CSIR NET CHEMICAL SCIENCE JULY 2025
(IFAS SOLVED PAPER)

Section: PART - A

1. Kavita starts from her house and walks 200 m northward, then turns 45° right and walks 70 m. After that, she turns 90° right and walks 70 m. Which of the following is the closest value of the shortest distance between Kavita's current location and her house?

1. 296 m
2. 240 m
3. 200 m
4. 223 m

2. A number is mistakenly divided by 2 instead of being multiplied by 2. What is the change in the result caused by this mistake?

1. 25%
2. 50%
3. 75%
4. 100%

3. Suresh asked Ramesh to identify the person in a photo that the latter is holding. Ramesh responds, "I have no brothers or sisters. However, that man's father is my father's son." Who is the person in the photo?

1. Suresh
2. Ramesh
3. Ramesh's son
4. Ramesh's cousin

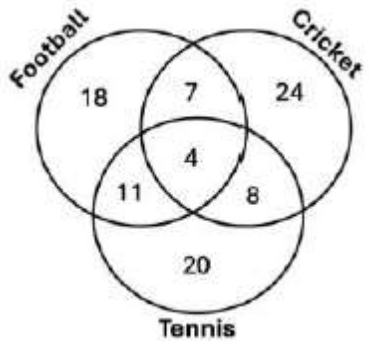
4. The value of a company is measured as the total value of its shares owned by different investors. Rakesh owns 2/15 of the shares of a company. He sells 1/3 of his shares for Rs. 75,000/-. What is the total value of the company at that time?

1. Rs. 15,75,800
2. Rs. 16,87,500
3. Rs. 17,75,800
4. Rs. 18,27,500

5. Three friends, Mr. Rahman, Mr. George and Mr. Vedant, met after a long time. They were wearing red, green and violet colour shirts. Mr. Rahman and the person wearing violet shirt noticed that none of the three is wearing a colour that starts with same letter as his name. Which one of the following is the correct match of the persons with the colour of their shirts?

1. Rahman-Violet, George-Red, Vedant-Green
2. Rahman-Green, George-Violet, Vedant-Red
3. Rahman-Green, George-Red, Vedant-Viole
4. Rahman-Red, George-Violet, Vedant-Green

6. The given Venn diagram shows numbers of players playing one or more than one sport.



The percentage of players who play exactly two sports is closest to

1. 5
2. 14
3. 28
4. 32

7. Consider the following statements:
Statement I: All Booklets are Manuals.
Statement II: All Manuals are Catalogues.
If Statements I and II are True, which one of the following conclusions can be conclusively drawn?

1. All Manuals are Booklets.
2. All Catalogues are Booklets.
3. All Booklets are Catalogues.
4. All Catalogues are Manuals.

8. A cylindrical container of radius 20 cm was filled with water up to 25 cm height. A solid spherical ball of radius 7 cm was then immersed in the water. What would be the approximate increase in water level in the container after the ball was fully immersed?

1. 1.14 cm
2. 2.28 cm
3. 5.50 cm
4. 7.00 cm

9. The initial monthly salaries of employees John, Riya, and Sunil were in the proportion 4:3:5. After an increase of Rs 10000 monthly to all, the new proportion becomes 6:5:7. What was the initial salary of Sunil?

1. Rs 20000
2. Rs 25000
3. Rs 30000
4. Rs 35000

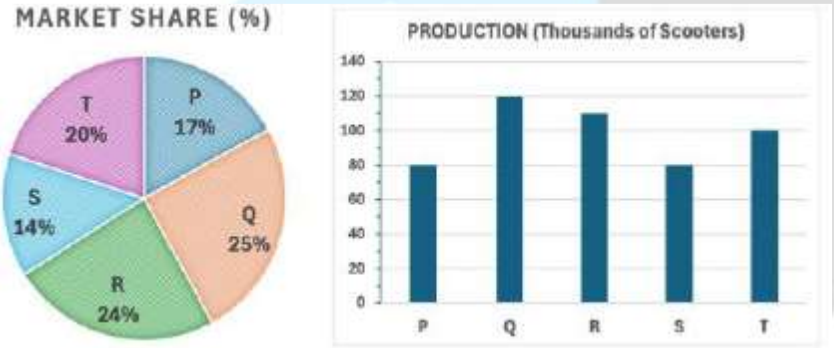
10. Rahul and his father started jogging on a circular track of radius 'r' (r>2). Rahul completed one round and stopped. His father got tired half way into the first round and returned to his starting point along a straight line. What is the ratio of the distances covered by Rahul and his father?

1. $\pi r/(\pi + 2)$
2. $2\pi/(\pi + 2)$

3. 1
4. 2

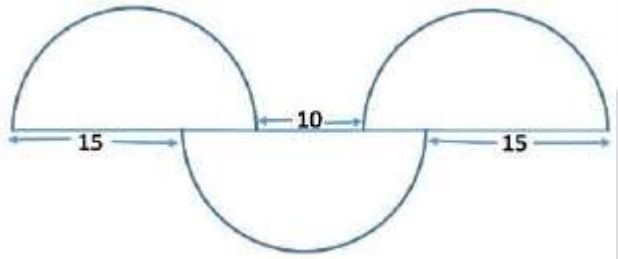
11. What will be the digit at the unit's place of $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$?
1. 0
2. 5
3. 7
4. 9

12. The market share (%) and annual production of scooters from five automobile companies P, Q, R, S, and T are shown in graphs.



If the profit of a company is directly proportional to the ratio of market share to production, then which of the following statements is/are CORRECT?
Statement X: Companies T and P have same profit
Statement Y: Company R has the maximum profit
Statement Z: Company S has the minimum profit
1. X and Y
2. X and Z
3. Y and Z
4. Only Z

13. Three identical semi-circles are arranged as shown. What is the diameter of the semi-circles?



1. 5π
2. 20
3. $15\pi/2$
4. 25

14. In a code, the word DELTOID is written as 3152893. Then LOTION could be written as
1. 582986
2. 582981

3. 198396
4. 198392

15. A stock market trader has lost two thirds of her investment on a day. Next day she recovered one third of the previous day's loss. What fraction of her initial investment is she left with?
1. $\frac{1}{3}$
2. $\frac{2}{3}$
3. $\frac{2}{9}$
4. $\frac{5}{9}$

16. A circle of radius 1 unit is divided into four quarters and rejoined as shown below.

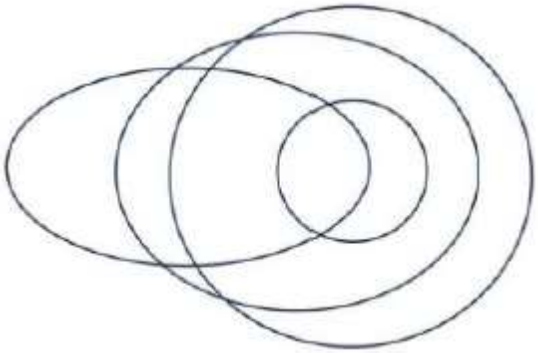


What is the area of this shape?
1. π
2. 1
3. 2
4. 4

17. A car has wheels of diameter 36 cm. If it runs at a speed of 60 km/h, then the rotation per minute (RPM) will be closest to
1. 884
2. 898
3. 906
4. 986

18. Numbers of Rose, Lotus, and Marigold plants in a garden are in the proportion 8:5:7. Later, 75%, 40% and 50% more plants of their respective categories were added. What will be the new proportion of plants, in the same order?
1. 5:3:4
2. 4:2:3
3. 5:4:3
4. 7:4:5

19. The following diagram represents the relationship between four categories.



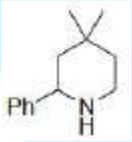
The categories could be

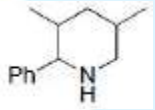
1. Rivers, water bodies, oceans, sources of evaporation
2. Parliamentarians, celebrities, elected persons, professional politicians
3. Monkeys, four-legged animals, pet animals, land animals
4. Furniture, chairs, seats, wooden objects

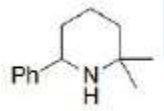
20. Sum of the digits of a two-digit number 'ab' is subtracted from the number and the result is divided by 9. Then the result of this will be

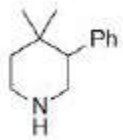
1. always a
2. always b
3. neither a nor b
4. either a orb depending on a+ b

21. Compound A on Hofmann exhaustive N-methylation procedure (involving two cycles), followed by ozonolysis (i. O_3; ii. Me_2S) gives benzaldehyde, formaldehyde and 2,2-dimethylpropanedial. The structure of A is

1. 

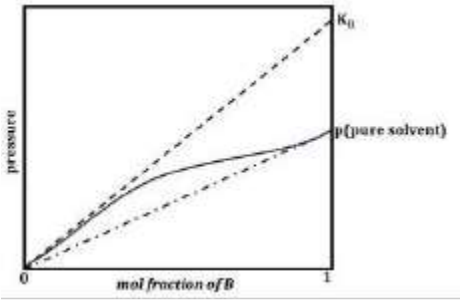
2. 

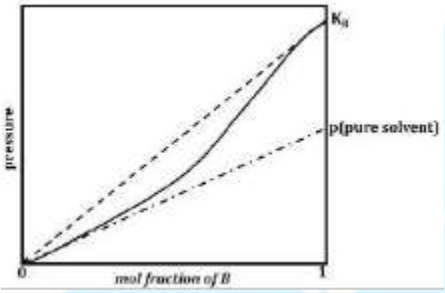
3. 

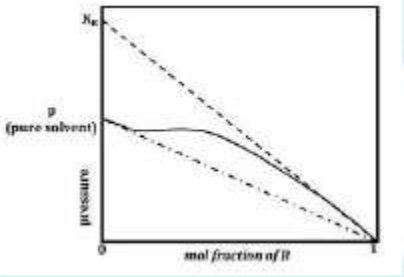
4. 

