.5 pm. Atomic weight of Ag is 107.87 g mol^{-1}. The atomic weight of X (in g mol^{-1}, *rounded off to two decimal places*) is _____ (GATE CY 2020)

47. The total number of g_{11} lines expected in the EPR spectrum of a solution of bis(salicylaldimine) copper(II) having pure ^{63}Cu and ^{14}N at 77 K is _____

(Given: I values of ^{63}Cu, ^{14}N and ^{1}H are $\frac{3}{2}$, 1 and $\frac{1}{2}$, respectively) (GATE CY 2020)

48. Among the following,

[$[B_2H_{12}]^{2-}$, $[NiS(CO)_2]^{2-}$, $[C_2B_5H_{11}]^{2-}$, $Rh_3(CO)_{16}$, $Os_6(CO)_{20}$, B_5H_{11}, B_6H_{10}]

the total number of species having *nido* structure is _____

(Given: atomic numbers of H, B, C, O, Ni, Rh and Os are 1, 5, 6, 8, 28, 45 and 76, respectively) (GATE CY 2020)

49. The frequency (in cm^{-1}, *rounded off to two decimal places*) for pure rotational line in the spectrum of NO molecule due to change in the quantum number from $J = 1$ to $J = 2$ is _____

(Given: Moment of inertia of NO = 1.6427×10^{-46} kg m^2; $h = 6.626 \times 10^{-34}$ J s; $c = 3 \times 10^8$ m/s) (GATE CY 2020)

50. The % error (*rounded off to two decimal places*) in the ground state energy of a particle in a one dimensional box of length 'a' described by a trial variation function $\varphi = x(a - x)$, where $0 \leq x \leq a$, is _____

(Given: The true ground state energy of the above system is $h^2/(8ma^2)$; $\int_0^a \varphi^2 dx = a^5/30$) (GATE CY 2020)

51. Assuming no interaction between vibrational and rotational energy levels in HF, the frequency (in cm^{-1}, *rounded off to the nearest integer*) of the R branch line originating from $J = 4$ in its IR spectrum is _____

(Given: Rotational constant for HF = 19.35 cm^{-1}; $\tilde{\nu}_0$ = 4138.52 cm^{-1}) (GATE CY 2020)

52. The van der Waals constants a and b for gaseous CO are given as 1.49 L^2 atm mol^{-2} and 0.0399 L mol^{-1}, respectively. The fugacity (in atm, *rounded off to two decimal places*) of CO at 35°C and 95 atm is _____

(Given: R = 0.082 L atm K^{-1} mol^{-1}) (GATE CY 2020)

53. At 30°C, the vapor pressure and density of a 1.0 M aqueous solution of sucrose are 31.207 mm Hg and 1.1256 g/mL, respectively. If the vapor pressure of pure water at 30°C is 31.824 mm Hg, the activity coefficient (*rounded off to three decimal places*) of water in the given solution is _____

(Given: The molar mass of sucrose = 342.3 g mol^{-1}) (GATE CY 2020)

54. For the ring opening reaction of cyclopropane to propene at 25°C, the pre-exponential factor is 4.3×10^{15} s^{-1}. The entropy of activation (in J K^{-1} mol^{-1}, *rounded off to two decimal places*) is _____

(Given: $h = 6.626 \times 10^{-34}$ Js; $k_B = 1.38 \times 10^{-23}$ K^{-1}; R = 8.314 J K^{-1} mol^{-1}) (GATE CY 2020)

55. In a reaction, reactant X is converted to products Y and Z consecutively with rate constants 6.0×10^{-2} min^{-1} and 9.0×10^{-3} min^{-1}, respectively. If the initial amount of X is 12.5 moles, the number of moles (*rounded off to one decimal place*) of Y formed after 10 minutes is _____ (GATE CY 2020)