TEST SERIES GATE 2017

BOOKLET SERIES B

[SOLUTIONS]

Paper Code: CY

Test Type: TEST SERIES

Duration: 3:00 Hours

CHEMISTRY-CY

Date: 20-01-2017

Maximum Marks: 100

Read the following instructions carefully:

1. Attempt all the questions.
2. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory. The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
   The subject specific GATE paper section consists of **55** questions, out of which question numbers 11 to 35 are of 1-mark each, while question numbers 36 to 65 are of 2-mark each.
3. The question paper may consist of questions of **multiple choice type** (MCQ) and **numerical answer type**.
4. Multiple choice type questions will have four choices against (a), (b), (c), (d), out of which only **ONE** is the correct answer.
5. For numerical answer type questions, each question will have a numerical answer and there will not be any choices**.**
6. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of ⅓ marks for a **1-mark** question and ⅔ marks for a **2-mark** question.
7. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
8. Non-programmable type Calculator is allowed

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Q.1-Q. 5 carry ONE mark each.

1. If the sum of five consecutive integers is S, what is the largest of those integers in terms of S?

(a) $\frac{S-10}{5}$ (b) $\frac{S-10}{4}$ (c) $\frac{S+10}{5}$ (d) $\frac{S-10}{10}$

Soln. Let the number be 1, 2, 3, 4 and 5 largest = 5

Then, S = 1 + 2 + 3 + 4 + 5 = 15

by options

(a) $\frac{S-10}{5}=\frac{15-10}{5}=\frac{5}{5}=1$ not largest

(b) $\frac{S-10}{4}=\frac{15-10}{4}=\frac{5}{4}\neq 5$

(c) $\frac{S+10}{5}=\frac{15+10}{5}=5$ which is largest

(d) $\frac{S-10}{10}=\frac{15-10}{10}=\frac{5}{10}\neq 5$

Correct option is (c)

2. If the product of 4 consecutive integers is equal to one of them, what is the largest possible value of one of the integers?

(a) 0 (b) 3 (c) 4 (d) 6

Soln. Out of these 4 consecutive numbers, one number will be 0 because of these integers is sequal to one of them

Numbers are 0, 1, 2, 3

We have to select the largest number which is 3

Correct option is (b)

3. Fill in the blank with appropriate word. He is _____ opponent, you must respect and fear him at all times.

(a) A redoubtable (b) A disingenuous

(c) C raven (d) An insignificant

Soln. He is a redoubtable opponent, you must respect and fear him all times.

Correct option is (a)

4. $(0.55)^{150}$ is closest to

(a) 0.1 (b) 0 (c) 10 (d) 100

Soln. When it expands it is closest to 0.

Correct option is (b)

5. What is the Missing term in sequence ABC, A^2BC, A^2B^2C, _____, $A^3B^2C^2$.

(a) A^3B^2C (b) $A^2B^2C^2$ (c) $A^3B^3C^2$ (d) A^3BC

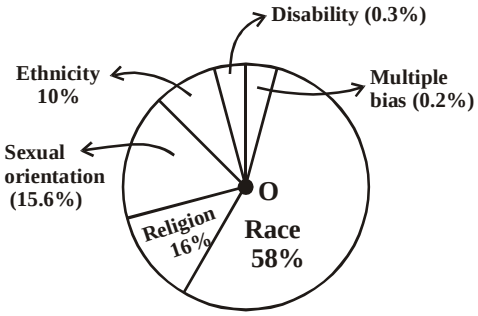
Soln. $AB\underbrace{C, A^2}_{XA}\ B\underbrace{C\quad A^2}_{XB}\ B^2\ \underbrace{C\quad A^2}_{XC}\ B^2\ \underbrace{C\quad A^2}_{XA}\ B^2C$

Therefore, $A^2B^2C^2$

Correct option is (b)

Q.6-Q. 10 carry TWO marks each.

6.



Percent– distribution of Bias – Motivated offenses in 1998 in USA.
If in 1998, there were 10, 000 bias motivated offenses based on ethnicity, how many more offenses were based on religion than on sexual orientation?

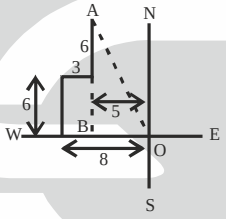
(a) 4 (b) 40 (c) 400 (d) 4000

Soln. 10% = 10000
Religion – sexual orientation = ?
16 % – 15.6% $\Rightarrow$ 0.4 = ?
10% = 10000
0.4% = 0.4×1000 = 400
Correct option is (c)

7. A person moves 8 km west, 6 km north, 3 km east, and 6 more km north. How far is this person from his starting place

(a) 13 (b) 17 (c) 19 (d) 21

Soln. We have to find OA
In triangle OAB
OB = 8–3 = 5
AB = 6 + 6 = 12
OA = $\sqrt{5^2+12^2} = 13$
Correct option is (a)



8. Fill in the blank by appropriate words?
The new computer system ____ next month.

(a) Is being installed by people (b) Is be installed
(c) Is being installed (d) Is been installed

Soln. The new computer system is being installed next month. Sentence in passive form.
Correct option is (c)

9. Fill in the blank by appropriate words it's _____ disappointing.

(a) Very much (b) Very (c) Much (d) Much very

Soln. It is very disappointing.
Correct option is (b)

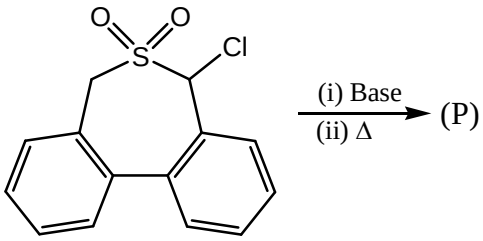
10. If Rout is related to Defeat then which pair is correctly matched

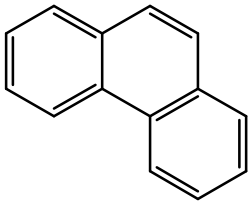
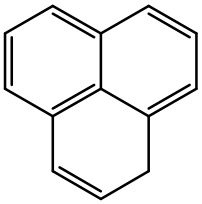
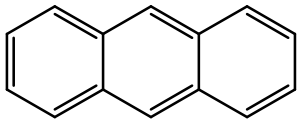
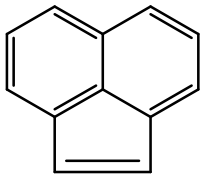
(a) Grief : Loss (b) Pathway : Ruin
(c) Memory : Oblivion (d) Ovation : Applause

Soln. Rout : Defeat : : Ovation : Applause
Correct option is (d)

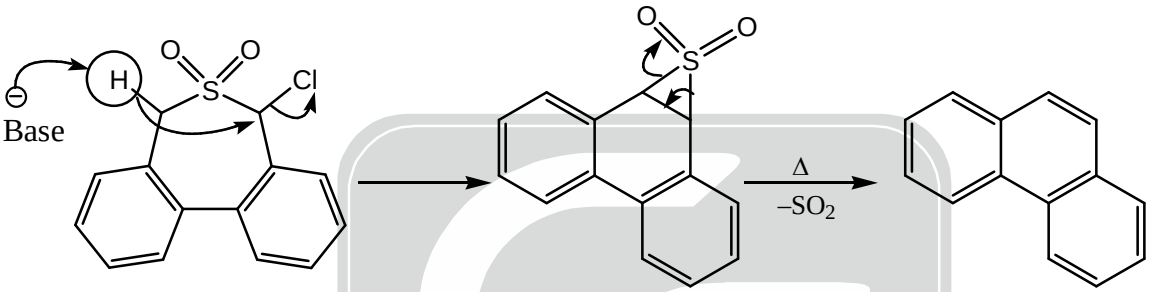
Q.11-Q.35 carry one mark each.