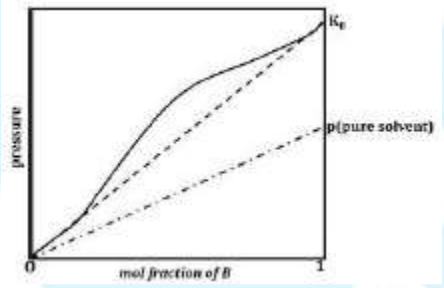
22. The correct option for a real solution formed by mixing liquid A with liquid B is

[Here K_B is Henry's law constant and solid line represents real solution]

1. 

2. 

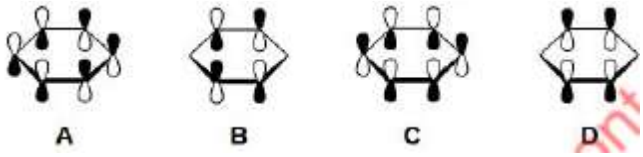
3. 

4. 

23. Two conformations, A and B, of a single molecule have energies $5k_BT$ and $9k_BT$, respectively, at a temperature T. The fraction of molecules in conformation B is

1. $e^{-9}/(1+e^{-9})$
2. $e^{-5}/(1+e^{-5})$
3. $1/(1+e^{-4})$
4. $1/(1+e^{4})$

24. Among the following, the correct representation for the LUMO of benzene is



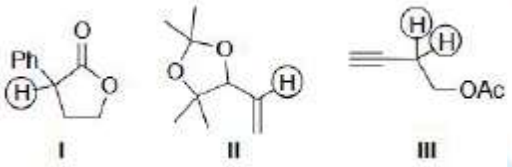
1. A and D
2. A and C

3. B and C
4. B and D

25. In a colloidal solution, the zeta potential is the electric potential at the
1. radius of the colloid particle
2. radius of Stern layer
3. radius of shear surface
4. outer radius of diffuse ion layer

26. A radioactive element X emits two a and one y particles to yield element Y of mass number 82. X also emits one α and one β particles to yield element Z with an atomic number 44.
$_{44}Z + \alpha + \beta \leftarrow X \rightarrow {}^{82}Y + 2\alpha + \gamma$
The elements, X, Y and Z, respectively, are
1. $^{90}_{45}X, ^{82}_{42}Y \; and \; ^{88}_{44}Z$
2. $^{90}_{45}X, ^{82}_{41}Y \; and \; ^{86}_{44}Z$
3. $^{91}_{45}X, ^{82}_{41}Y \; and \; ^{86}_{44}Z$
4. $^{91}_{45}X, ^{82}_{42}Y \; and \; ^{86}_{44}Z$

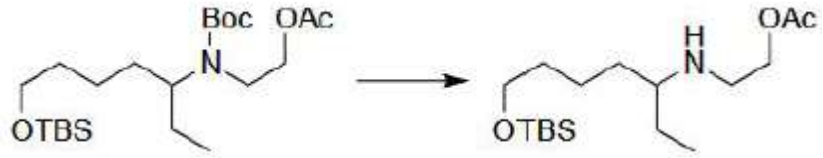
27. In ^{1}H NMR, the multiplicity pattern expected for the highlighted protons in the following compounds is



1. I = dd, II = ddd, III = td
2. I = dd, II= dt, III = dt
3. I=t, II = ddd, III = dt
4. I=t, II = dt, III = td

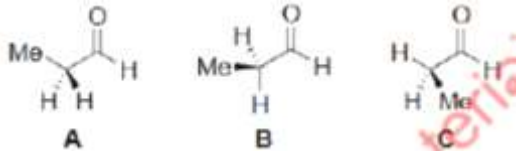
28. The geometries of $[Hgl_3]^-$ and $[SnCl_3]^-$, respectively, a
1. trigonal planar and trigonal pyramidal
2. trigonal pyramidal and trigonal planar
3. trigonal planar and tetrahedral
4. tetrahedral and trigonal pyramidal

29. The reagent that would effect the following transformation is



1. $H_2, Pd - C, EtOAc$
2. $TBAF, THE$
3. $AlCl_3, CH_2Cl_2$
4. $K_2CO_3, MeOH$

30. The correct order of stability for the following conformations of propanal is



1. A>C>B
2. A > B > C
3. B>A>C
4. C>B>A

31. The correct statements about $SnCl_4$ and $SnMe_4$.

A. $SnCl_4$ forms $SnCl_6^{2-}$.

B. SnMe4 does not form $SnMe_6^{2-}$.

C. $SnCl_4$ does not undergo hydrolysis.

D. $SnMe_4$ readily hydrolyses.

Are

1. A and B only
2. B and C only
3. A and D only
4. B and D only

32. Among the following linear combinations of determinants (written with the spatial wavefunctions 1s and 2s and electronic spin wavefunctions α and β, using 1 and 2 as labels of the two electrons), the one that denotes the unnormalized wavefunction of a triplet excited state $(1s^1 2s^1)$ of He, is

1. $\begin{vmatrix} 1s\alpha(1) & 2s\beta(1) \\ 1s\alpha(2) & 2s\beta(2) \end{vmatrix} + \begin{vmatrix} 2s\alpha(1) & 1s\beta(1) \\ 2s\alpha(2) & 1s\beta(2) \end{vmatrix}$
2. $\begin{vmatrix} 1s\alpha(1) & 2s\beta(1) \\ 1s\alpha(2) & 2s\beta(2) \end{vmatrix} - \begin{vmatrix} 2s\alpha(1) & 1s\beta(1) \\ 2s\alpha(2) & 1s\beta(2) \end{vmatrix}$
3. $\begin{vmatrix} 1s\alpha(1) & 1s\alpha(2) \\ 2s\beta(1) & 2s\beta(2) \end{vmatrix} + \begin{vmatrix} 2s\alpha(1) & 2s\alpha(2) \\ 1s\beta(1) & 1s\beta(2) \end{vmatrix}$
4. $\begin{vmatrix} 1s\beta(1) & 2s\alpha(1) \\ 1s\beta(2) & 2s\alpha(2) \end{vmatrix} - \begin{vmatrix} 1s\alpha(1) & 2s\beta(1) \\ 1s\alpha(2) & 2s\beta(2) \end{vmatrix}$

33. The correct statements about the copper-containing protein, hemocyanin, from the following

A. It is an extracellular protein.

B. It has an oligomeric structure with each sub-unit containing a pair of two copper atoms.

C. In deoxy form, the two Cu(I) atoms are separated by 2.8 A.

D. The blue colour of oxy form is due to charge-transfer from superoxide- to-Cu(II) ion.

Are

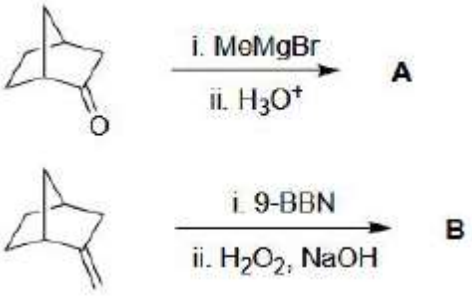
1. A and B only
2. A and C only
3. B and C only
4. C and D only

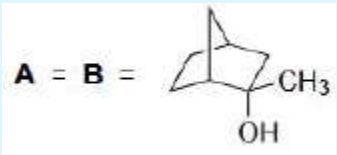
34. The numbers of Matal- matal bonds in $[Os_4(CO)_{16}]$, is

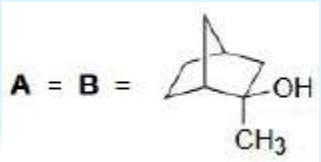
1. 4
5. 5
3. 6
4. 3

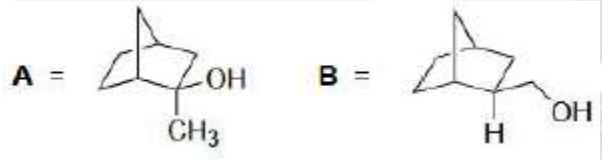
35. The correct option with respect to $Cs_2[XeF_8]$, is
1. square antiprismatic with stereochemically inactive lone pair
2. square antiprismatic with stereochemically active lone pair
3. capped square antiprismatic with stereochemically active lone pair
4. capped square antiprismatic with no lone pair

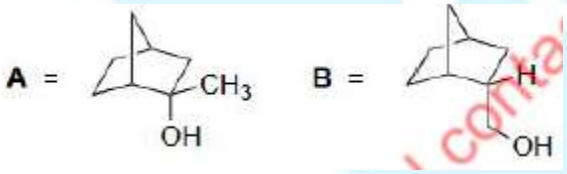
36. The major products A and B formed in the following reactions are



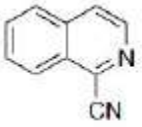
1. 

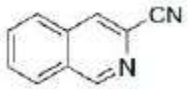
2. 

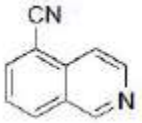
3. 

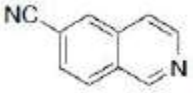
4. 

37. Isoquinoline on sequential reaction with benzoyl chloride and KCN followed by heating with aq. NaOH gives

1. 

2. 

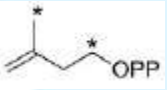
3. 

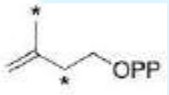
4. 

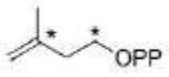
38. The complete combustion of 9.83 mg of an organic compound $(C_X H_Y O_Z)$ gives 23.26 mg of CO_2 and 9.52 mg of H_2O. The ESI-MS analysis of this compound gave a molecular ion peak at 130 (m/z). The value of X is
[Given: Atomic weight: C 12; H= 1; 0 = 16]
1. 7
2. 3
3. 4
4. 8

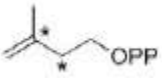
39. For an eigenstate ψ of a time-independent Hamiltonian
1. Both ψ and $\psi^*\psi$ are time-independent
2. ψ is time-dependent, but $\psi^*\psi$ is time-independent
3. ψ is time-independent, but $\psi^*\psi$ is time-dependent
4. Both ψ and $\psi^*\psi$ are time-dependent

40. The isopentenyl pyrophosphate formed through mevalonate pathway using acetyl CoA containing a ^{14}C labelled $(*)$ carbonyl carbon is

1. 

2. 

3. 

4. 

41. The wavefunction, $\Psi(x)$, of a one-dimensional quantum system is given by
$\Psi(x) = A\ x\ exp(-x^2/a^2)$
The dimension of A is
[L is the dimension of length]
1. $L^{-1/2}$
2. L^{-3}
3. $L^{-3/2}$

4. L^0 (dimensionless)

42. Considering the potential energy at the equilibrium position (x_B) to be zero, the internuclear potential, V(x) as a function of distance, x between two atoms in a diatomic molecule is given by

$V(x) = D_e\left[1 - e^{-\alpha(x-x_e)}\right]^2$

where D_e and α are two constants.

The force constant of the bond between the two atoms is

1. $D_e\alpha^2$
2. $2D_e\alpha^2$
3. $\frac{1}{2}D_e\alpha^2$
4. $2D_e\alpha$

43. The correct statements about C_{60} from the following

A. it exhibits greater degree of delocalization than benzene.

B. it is susceptible towards addition reactions than substitution reactions.

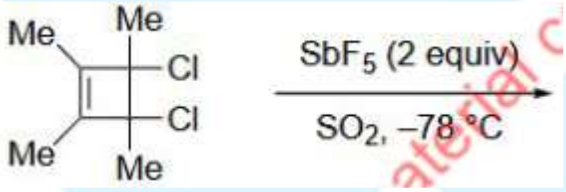
C. the spherical structure of C_{60} makes the C=C bonds more reactive.

D. its overall reactivity is more like cycloalkenes than benzene.

are

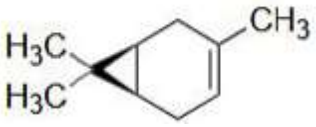
1. B, C and D only
2. A, B and C only
3. A, B and D only
4. C and D only

44. The major product formed in the following reaction is



1. aromatic
2. nonaromatic
3. antiaromatic
4. homoaromatic

45. The correct IUPAC name for the following compound is

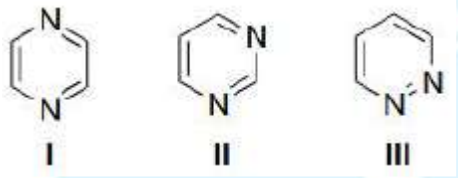


1. $(1S, 6R) - 3,7,7 - trimethylbicyclo[4.1.0]hept - 3 - ene$
2. $(1R, 6S) - 3,7,7 - trimethylbicyclo[4.1.0]hept - 3 - ene$
3. $(1R, 6S) - 4,7,7 - trimethylbicyclo[4.1.0]hept - 3 - ene$
4. $(1S, 6R) - 4,7,7 - trimethylbicyclo[4.1.0]hept - 3 - ene$

46. Consider the following unbalanced chemical reactions:

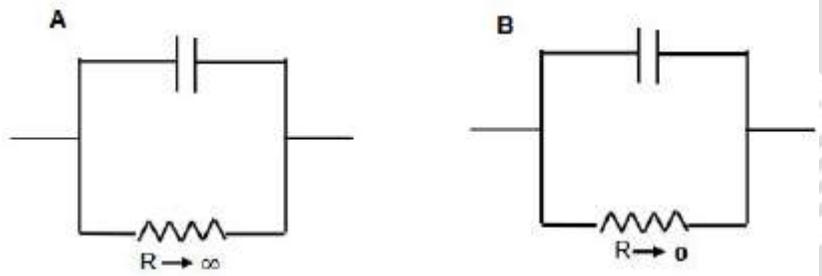
A. $NH_3 \rightarrow NO_2^-$
B. $O_2 \rightarrow H_2O_2$
C. $NO_2^- \rightarrow NO_3^-$
D. $H_2S \rightarrow S_8$
E. $CO_2 \rightarrow CO$
The reactions that are brought about by the chemolithotropic bacteria, are
1. B, C and D
2. A, C and D only
3. A, B and E only
4. B, C and E only

47. The correct order of basicity for the following compounds is



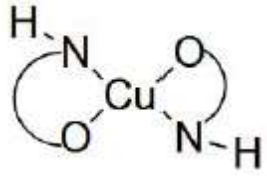
1. I >III >II
2. II >I > III
3. III > I > II
4. III> II >I

48. Among the following equivalent circuits A and B for an electrode / electrolyte interface, the correct option is



1. Both A and B are ideally polarizable
2. A is ideally non-polarizable, B is ideally polarizable
3. A is ideally polarizable, B is ideally non-polarizable
4. Both A and B are ideally non-polarizable

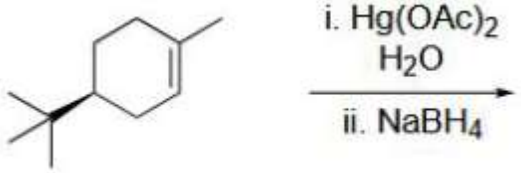
49. The total number of lines expected in the EPR spectrum of the Cu(II) complex [Given: Cu (1=3/2); N (1-1)] shown below

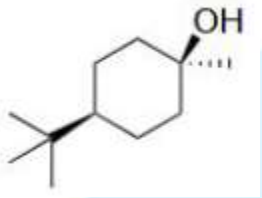


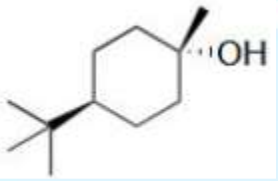
Is
1. 4
2. 40

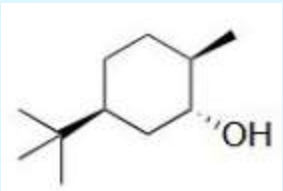
3. 12
4. 20

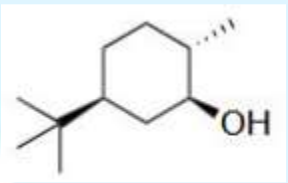
50. The major product formed in the following reaction is



1. 

2. 

3. 

4. 

51. The standard Gibbs energy of a substance refers to the Gibbs free energy of its pure form at
1. temperature = 25 °C only and pressure = 1 atm
2. temperature = 25 °C only and pressure = 1 bar
3. any temperature and pressure = 1 bar
4. any temperature and pressure = 1 atm

52. According to Karplus equation, the vicinal proton-proton coupling contact is minimum when the value of dihedral angle is
1. 0°
2. 60° and 120°
3. 90°
4. 180°

53. For actinides, complex formation tendency follows the order
1. $M^{4+} > M^{3+} > MO_2^+ > MO_2^{2+}$
2. $MO_2^{2+} > MO_2^+ > M^{4+} > M^{3+}$

3. $M^{4+} > M^{3+} > MO_2^{2+} > MO_2^+$
4. $M^{4+} > MO_2^{2+} > M^{3+} > MO_2^+$

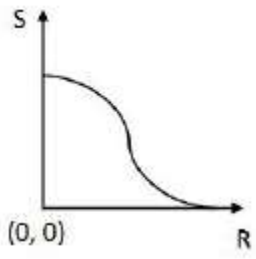
54. The pair of electronic configurations representing ground term $^3F_2$ is
1. $p^1d^1 \; and \; s^1d^1$
2. $s^1f^1 \; and \; d^1f^1$
3. $d^1f^1 \; and \; p^1d^1$
4. $p^1d^1 \; and \; s^1f^1$

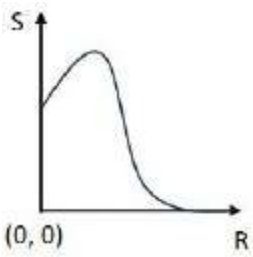
55. Nitramide (NH_2NO_2) decomposes under basic condition to generate
1. N_2O
2. HNO_3
3. NH_3
4. NO

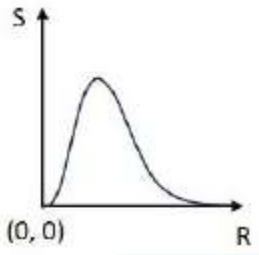
56. The activation energy and enthalpy change in the reaction $H_2 + I_2 \rightarrow 2HI$, respectively, are $167kJmol^{-1}$ and $-8kJ\,mol^{-1}$. Assuming the pre-exponential factors for production and decomposition of HI to be same at all temperatures, the correct option is
[k_p and k_d are the rate constants for production and decomposition of HI, respectively]
1. k_p and k_d have the same temperature dependence.
2. k_d changes more rapidly with temperature than k_p
3. k_p changes more rapidly with temperature than k_d
4. The activation energies of production and decomposition reaction of HI are same.

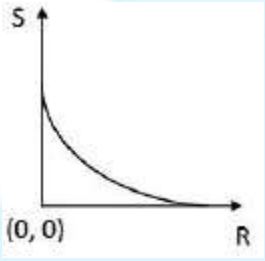
57. The density, mass and unit cell edge length of a crystalline solid X are $2.7gcm^{-3}, 27gmol^{-1}$ and 400 pm, respectively. The crystal lattice of X is
1. FCC
2. BCC
3. Simple cubic
4. Tetragonal

58. For a diatomic molecule AB, the internuclear distance is R and the internuclear axis is along the z-direction. The plot of the overlap integral S for the p_x orbital of A and d_{zx} orbital of B, against R, is

1. 

2. 

3. 

4. 