11. The major product (P) formed in the reaction is



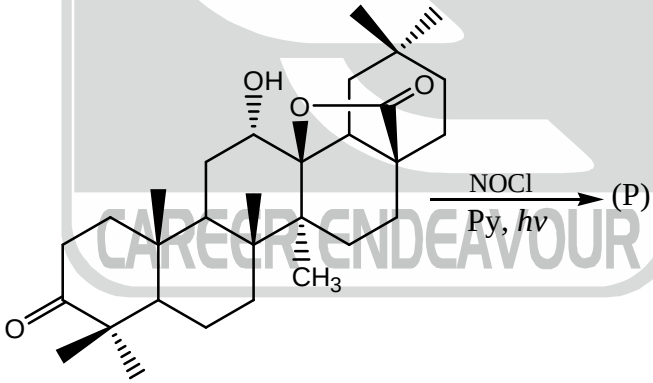
(a)  (b)  (c)  (d) 

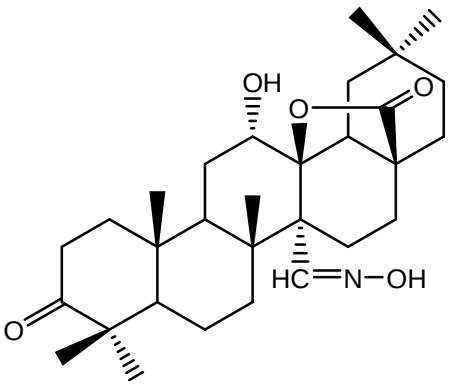
Soln.

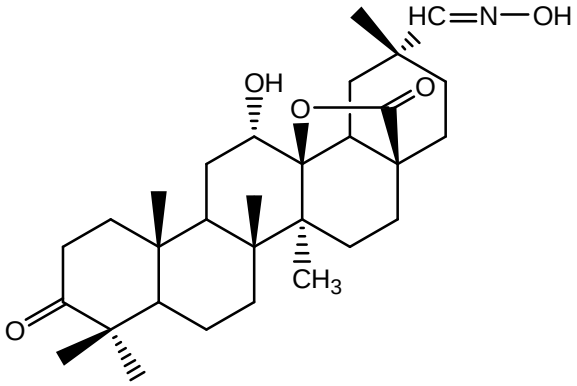


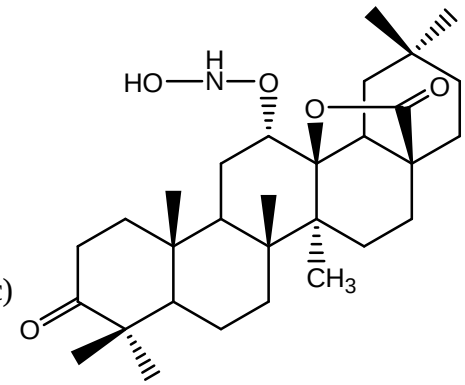
Correct option is (a)

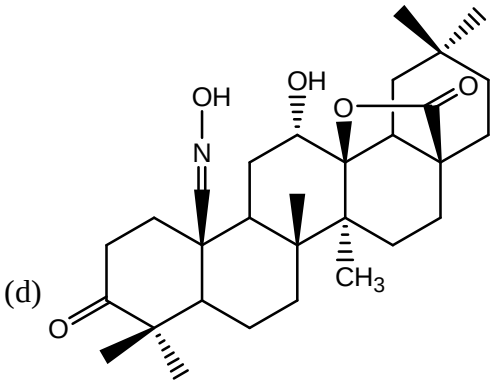
12. The product (P) is

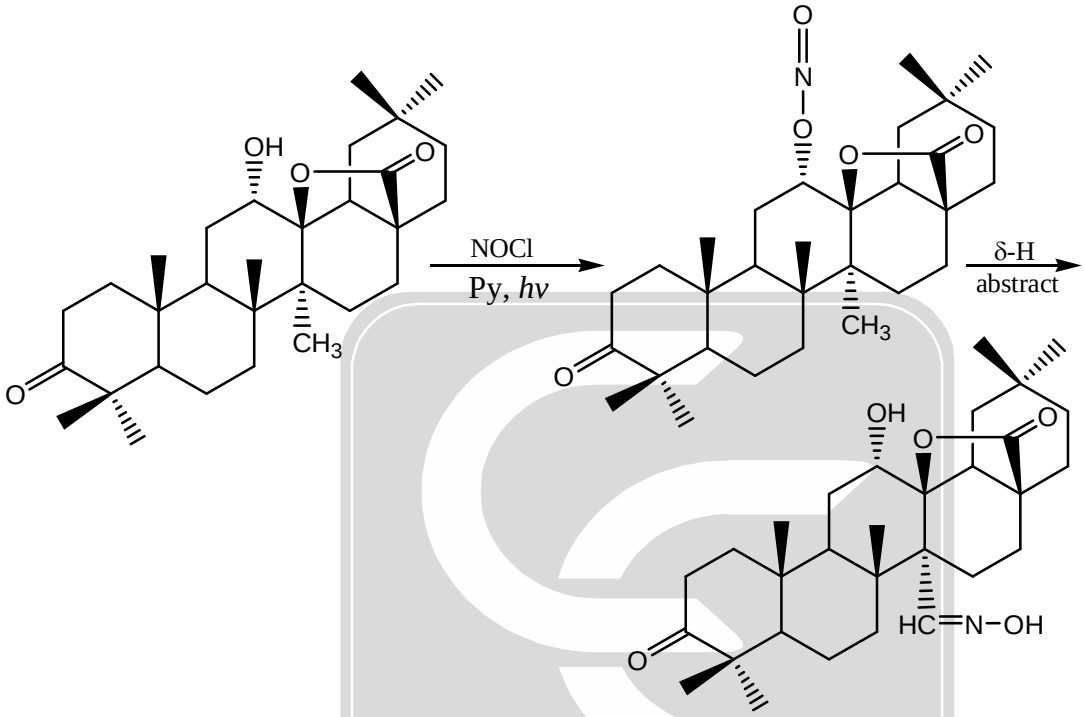


(a) 

(b) 

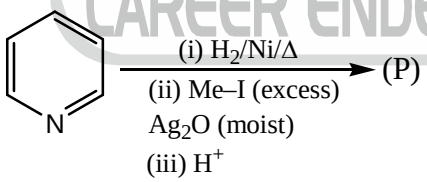
(c) 

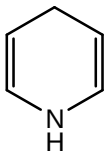
(d) 

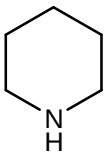
Soln. 