59. Consider the following statements about NO and NO_2.

A. The unpaired electron is in π^* orbital of NO while it is in σ_{nb} orbital of NO_2.

B. NO does not prefer dimerization, whereas NO_2 does.

C. The reduction of NO is comparatively easier than NO_2.

D. There is a center of inversion in NO_2.

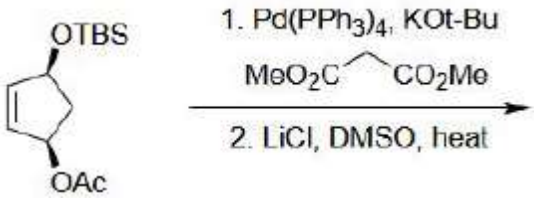
The option with the correct statements is

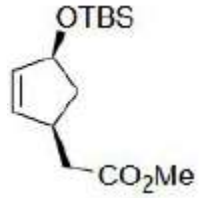
1. A and B only
2. A and D only
3. C and D only
4. C and B only

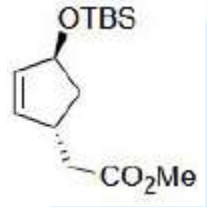
60. For the reaction $K + Br_2 \rightarrow KBr + Br$, the rate constant can be described as $k = A\ exp\left(-\frac{E_\alpha}{RT}\right)$. Choose the correct option regarding activation energy (E_α) and pre-exponential factor (A_E: obtained from experiment and A_T: estimated sing collision theory)

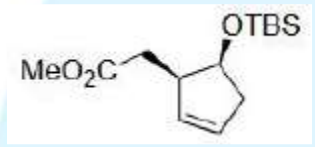
1. $E_\alpha > 0; A_T > A_E$
2. $E_\alpha < 0; A_T < A_E$
3. $E_\alpha = 0; A_T < A_E$
4. $E_\alpha \geq 0; A_T > A_E$

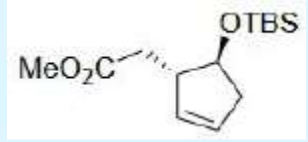
61. The major product formed in the following reaction sequence is



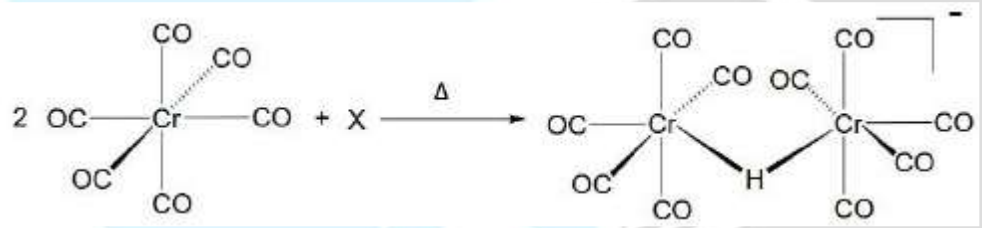
1. 

2. 

3. 

4. 

62. Consider the following reaction.



X is

1. H^+
2. H^-
3. HO^-
4. H_2O

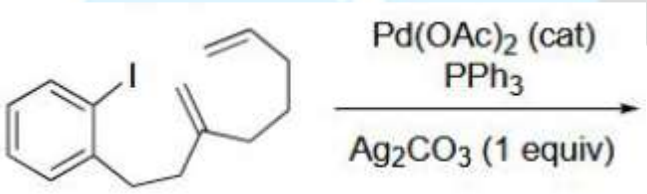
63. The XRD pattern of a crystalline material, measured using $Cu\ K_\alpha$ radiation ($\lambda = 1.54\ A$), is as follows:

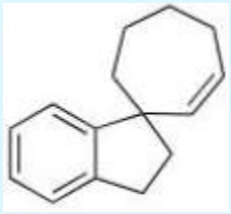
2θ(degree)
38.43
44.65
65.02
78.13

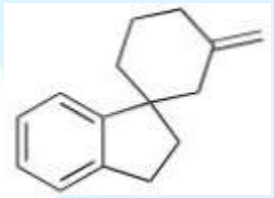
Considering the cubic edge length ~4 A, the Miller indices and Bravais lattice of this material are
1. (111) (200) (22 (311), BCC
2. (111) (200) (220) (311), FCC
3. (110) (200) (211) (220), BCC
4. (110) (200) (211) (220), FCC

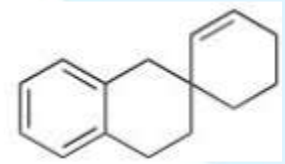
64. The number of microstates, the ground term, the energy separation between the ground term and the next excited state term of identical multiplicity, and the j value for the lowest energy spin-orbit state for the ground state for a d^3 configuration, respectively, are
1. $120, {}^4F, 15B, 3/2$
2. $120, {}^4F, 15B, 9/2$
3. $156, {}^4F, 15B + C, 3/2$
4. $156, {}^4F, 15B, 9/2$

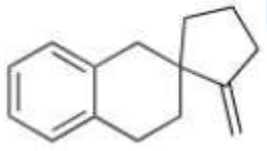
65. The major product formed in the following reaction is



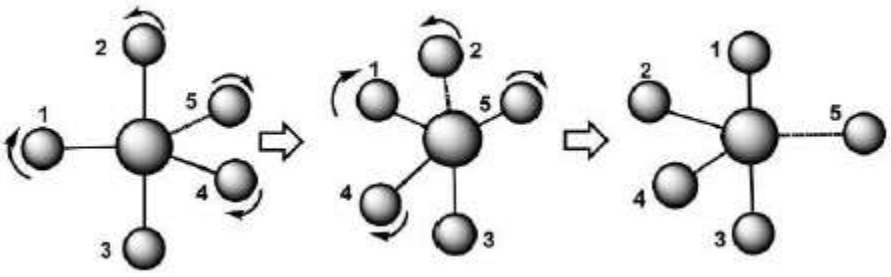
1. 

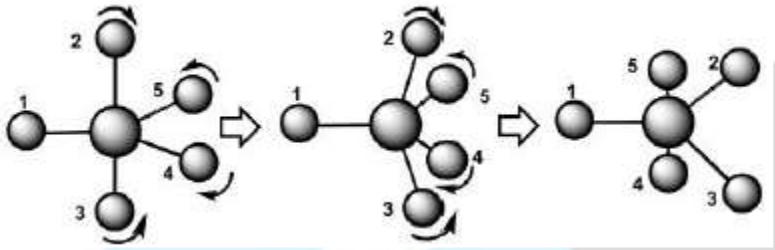
2. 

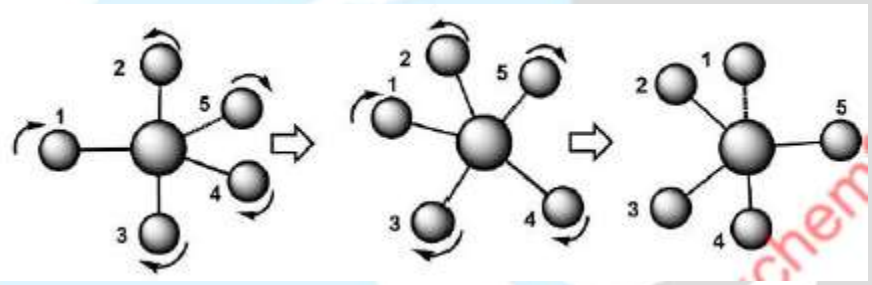
3. 

4. 

66. The option showing the correct Berry-pseudo rotation is

1. 

2. 

3. 

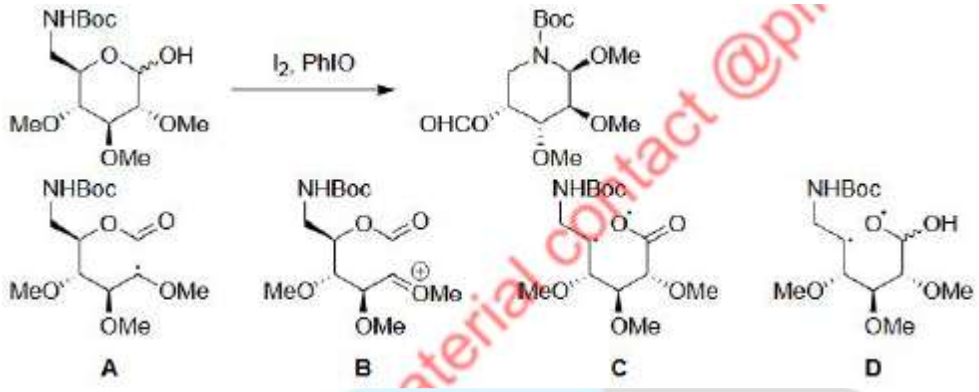
4. 

67. The unnormalized probability density distribution of a continuous variable x is given by $p(x) = e^{-ax^2}$ $-\infty \leq x \leq \infty$ (a is a constant)

The average of x^2 over the normalized distribution is

1. a^2
2. $2a$
3. $a^2/2$
4. $\frac{1}{2a}$

68. The intermediates involved in the following reaction are



1. A and B
2. B and C
3. C and D
4. A and D

69. For a heteronuclear diatomic molecule AB, the un-normalized wavefunctions for HOMO and one of the two degenerate LUMOS, respectively, are

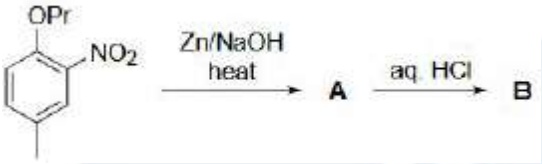
$\psi_{HOMO} = 0.9\left(\phi_{2s}^{A} + 3\phi_{2pz}^{A}\right) + 0.1\phi_{2pz}^{B}$

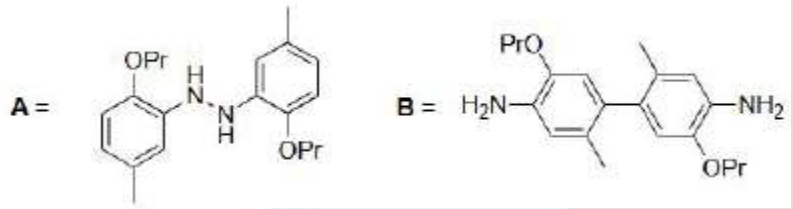
(Atomic orbitals of A and B are denoted by ϕ. The internuclear axis is along the z-direction.)

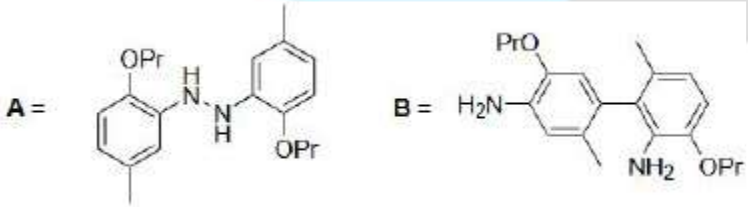
AB is a

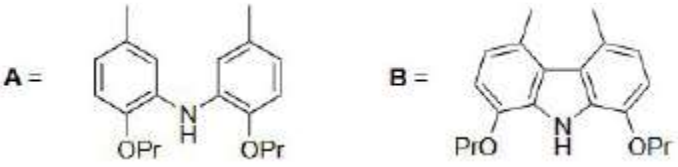
1. σ-donor through A, π-acceptor through A
2. σ-donor through B, π -acceptor through B
3. σ -donor through A, π -acceptor through B
4. σ -donor through B, π -acceptor through A

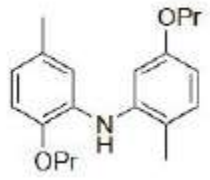
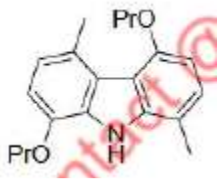
70. The major products A and B formed in the following reaction sequence are



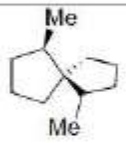
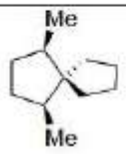
1. 

2. 

3. 

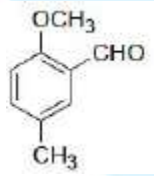
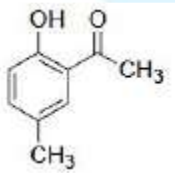
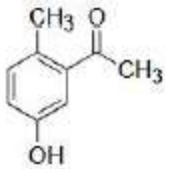
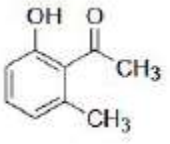
4. A =  B = 

71. The correct match for methyl groups of molecules in Column P with their topicity in Column Q is

	Column P		Column Q
A.		i.	Enantiotopic
B.		ii.	Homotopic
C.		iii.	Diastereotopic

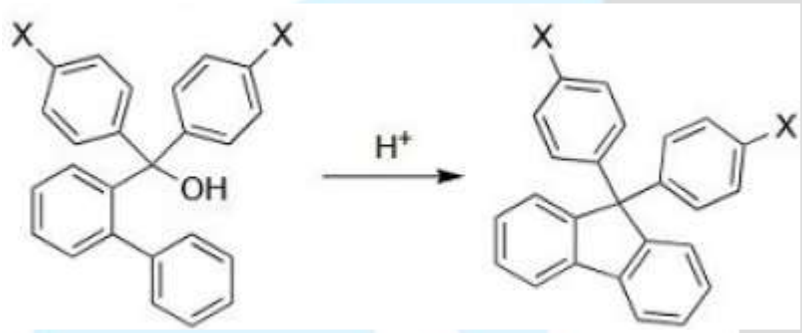
1. A ii; Bi; c-iii
2. A iii; B ii; C-i
3. A i; Bii; Ciii
4. A-ii; B-iii; C-i

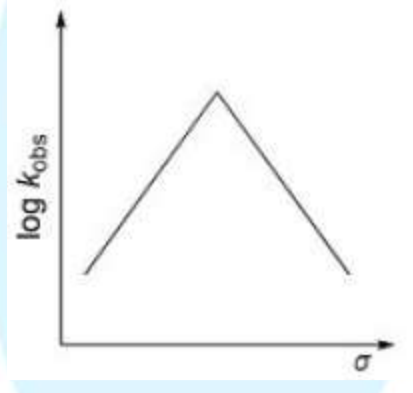
72. The compound that gives the following ^1H NMR spectral data is $^1H\ NMR\ (CDCl_3)$: $\delta 11.80\ (s, 1H), 7.69\ (d, J = 2.3\ Hz, ^1H), 7.35\ (dd, J = 8.5, 2.3\ Hz, ^1H), 6.86\ (d, J = 8.5\ Hz, ^1H), 2.63\ (s, 3H), 2.28\ (s, 3H)\ ppm.$

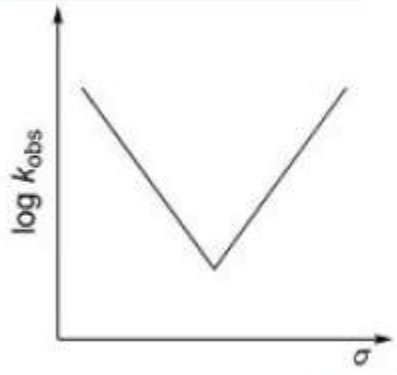
1. 
2. 
3. 
4. 

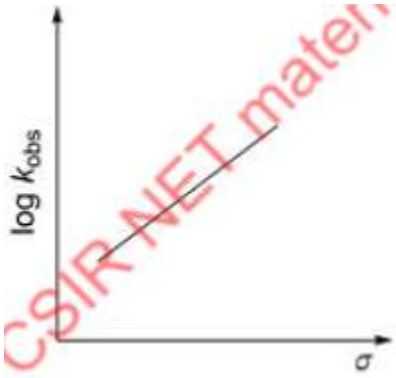
73. At 100 Pa and 500 K, the number of collisions Ar atoms make on a solid surface of area 1.0 cm^2 in 10 s is closest to
[Molar mass of Ar is 40 $g\ mol^{-1}$; assume Ar to behave as a perfect gas]
1. 1.9×10^{21}
2. 2.1×10^{23}
3. 3.5×10^{19}
4. 4.7×10^{17}

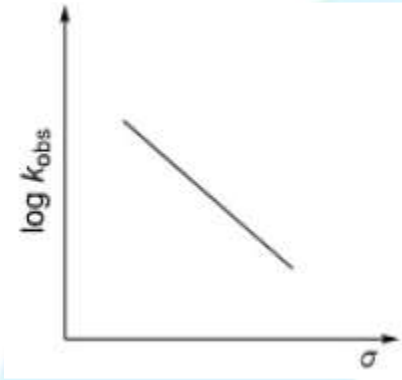
74. The Hammett plot for the following transformation is



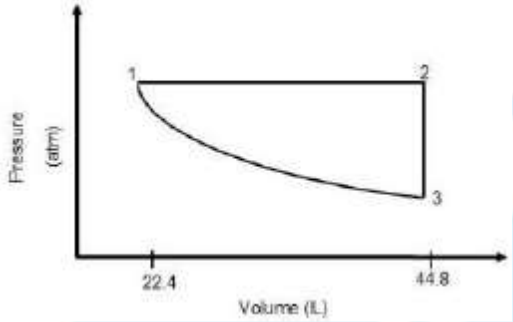
1. 

2. 

3. 

4. 

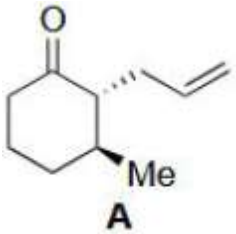
75. One mole of a monoatomic ideal gas at 1 atm pressure is taken through the p-V cycle as shown below.



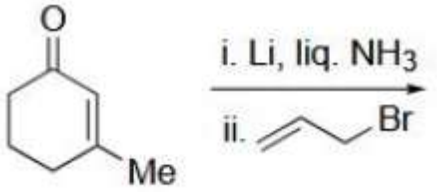
For the process $1 \rightarrow 2$, the reversible work done and the change in enthalpy (in kJ), respectively, are

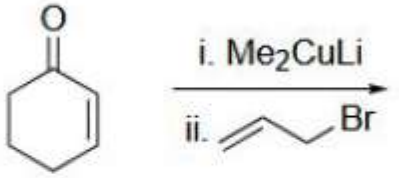
1. -2.27 and 5.67
2. 3.40 and 2.27
3. 3.40 and -5.67
4. -2.27 and 3.40

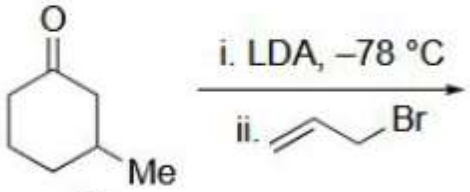
76. The reactions that give A as the major product are

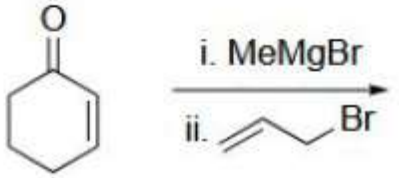


A

I. 

II. 

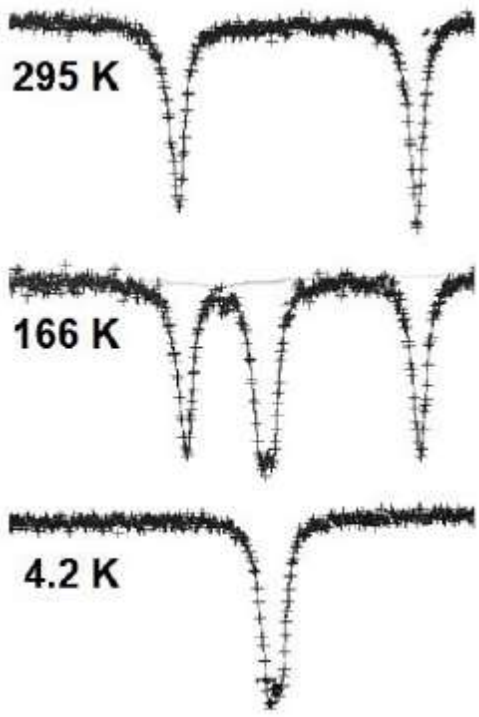
III. 