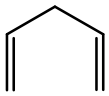
Correct option is (a)

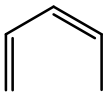
13. The major product (P) is

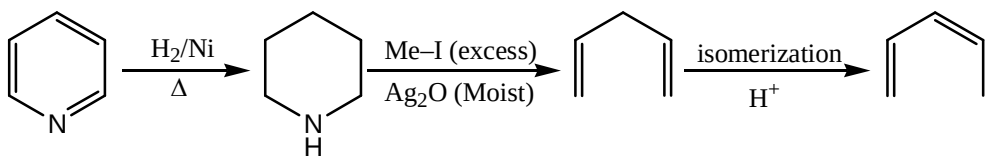


(a) 

(b) 

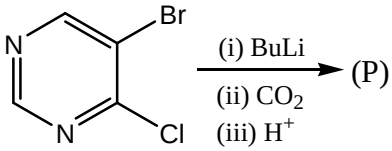
(c) 

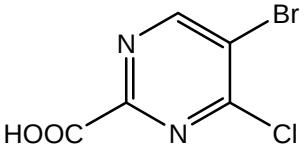
(d) 

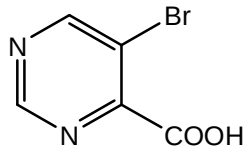
Soln. 

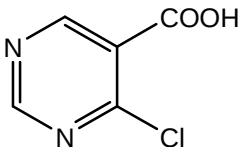
Correct option is (d)

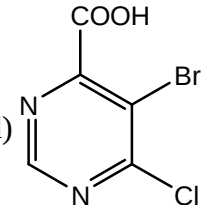
14. The major product (P) is

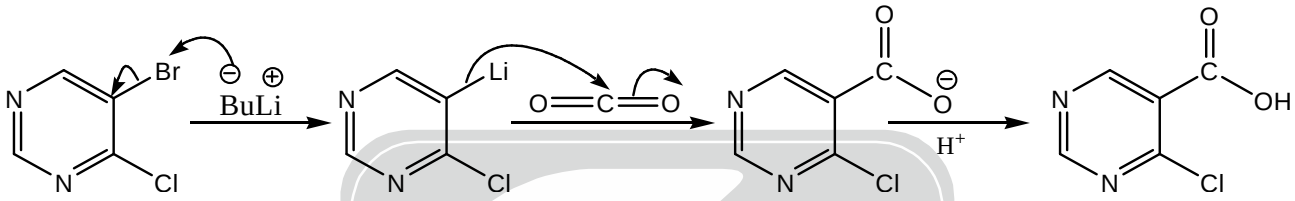


(a) 

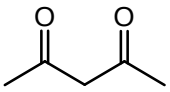
(b) 

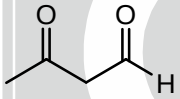
(c) 

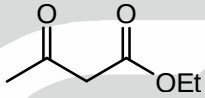
(d) 

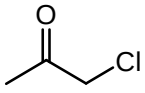
Soln. 

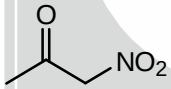
Correct option is (c)

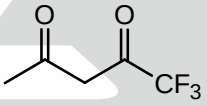
15. (A) 

(B) 

(C) 

(D) 

(E) 

(F) 

Correct order of pK_a value of the above compounds

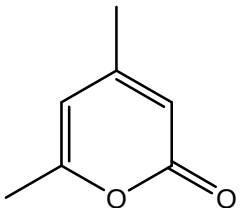
(a) C > D > A > B > E > F
(b) D > C > A > B > E > F
(c) F > E > B > A > C > D
(d) C > D > B > A > F > E

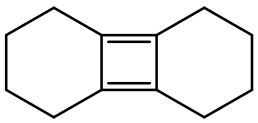
Soln. pK_a value of the following compounds.

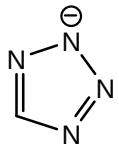
A = 9, B = 5.9, C = 10.7, D = 16.5, E = 5.1, F = 4.7

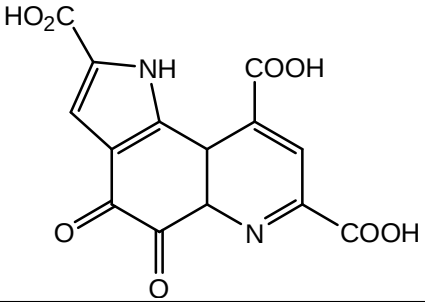
Correct option is (b)

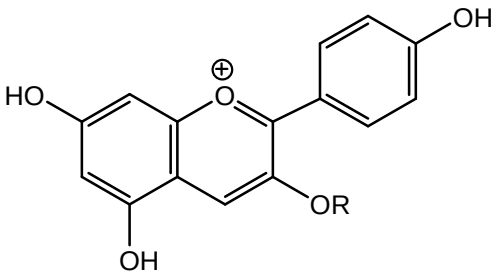
16. In the following compounds, the number of aromatic compound is/are _____

(A) 

(B) 

(C) 

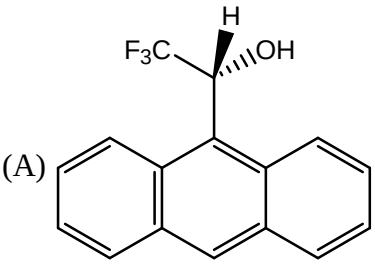
(D) 

(E) 

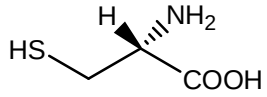
Soln. Structure (A), (C) and (E) are aromatic in nature.

Correct answer is (3)

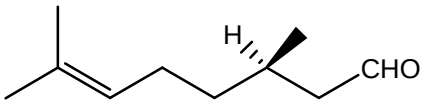
17. Assign the configuration R/S of following compound respectively



(A)



(B)



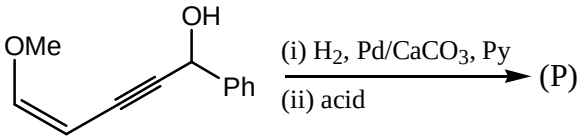
(C)

(a) S, S, R (b) R, R, R (c) S, R, S (d) S, S, S

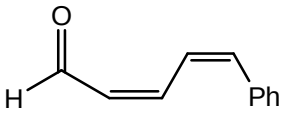
Soln. A = R, B = R, C = R

Correct option is (b)

18.



(a)



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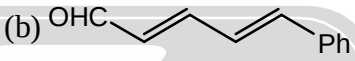
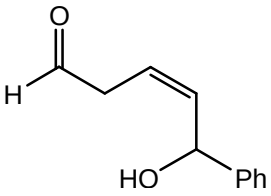
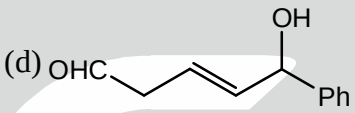


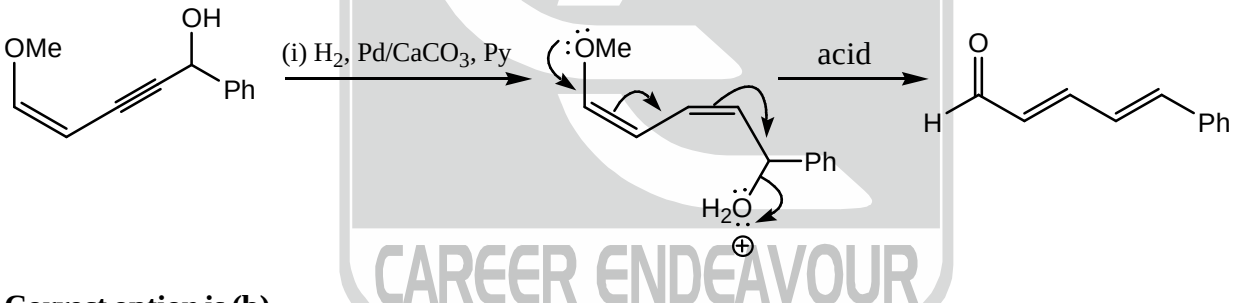
(c)



(d)

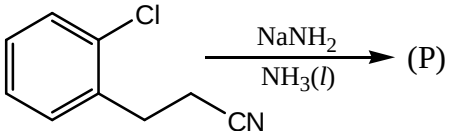


Soln.