IV. 

1. I and II
2. I and III
3. II and III
4. II and IV

77. If the crystal field splitting energy of d-orbitals follows the order: $d_{z^2} < d_{xy} = d_{x^2-y^2} < d_{xz} = d_{yz}$, the ligand field is
1. square planar
2. trigonal bipyramidal
3. square antiprismatic
4. pentagonal bipyramidal

78. The Mössbauer spectra of $[Fe(L)_2]_2$ (L= 3,5-dimethyl-tris-pyrazolylborate), shown below, exhibit temperature-dependent spin-transition behaviour.



The correct statements from the following

A. At 295 K, the Fe(II) center is high-spin.

B. At 4.2 K, the Fe(II) center is low-spin.

C. At 295 K, the Fe(II) center is low-spin.

D. At 4.2 K, the Fe(II) center is high-spin.

E. At 166 K, it represents a mixture of low-spin and high – spin Fe(II) complexes.

are

1. A, B and C only
2. B, C and E only
3. C, D and E only
4. A, B and E only

79. The mass spectra of $Pd(PPh_3)_4$ alone and a mixture of $Pd(PPh_3)_4$ and sulfonated triphenylphosphine, [L], are recorded on two different machines. The relevant data is given below.

Species	Machine	Mode	Relative intensity of the corresponding mass signal				
			n=0	n=1	n=2	n=3	n=4
$[\mathrm{Pd(PPh_3)_n}]^+$	Machine I	(+)-ion	-	1%	22%	100%	8%
$[Pd(L)(PPh_3)_n]^-$	Machine I	(-)-ion	2%	35%	100%	-	-
$[Pd(L)(PPh_3)_n]^-$	Machine II	(-)-ion	12%	100%	1%	-	-

Consider the following statements based on the above data:

A. Machine I provides a softer ionization conditions than Machine II.

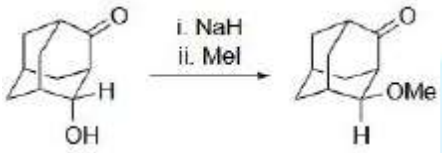
B. In Machine I, the stable species under the MS conditions contain three phosphine ligands.

C. Mass data reveal ligand exchange reaction.

D. The increased prevalence of monophosphine ion, $[Pd(L)]^-$, in Machine II is attributed to ion fragmentation.

The option containing the correct statements is
1. A, B, C and D
2. A, B and C only
3. B, C and D only
4. A, C and D only

80. The correct sequence of processes involved in the following transformation is



1. i. deprotonation, ii. O-methylation
2. i. enolate formation, ii. retro-aldol reaction, iii. O-methylation
3. i. deprotonation, ii. retro-aldol reaction, iii. O-methylation, iv. aldol reaction
4. i. deprotonation, ii. retro-aldol reaction, iii. aldol reaction, iv. O-methylation

81. The correct statements regarding olefin polymerization involving metallocene and alkyl aluminum species, from the following
A. Trace amounts of water cause a significant increase in the rates of ethylene polymerization by the $Cp_2\ TiEtCI/AIEt_2Cl$ system
B. Methylaluminoxane (MAO) is employed as an activator for the catalyst, Cp_2ZrMe_2.
C. $B(C_6F_5)_3$ is an activator for Cp_2ZrMe_2.
D. The termination step of the polymerization reaction is β-hydride elimination.
are,
1. A, B, C and D
2. A, B and C only
3. A, B and D only
4. B, C and D only

82. The EPR spectrum of $[InH_{3^*}]^-$ [Given: In $\left(I=\frac{9}{2}\right)$; $H\left(I=\frac{1}{2}\right)$] is comprised of
1. 10 lines of equal intensity where each line further splits into 4 lines with intensity 1:3:3:1.
2. 4 lines with intensity 1:3:3:1 where each line further splits into 10 lines with equal intensity.
3. 10 lines with unequal intensity where each line further splits into 4 lines with intensity 1:3:3:1.
4. 4 lines with intensity 1:1:1:1 where each line further splits into 10 lines with unequal intensity.

83. The electronic configurations showing tetragonal compression and elongation in their octahedral complexes, respectively, are
1. d^1 and low-spin d^4
2. d^1 and d^9
3. d^9 and d^3
4. low-spin d^4 and high-spin d^5

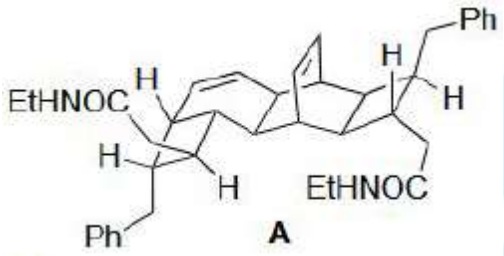
84. The correct statements about agostic interactions from the following
A. It involves a three-center-two-electron interaction with a C-H bond of the ligand.

B. The C-H bond of the ligand involved in agostic interaction is lengthened.
C. Its presence is identified by an upfield chemical shift of the C-H bond of the ligand.
D. It lowers the pKa of the C-H bond of the ligand.
are
1. A, B, C and D
2. A, B and C only
3. B, C and D only
4. A, C and D only

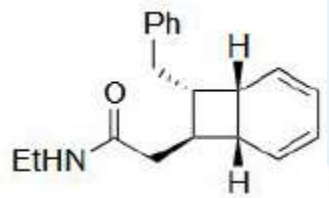
85. The dielectric constants of electrolyte solutions, A and B, are ε and 2ε, respectively. At a given temperature T, the ratio, $\lambda_D(A)/\lambda_D(B)$ of two Debye (ionic) screening lengths $\lambda_D(A)$ and $\lambda_D(B)$ is
1. 1
2. 2
3. $\sqrt{2}$
4. $1/\sqrt{2}$

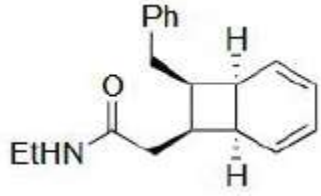
86. The rate law for the reaction $N_2O_2(g) \rightarrow 2NO(g)$ is first order in the concentration of N_2O_2. If the initial concentration of N_2O_2 is $1.0\, mol\, dm^{-3}$, the expression for time-dependent behavior of concentration of NO (in $mol\, dm^{-3}$) is
1. $2\left(1 - e^{-kt}\right)$
2. $1 - e^{-kt}$
3. $0.5\left(1 - e^{-kt}\right)$
4. $1 + e^{-kt}$

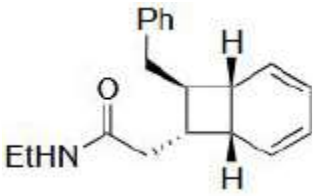
87. The starting material that gives compound A on heating is

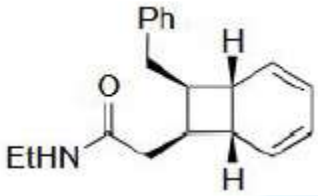


A

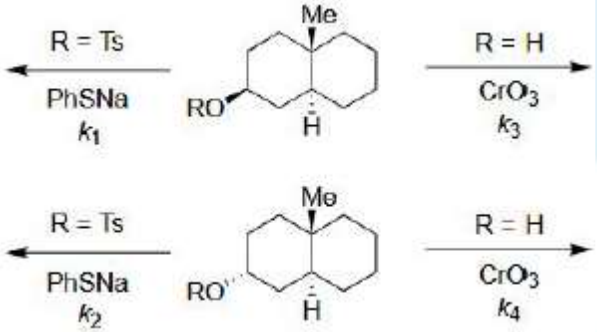
1. 

2. 

3. 

4. 

88. The relative order of rate constants in the following transformations are

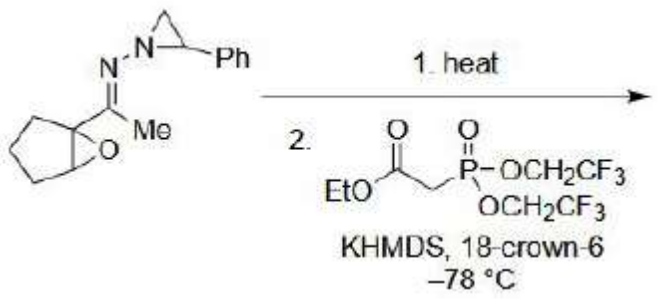


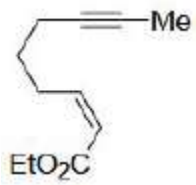
1. $k_2 > k_1; k_4 > k_3$
2. $k_2 > k_1; k_3 > k_4$
3. $k_1 > k_2; k_4 > k_3$
4. $k_1 > k_2; k_3 > k_4$

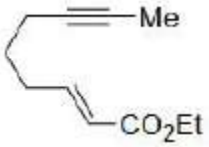
89. The magnitude of the orbital angular momentum vector of a quantum mechanical system is $\sqrt{6}h$. The smallest possible angle between its orbital angular momentum vector and the z-axis is

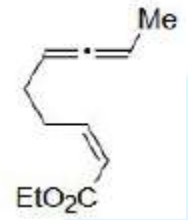
1. $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$
2. $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$
3. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$
4. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

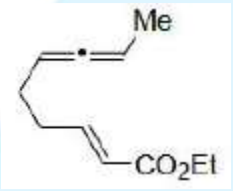
90. The major product formed in the following reaction sequence is



1. 

2. 

3. 

4. 