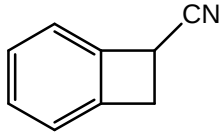
Correct option is (b)

19.



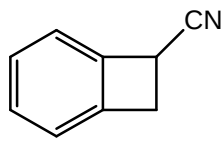
Select the major proudct (P) formed and respected mechanism

(a)

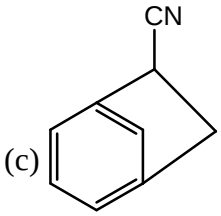


nucleophilic elimination reaction

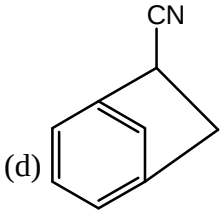
(b)



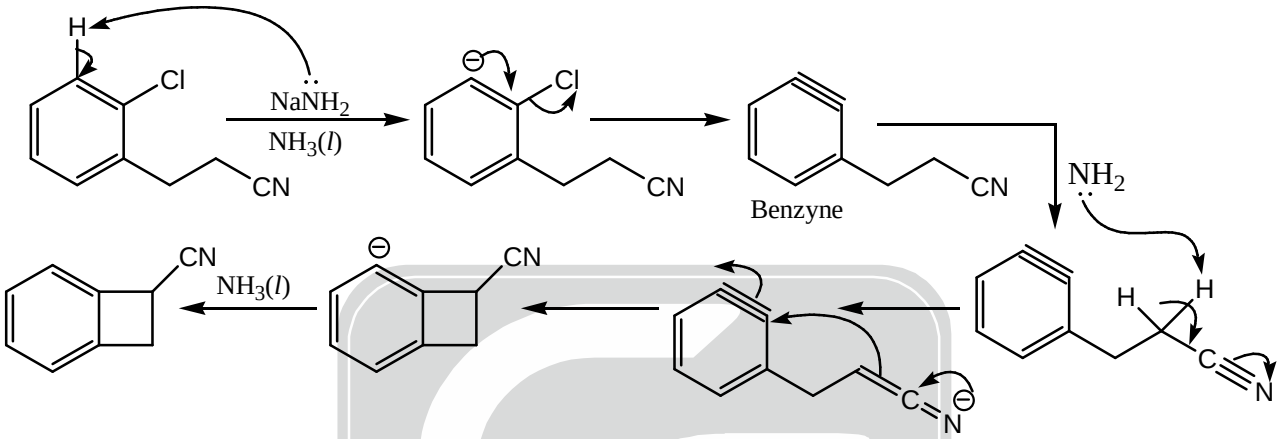
Benzyne intermediate

(c) 

Addition-elimination

(d) 

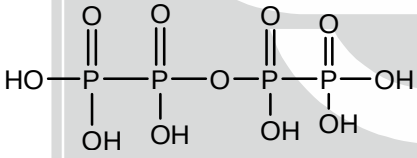
Benzyne mechanism

Soln. 

Correct option is (b)

20. The number of P-P bond present in $H_6P_4O_{11}$ is/are _____

Soln. Structure of $H_6P_4O_{11}$,



Correct option is ( )

21. Which of the following complex will show charge transfer transition in UV visible region

(1) CrO_4^{2-} (2) ReO_4^- (3) FeO_4^{2-} (4) HgI_2

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

Soln. In first three complexes due to higher oxidation state of metal there will be LMCT while in HgI_2 due to large size of iodide there will be LMCT.

Correct option is ()

22. A ten membered cyclic silicates is formed containing four sodium ions and some Zn ion this cyclic silicates contains hydrated H_2O molecules which are present in 1 : 3 in mole ratio. What is number of Zn metal ion in complete formula.

(a) 2 (b) 4 (c) 3 (d) 5

Soln. The formula will formed $Na_4Zn_3[Si_5O_{15}].9H_2O$ three zinc (Zn^{2+}) required to complete the formula.

Correct option is (c)

23. The total number of edges in $[Ce(NO_3)_6]^{2-}$ is/are_____

Soln. $[Ce(NO_3)_6]^{2-}$ complex has Icosahedral geometry. Hence, number of edges equal to 30

Correct answer is (30)

24. The structure of $[CB_9H_{10}AsCo(n^5-Cp)]$ compound is

(a) nido (b) arachno (c) closo (d) hypercloso

Soln. On solving $[CB_9H_{10}AsCo(\eta^5-Cp)]$, it give structure of $B_{12}H_{14}$ which is closo

C = BH,

As = BH_2, $[Co(\eta^5-Cp)]$, 9 + 5 = 14 electrons related to four electrons carbon of 4 electrons BH unit

$B_9H_{10} + BH + BH_2 + BH \rightarrow B_{12}H_{14} \rightarrow$ closo

Correct option is (c)

25. Reaction which is not catalyzed by co-enzyme B_{12} is

(a) dehydration (b) isomerization

(c) conversion of DNA to RNA (d) deammination

Soln. Co-enzyme B_{12} catalyse dehydration, deammination and isomerization. It catalyses the conversion of RNA to DNA.

Correct option is (c)

26. The far infrared rotational absorption spectrum of a diatomic molecule shows equivalent lines with spacing 40 cm^{-1}. The position of the second Stoke's line in the rotational Raman spectrum of this molecule is

(a) 200 cm^{-1} (b) 300 cm^{-1} (c) 400 cm^{-1} (d) 600 cm^{-1}

Soln. The line spacing in the infrared rotational absorption spectrum $2B = 40\ cm^{-1}$ and $B = 20\ cm^{-1}$.

The distance of second Stoke's line from Rayleigh line is 10 B.

The position of second Stoke's line in the rotational Raman spectrum $= 10 \times 20 = 200\ cm^{-1}$.

Correct answer is (200).

27. The ratio of molecules distributed between two states is 8×10^{10} at 500 K, the difference in energy (in kJ/mol) of the two states is_____.

Soln. $\frac{N_J}{N_0} = e^{-\Delta E/k_BT}$

$$8\times10^{10} = e^{-\frac{\Delta E}{1.38\times10^{-23}\ \text{J/K}\times 500\ \text{K}}}$$

$$8\times10^{10} = e^{\frac{-\Delta E}{1.38\times500\times10^{-23}\ \text{J}}}$$

$$\ell n\left(8\times10^{10}\right) = \frac{-\Delta E}{1.38\times500\times10^{-23}\ \text{J}}$$

$$25.10 = \frac{-\Delta E}{1.38\times500\times10^{-23}\ \text{J}}$$

$$-\Delta E = 25.10\times1.38\times500\times10^{-23}\ \text{J}\times6.023\times10^{23}/\text{mol}$$

$$= 25\times6\times1.38\times5\times10^{2}\ \text{J/mol}$$

$$= 103.5\times\ \text{kJ/mol}$$

$$= 102-104\ \text{kJ/mol}$$

Correct answer is (102 – 104).

28. Using cuvettcs of 0.8 cm path length a 10^{-6} M solution of a chromophore shows 60% transmittance at certain wave length. The molar extinction coefficient of the chromophore at this wave length is

(a) $27.75\times10^4\ m^{-1}M^{-1}$ (b) $20.75\times10^4\ m^{-1}M^{-1}$

(c) $20.75\times10^4\ cm^{-1}M^{-1}$ (d) $27.75\times10^4\ cm^{-1}M^{-1}$

Soln. $A=\log\frac{1}{T}$; $A=\log\frac{1}{60/100}$; $A=\log\frac{100}{60}$; $A=\log10-\log6$; $A=1-0.778=0.222$

$A=\in c\cdot\ell$; $0.222=E\times10^{-6}\times0.8$; $E=\frac{0.222\times10^6}{800}=\frac{222\times10^4}{8}=27.75\times10^4\ cm^{-1}M^{-1}$

Correct option is (d).

29. The adsorption of a gas is described by langmuir isotherm with the equilibrium constant $K=0.5\ kPa^{-1}$ at 25 ºC. The pressure (in kPa) at which the fractional surface coverage is 0.25 is_____.

Soln. $\theta=\frac{kP}{1+kP}$ $P=\frac{1}{k}\left(\frac{0.25}{1-0.25}\right)$

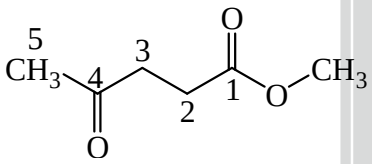
$\theta+\theta\,kP=kP$ $P=\frac{1}{0.5}\left(\frac{0.25}{0.75}\right)$

$kP=\left(\frac{\theta}{1-\theta}\right)$ $=\frac{1}{0.5}\times\frac{1}{3}=\frac{1}{1.5}=\frac{10}{15}=0.66$

Correct answer is (0.66).

30. Methyl 4-oxo pentanoate exhibited signals at δ 208, 172, 51, 37, 32 and 27 ppm in its ^{13}C NMR spectrum. The signals due to C1 carbons is _____ ppm.

Soln.



C – 1 is ester carbonyl gap below 200

C – 4 is aliphatic carbonyl centre so above 200.

Correct answer is (172).

31. A polymer sample has the following composition

Number of molecules	Molecular weight
10	2000
50	4000
40	8000

The polydispersity index (P.D.I.) of the polymer is

(a) $\frac{760}{670}$ (b) $\frac{787}{675}$ (c) $\frac{760}{600}$ (d) $\frac{800}{670}$

Soln. $M_n^- = \frac{\sum N_i M_i}{\sum N_i} = \frac{N_1M_1+N_2M_2+N_3M_3}{N_1+N_2+N_3} = \frac{10\times2000+50\times4000+40\times8000}{10+50+40}$

$=\frac{20000+200000+320000}{100}=5400$

$$M_m^- = \frac{\sum N_i M_i^2}{\sum N_i M_i} = \frac{N_1M_1^2 + N_2M_2^2 + N_3M_3^2}{N_1 M_1 + N_2 M_2 + N_3 M_3} = \frac{10(2000)^2 + 50(4000)^2 + 40(8000)^2}{10\times 2000 + 50\times 4000 + 40(8000)}$$

$$= \frac{10\times 4000000 + 50\times 16000000 + 40\times 64000000}{10\times 2000 + 50\times 4000 + 40(8000)}$$

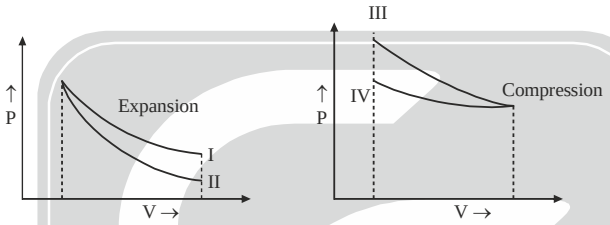
$$= \frac{40000000 + 800000000 + 2560000}{20000 + 200000 + 320000}$$

$$= \frac{4\times 10^7 + 80\times 10^7 + 256\times 10^7}{2\times 10^4 + 20\times 10^4 + 32\times 10^4} = \frac{10^7[4 + 80 + 256]}{10^4[54]} = \frac{10^3[340]}{54} = 6.596\times 10^3 = 6296$$

$$\text{P.D.I.} = \frac{\bar{M}_m}{\bar{M}_n} = \frac{6296}{5400} = \frac{787}{675}$$

Correct option is (b).

32. Which of the following graphs given below show adiabatic process?



(a) II, III (b) I, III (c) II, IV (d) I, IV

Soln. Adiabatic slope are more steeper than isothermal slope of adiabatic process = $\gamma\times$ slope of isothermal process. Therefore, adiabatic process graphs are II and III

Correct option is (a)

33. Relation between viscosity of gas and temperature is

(a) $\eta \propto T$ (b) $\eta \propto \frac{1}{T}$ (c) $\eta \propto \sqrt{T}$ (d) $\eta \propto \frac{1}{\sqrt{T}}$

Soln. $\eta = \frac{1}{2}\rho u_{av} \lambda$

$e = M N^*$

$$\eta = \frac{1}{2} M N^* u_{av} \lambda \quad \Rightarrow \quad \eta = \frac{1}{2} M N^* \sqrt{\frac{8RT}{\pi M}} \left(\frac{1}{\sqrt{2}\pi\sigma^2 N^*}\right)$$

$$\eta = \frac{1}{2} M^{1/2} \sqrt{\frac{8RT}{\pi}} \left(\frac{1}{\sqrt{2}\pi\sigma^2}\right) \quad \Rightarrow \quad \eta \propto \sqrt{T}$$

Correct option is (c)

34. Which of the following pair of Lanthanoids will show strongest emission spectra?

(a) Ce^{3+} and Ho^{3+} (b) Eu^{3+} and Tb^{3+} (c) Yb^{3+} and Lu^{3+} (d) Sm^{3+} and Eu^{3+}

Soln. More the number of unpaired electron, more will be microstate hence more will possibility of intersystem crossing. Hence, more stronger emission spectrum.