91. The correct number of stereoisomers and the correct number of enantiomeric pairs of $[Co(trien)Br_2]^+$ (trien triethylenetetraamine), respectively, are

1. 5 and 2
2. 4 and 2
3. 5 and 4
4. 6 and 4

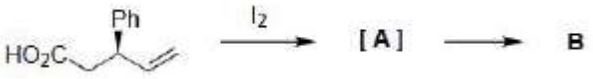
92. The number of permitted configurations for NV water molecules at absolute zero temperature is

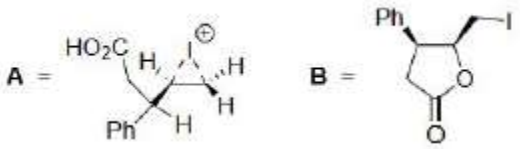
1. 2^{2N}
2. 2^{4N}
3. $2^{2N}\left(\frac{3}{8}\right)^N$
4. $2^{2N}\left(\frac{8}{3}\right)^N$

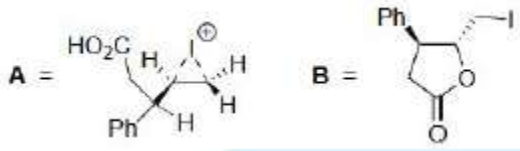
93. For complex $[Ni(RNH_2)_6]^{2+}$ (R = alkyl), Δ_0 is $12{,}600cm^{-1}$. The spin-orbit coupling constant (λ) for Ni^{2+} ion is $-315cm^{-1}$. The μ_{eff} (in BM) for the complex is closest to

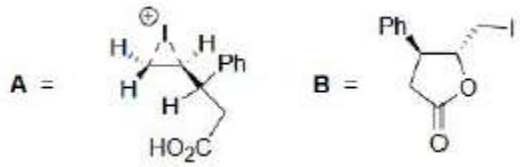
1. 3.11
2. 2.97
3. 2.83
4. 2.55

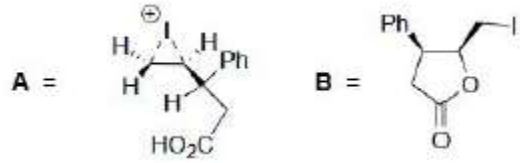
94. The intermediate A and major product B formed in the following reaction are



1. 

2. 

3. 

4. 

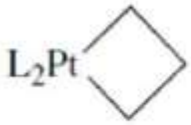
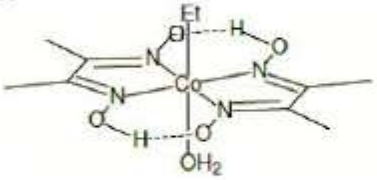
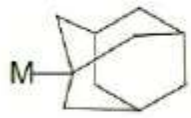
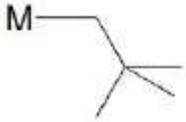
95. The solubility of Bi_2S_3 in aqueous solution at 25°C is $1.4 \times 10^{-20} M$. Given that $E^0\left(\frac{Bi^{3+}}{Bi}\right) = 0.226V$, the value of $E^0(Bi_2S_3/Bi, S^{2-})$ (in V) at 25°C is closest to

1. 1.18
2. -0.73
3. -0.96
4. 0.23

96. The wave function of a quantum mechanical system with the Hamiltonian H is $\Psi = c_1 f_1 + c_2 f_2$, where c_1, c_2 are constants and f_1, f_2 are orthonormal basis functions.
If $H_{11} = H_{22} = 5\ eV$ and $H_{12} = H_{21} - 2\ eV$, where $H_{ij} = \langle f_i|H|f_j\rangle$, the ground state energy (in eV) of the system obtained by variation method is

1. 7
2. 5
4. 3
4. 2

97. List I contains metal-alkyl compounds which do not undergo β-hydride elimination step and LIST II gives the reasons.

LIST I	LIST II
A. 	P. A planar transition state is not accessible
B. 	Q. No vacant coordination site on the metal center
C. 	R. Leads to a bridgehead olefin
D. 	S. Lacks β-hydrogen

The option containing the correct match is

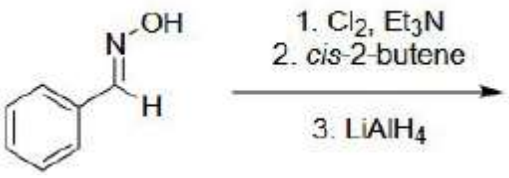
1. A-P, B-Q, C-R, D-S
2. A-Q, B-R, C-S, D-P
3. A-R, B-S, C-P, D-Q
4. A-S, B-P, C-R, D-Q

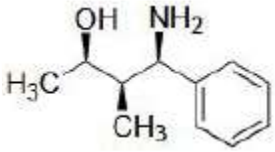
98. Let H(x) be the Hamiltonian defined by $H(x) = \frac{p_x^2}{2m} + V(x)$.

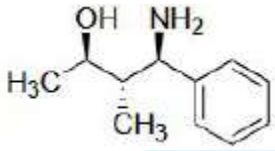
Given $[H, x] = \frac{h}{lm} p_x$ and $H\phi_j = \varepsilon_j \phi_j (j = 0,1,2,\ldots); \varepsilon_0 < \varepsilon_1 < \varepsilon_2 < \cdots$, the correct statement, for $j \neq 0$, is

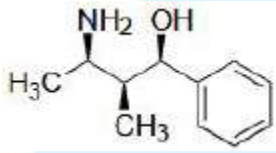
1. $\langle \phi_j | p_x | \phi_0 \rangle = \frac{ih}{m} \langle \phi_j | x | \phi_0 \rangle (\varepsilon_j - \varepsilon_0)$
2. $\langle \phi_j | p_x | \phi_0 \rangle = \frac{ih}{m} \langle \phi_j | x | \phi_0 \rangle (\varepsilon_0 - \varepsilon_j)$
3. $\langle \phi_j | p_x | \phi_0 \rangle = \frac{m}{ih} \langle \phi_j | x | \phi_0 \rangle (\varepsilon_j - \varepsilon_0)$
4. $\langle \phi_j | p_x | \phi_0 \rangle = \frac{m}{ih} \langle \phi_j | x | \phi_0 \rangle (\varepsilon_0 - \varepsilon_j)$

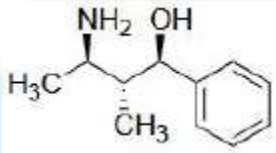
99. The major product formed in the following reaction sequence is



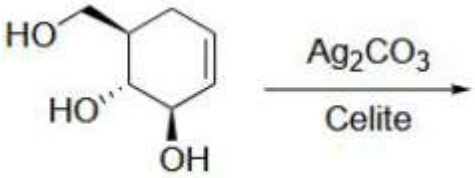
1. 

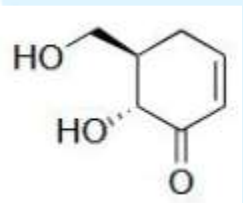
2. 

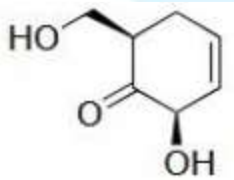
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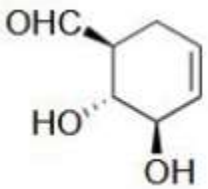
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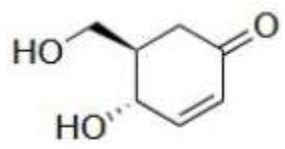
100. The major product formed in the following reaction is



1. 

2. 

3. 

4. 

101. The character table of C_{3v} point group is as follows.

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

For normal modes of vibration of NH3, the correct statement, among the following, is

1. Some of the normal modes are IR-inactive
2. At least one normal mode is both IR and Raman-inactive
3. Mixing of normal modes by the symmetry operations is not possible
4. For some of the normal modes, the wavefunction of first vibrational excited state is totally symmetric

102. The self-exchange rate and the reduction potential for the following redox couples are given below. ($R = 8.314\, JK^{-1}mol^{-1}$, Faraday constant $= 96485\ C\ mol^{-1}$)

	self-exchange rate $(M^{-1}s^{-1})$	$E^0(V)$
$Ce^{4+/3+}$	4.0	1.70
$[Fe(phen)]^{3+/2+}$	3×10^7	1.00

$Ce^{4+} + [Fe(phen)]^{2+} \rightarrow Ce^{3+} + [Fe(phen)]^{3+}$

For the above reaction, the approximate rate constant $(in\ M^{-1}s^{-1})$ at 25°C is

1. 1.1×10^{10}
2. 1.1×10^{5}
3. 1.2×10^{20}
4. 3.5×10^{26}

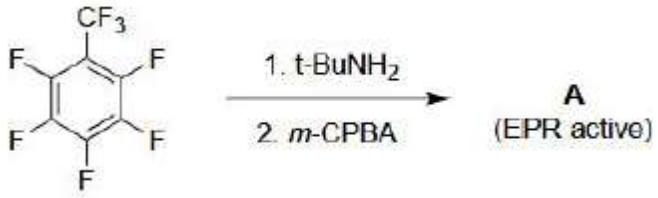
103. The θ-dependent part of an un-normalized atomic orbital is $\phi(\theta) = \cos\theta$. In the range $0° \leq \theta \leq 90°$, the maximum probability of finding an electron in this orbital, between θ and $\theta + d\theta$, is for $\theta =$

1. 0°
2. 35.3°
3. 54.7°
4. 90°

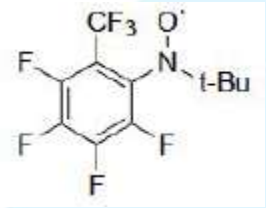
104. In the photochemical reaction $A \rightarrow B$, 2.5 mmol of A is converted into B on irradiation with 100 W light of wavelength 300 nm for 66 s. The quantum yield of the reaction is closest to

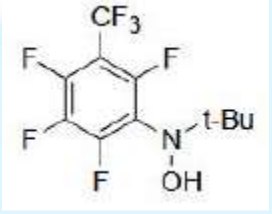
1. 0.05
2. 0.15
3. 0.25
4. 0.35

105. The major product A formed in the following reaction sequence is



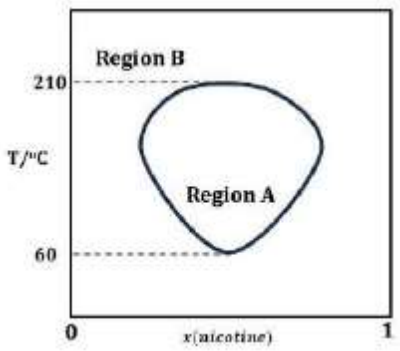
1. 