35. The Mulliken Notation for the following irreducible representation

E	C_n	nC_2	i	σ_h
2	1	1	–1	–1

(a) B'_{1u} (b) B''_{1u} (c) E'_{1u} (d) E''_{1u}

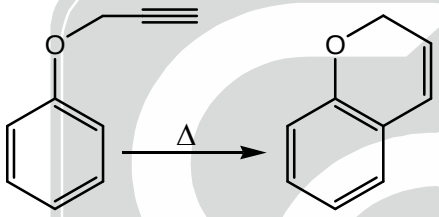
Soln. Two dimensional = E
Symmetric w.r.t. principle axis = 1
Antisymmetric w.r.t. inversion = double prime
Antisymmetric w.r.t. plane = u

So, the correct Mulliken Notation = E''_{1u}

Correct option is (d)

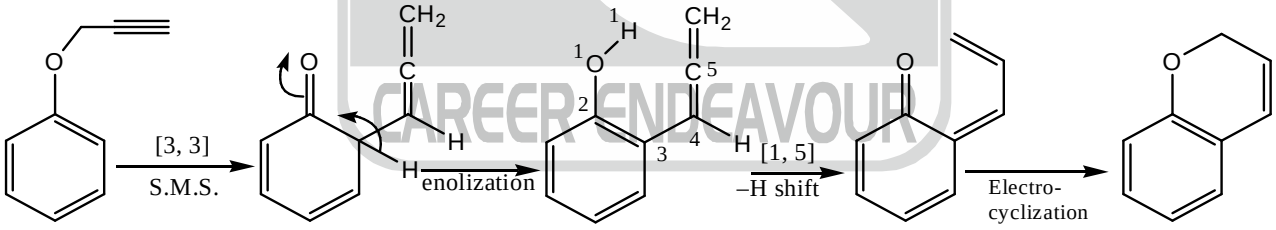
Q.36-Q.65 carry TWO marks each.

36. The following transformation involves



(a) (i) 3, 3, S.T.S. (ii) electrocyclization, (iii) 1, 5-H shift
(b) (i) 3, 3, S.T.S. (ii) 1, 5-H shift , (iii) electrocyclization
(c) (i) electrocyclization (ii) 1, 5-H shift, (iii) 3, 3, S.T.S.
(d) (i) 3, 3, S.T.S. (ii) 1, 7-H shift, (iii) electrocyclization

Soln.



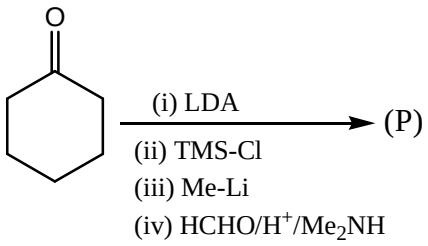
Correct option is (b)

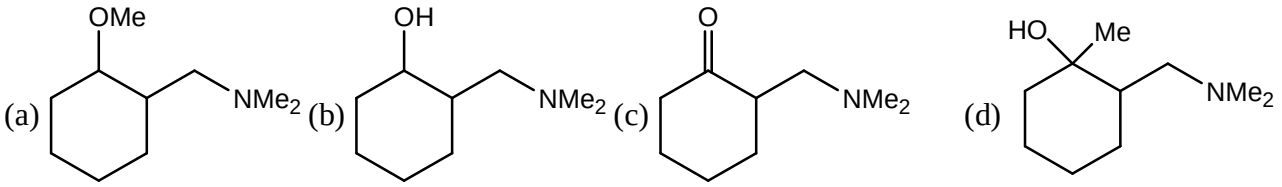
37. The incorrect statement among the following is

(a) The enzyme carboxypeptidase cuts the peptide chain from C-terminal side.
(b) The enzyme trypsin cuts the peptide chain from C-terminal side of basic amino acid
(c) The enzyme chymotrypsin cuts the peptide-chain from C-terminal side of amino acids having aromatic side chain.
(d) Cyanogenbromide cuts the peptide chain from N-terminal side of methionine.

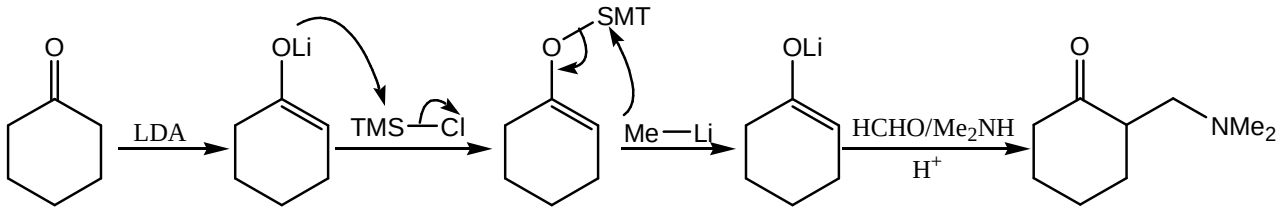
Soln. The cyanogenbromide cuts the peptide chain from C-terminal side of methionine. Hence, correct option is (d)

38. The major product (P) is



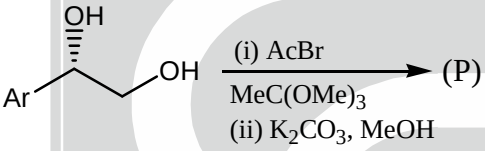


Soln.

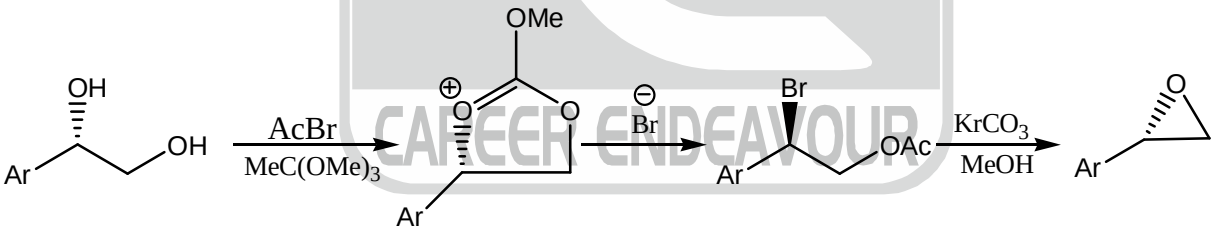


Correct option is (c)

39. The major product (P) is

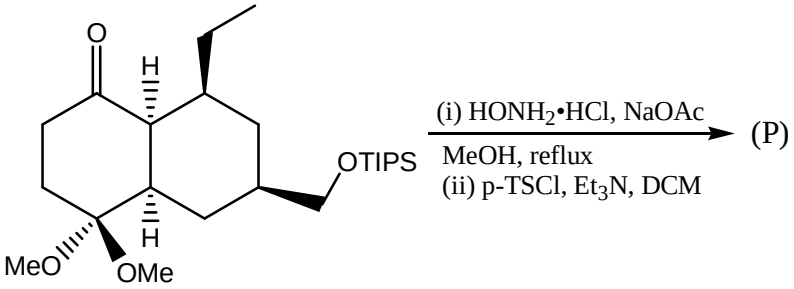


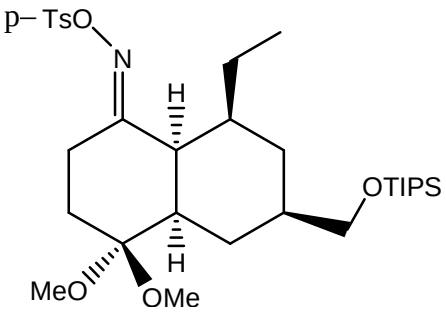
Soln.

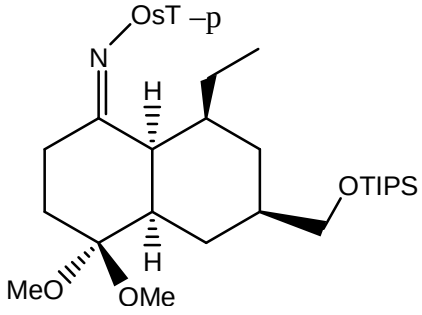


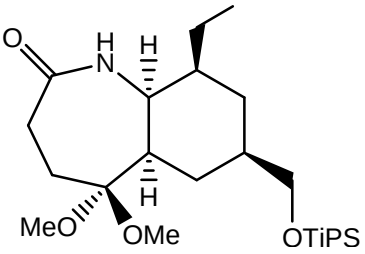
Correct option is (c)

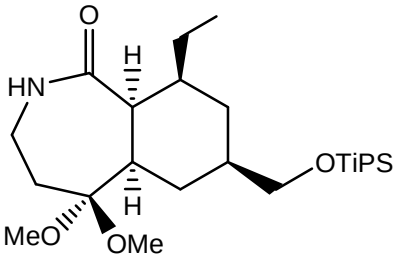
40. The major product (P) is

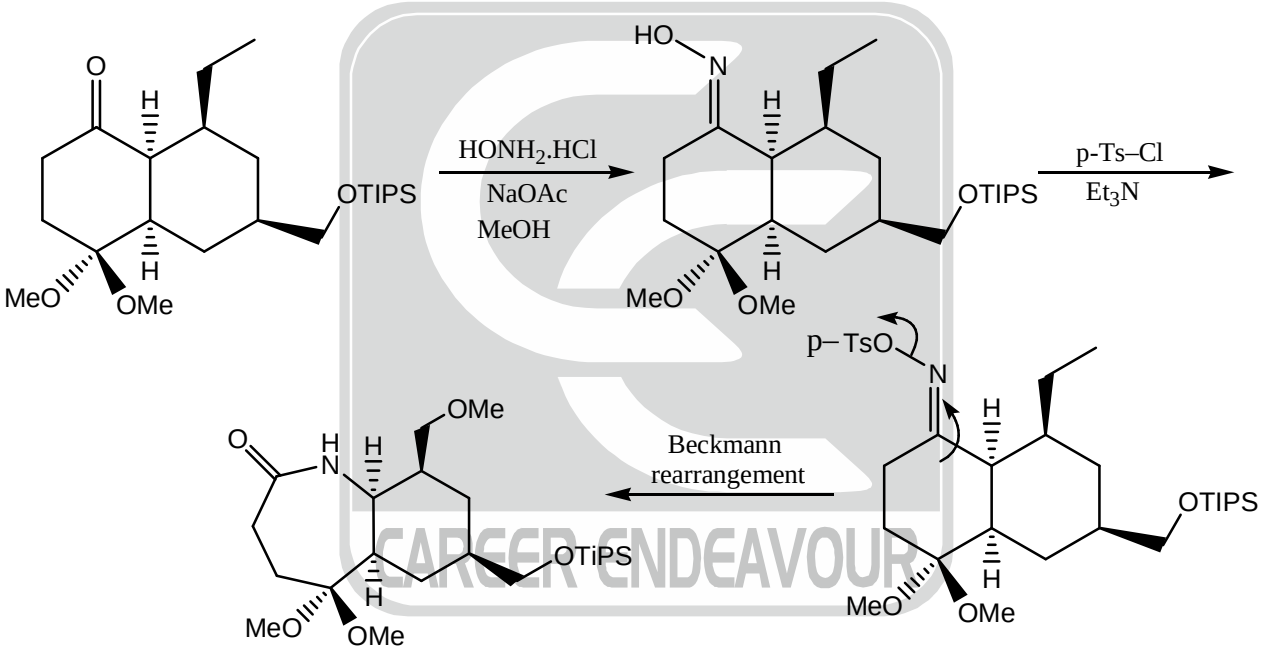


(a) 

(b) 

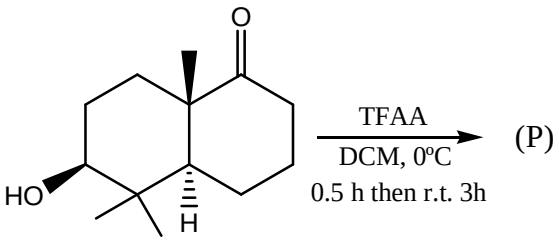
(c) 

(d) 

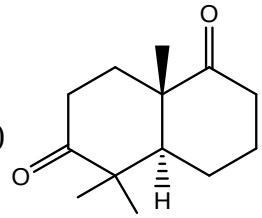
Soln. 

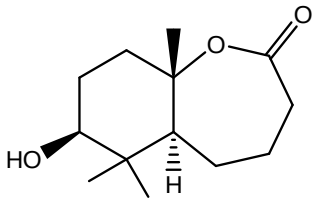
Correct option is (c)

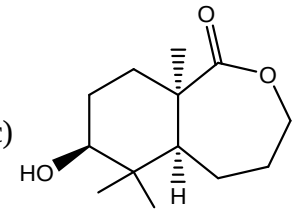
41. The major product (P) is

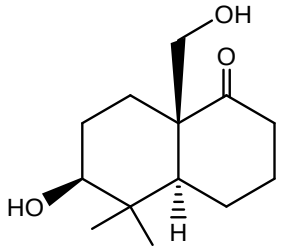


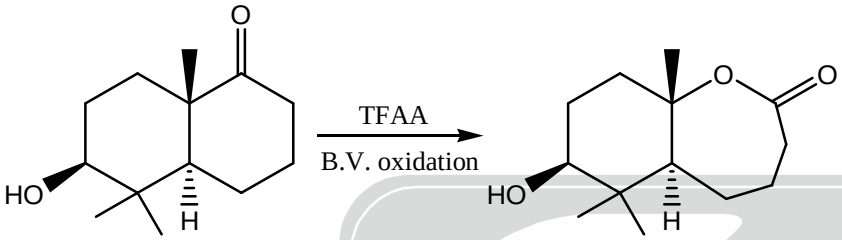
(TFAA = Trifluroperoxyacetic acid)

(a) 

(b) 

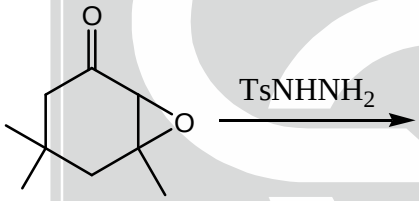
(c) 

(d) 

Soln. 