2. 

3. 

4. 

106. Consider the following temperature-composition diagram for water and nicotine.

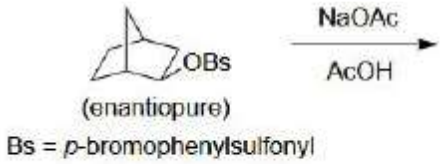


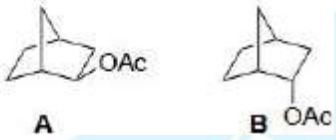
The correct option is

1. The system has two critical solution temperatures; both nicotine and water are completely miscible at 100 °C and x(nicotine) = 0.5
2. At 75 °C and x(nicotine) = 0.5, nicotine and water form a strong complex which does not dissociate
3. Nicotine and water form weak complex at 50 °C; the number of phases (P) in the region A is 2

4. Thermal motion homogenises the mixture in the entire region B where P = 1

107. The correct statement about the major product of the following reaction is



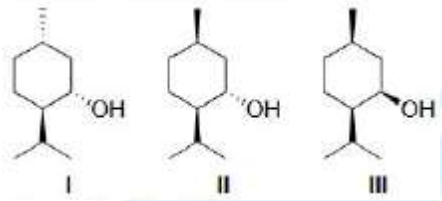


1. A is formed and is optically active
2. A is formed and is racemic
3. B is formed and is optically active
4. B is formed and is racemic

108. The rotational constant of a diatomic molecule is $2.0\ cm^{-1}$. The wavelength of the excitation laser is 333 nm. Assuming rigid rotor model of diatomic molecule, the first three Stokes lines cm^{-1}) in the rotational Raman spectrum are predicted to be closest to

1. 30018, 30010, 30002
2. 30058, 30050, 30042
3. 30018, 30014, 30010
4. 30034, 30030, 30026

109. The correct order for the relative rate of esterification of I, II, and III with p- nitrobenzoyl chloride is



1. I>III>II
2. I>II>III
3. II>III>I
4. III>I>II

110. The correct statements regarding the inner-transition elements from the following

A. The absorptions in the electronic spectra involve $4f \rightarrow 4f$ and $4f \rightarrow 5d$ transitions.

B. The experimental magnetic moment of Eu^{3+} ion is greater than the calculated spin-only magnetic moment.

C. The $4f \rightarrow 4f$ transitions are sharp while $4f \rightarrow 5d$ transitions are broad.

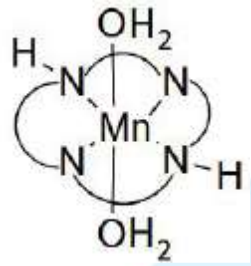
d. The peak positions for the $4f \rightarrow 4f$ transitions are marginally affected by the ligand environment.

are

1. A, B and C only

2. B, C and D only
3. A, C and D only
4. A, B, C and D

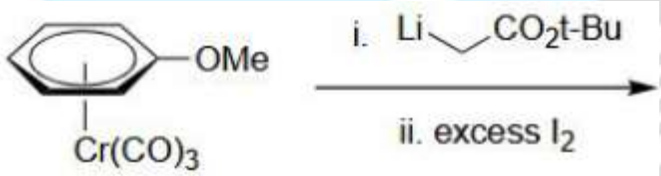
111. The total number of lines expected in the EPR spectrum of a high-spin Mn(II) complex [Given; $I_{Mn} = \frac{5}{2}; I_N = 1$], for which the schematic diagram is shown below

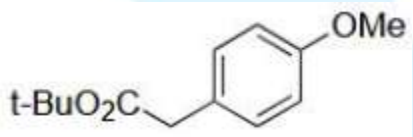


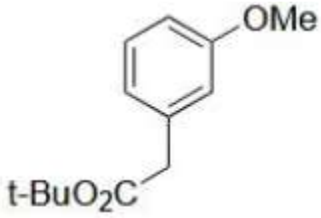
is
1. 6
2. 54
3. 270
4. 30

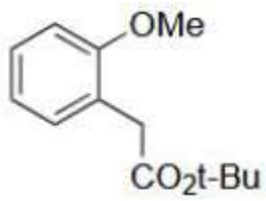
112. Double logarithmic plot of the intrinsic viscosity and the molar mass of polymers in solution is linear with slope $\frac{3}{4}$. The ratio of molar mass of two solutions of the same polymer of different molar mass is 16. The expected ratio of their measured intrinsic viscosity in an experiment will be
1. 2
2. 4
3. 8
4. 16

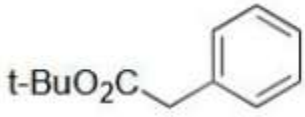
113. The major product formed in the following reaction is



1. 

2. 

3. 

4. 

114. Consider the following statements regarding corrin ring (P) and porphyrin ring (Q)

A. P is fully conjugated, rigid and bigger in size than Q.

B. P is fully conjugated, more flexible and ring size is same as Q.

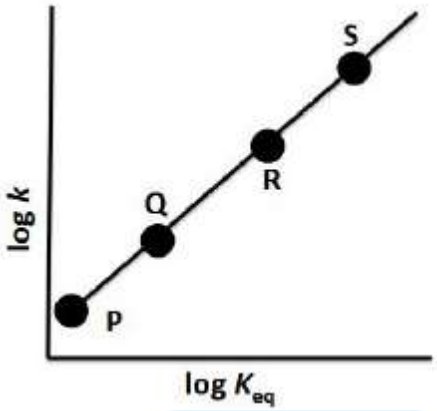
C. P is partially reduced, more flexible and smaller in size than Q.

D. The flexibility of P supports multiple oxidation states of cobalt.

The correct statements are:

1. A and B only
2. C and D only
3. A and D only
4. B and D only

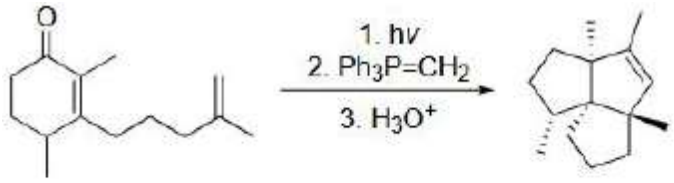
115. The plot shown below is for the rate of acid hydrolysis reaction of $[Co(NH_3)_5X]^{2+}$ at 25 °C, where X is an anionic ligand $(F^-, CH^-, NO_3^-, H_2PO_4^-)$.

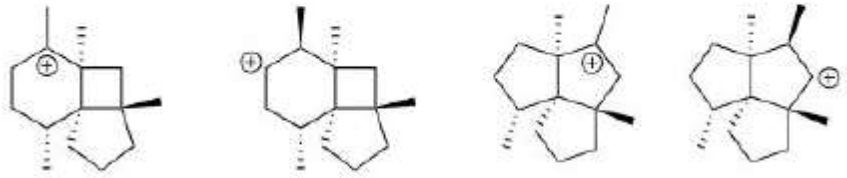


The correct option is

1. $P = F^-, Q = H_2PO_4^-, R = CI^-, S = NO_3^-$
2. $P = Cl^-, Q = H_2PO_4^-, R = F^-, S = NO_3^-$
3. $P = H_2PO_4^-, Q = Cl^-, R = F^-, S = NO_3^-$
4. $P = NO_3^-, Q = Cl^-, R = H_2PO_4^-, S = F^-$

116. The intermediates involved in the following reaction sequence are





A B C D

1. A and B
2. B and D
3. A and C
4. C and D

117. A particle of mass m is confined to a one-dimensional box of unit length. The wave function of the system is $\Psi(x) = \sqrt{\frac{8}{5}} sin(\pi x)\,[1 + cos(\pi x)]\; for\; 0 \leq x \leq 1$, and zero elsewhere. The average value of the energy in this state is

1. $h^2/5m$
2. $h^2/3m$
3. $h^2/8m$
4. $h^2/10m$

118. The free ion ground term, the calculated spin plus orbital magnetic moment value, the calculated spin-orbit magnetic moment value and the observed magnetic moment value (300 K), for a gaseous $3d^5$ ion, respectively, are

1. $^6S_{5/2}, 5.92\ BM, 5.92\ BM, 5.8 - 6.0\ BM$
2. $^6S_{5/2}, 5.92\ BM, 6.70\ BM, 5.8 - 6.0\ BM$
3. $^6S_{5/2}, 5.92\ BM, 5.92\ BM, 4.8 - 5.0\ BM$
4. $^6S_{5/2}, 5.59\ BM, 6.70\ BM, 5.8 - 6.0\ BM$

119. For the C_3 point group, with C_3 axis along the z-direction, the correct statement is

1. All the three symmetry operations ($C_3, C_3^2\ and\ C_3^3 = E$) belong to the same class
2. The character table contains a two-dimensional irreducible representation
3. All the characters in the character table are ± 1
4. x and y jointly form a basis for a two-dimensional representation.

120. The correct match between the enzymes (Column P) and the biological functions (Column Q) from the table below

Column P	Column Q
(a) Cytochrome C Oxidase	(i) DNA biosynthesis
(b) Tyrosinase	(ii) Hydrolysis
(c) Purple acid phosphatase	(iii) Oxidation of phenols

(d) Galactose oxidase	(iv) Oxidation of alcohols
(e) Ribonucleotide reductase	(v) Reduction of O_2 to water

is

1. a-iii, b-i, c-iv, d-ii, e-v
2. a-i, b-ii, c-iii, d-iv, e-v
3. a-v, b-iii, c-ii, d-iv, e-i
4. a-ii, b-iv, c-v, d-i, e-iii