Correct option is (b)

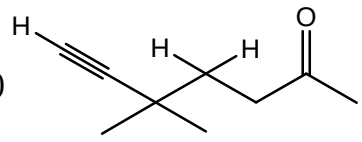
42. Treatment of this epoxy-ketone gives a compound with a spectra shown below. The correct structure is:

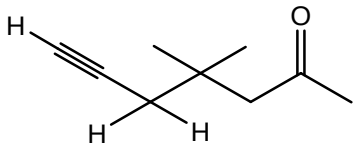


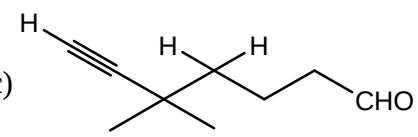
m/z 138 (M^+, 12%), 109(56%), 95(100%), 81(83%), 82 (64%) and 79(74%)
IR : 3290, 2115, 1710 cm^{-1}

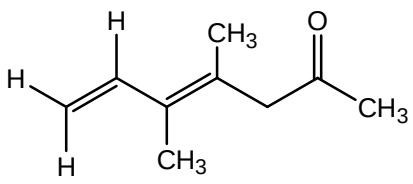
δ_H ($CDCl_3$) (ppm), 1.12 (6H, s)
2.02 (1H, t, J=3Hz)
2.15 (3H, s)
2.28 (2H, d, J=3Hz)
2.50 (2H, s)

δ_C ($CDCl_3$) : 26, 31, 32, 33, 52, 71, 82 and 208 ppm.

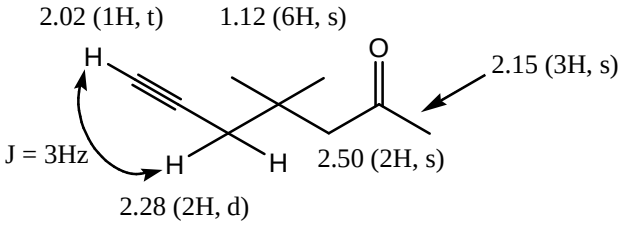
(a) 

(b) 

(c) 

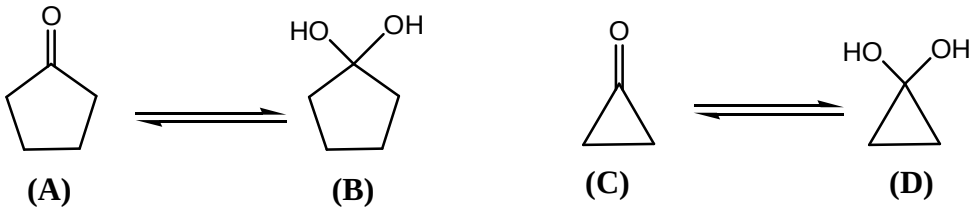
(d) 

Soln.



Correct option is (b)

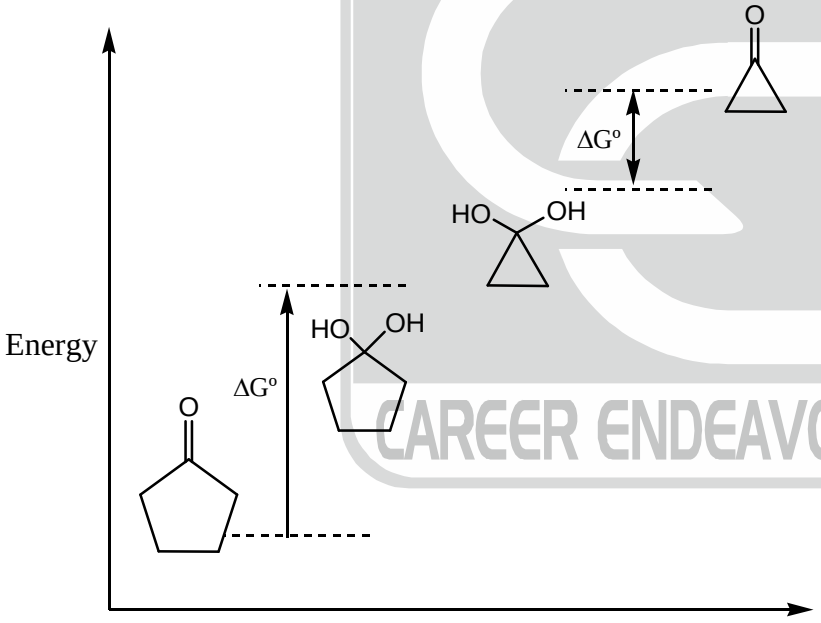
43.



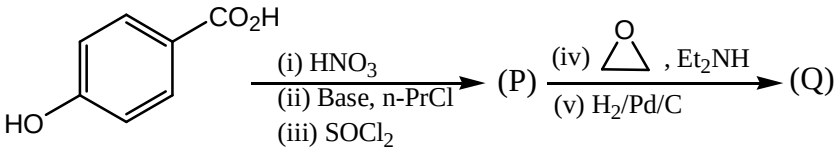
(A) **(B)** **(C)** **(D)**

The correct statement about above equilibrium reactions
(a) B and D are more stable than A and C respectively
(b) A and C are more stable than B and D respectively
(c) A is more stable than B, D is more stable than C
(d) B is more stable than A, C is more stable than D

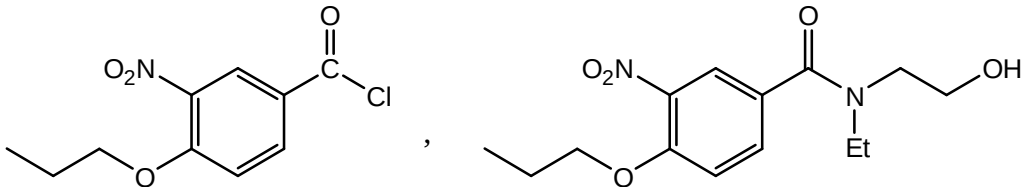
Soln. Energy profile diagram of the above compounds

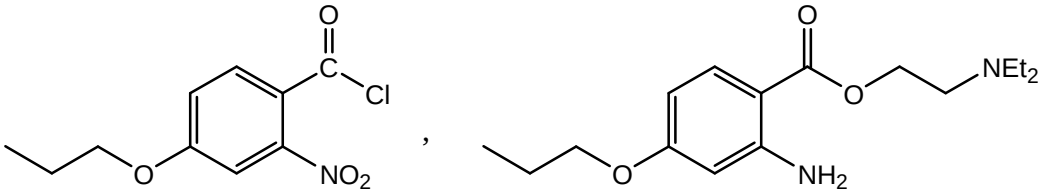


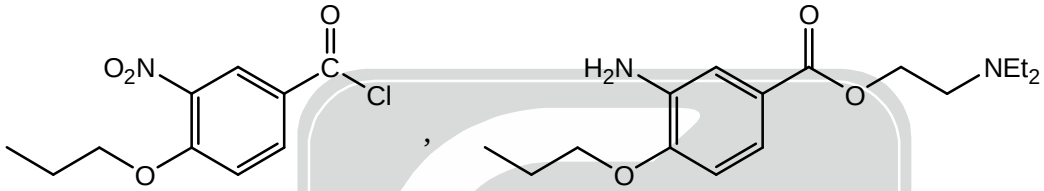
Correct option is (c)

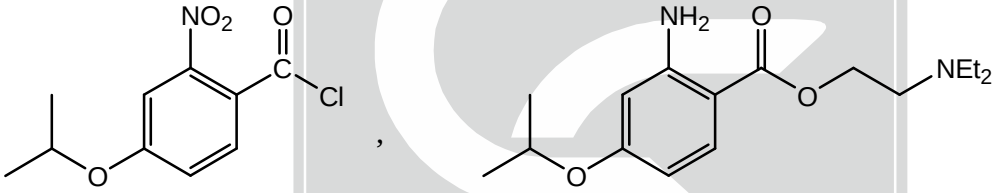
44. 

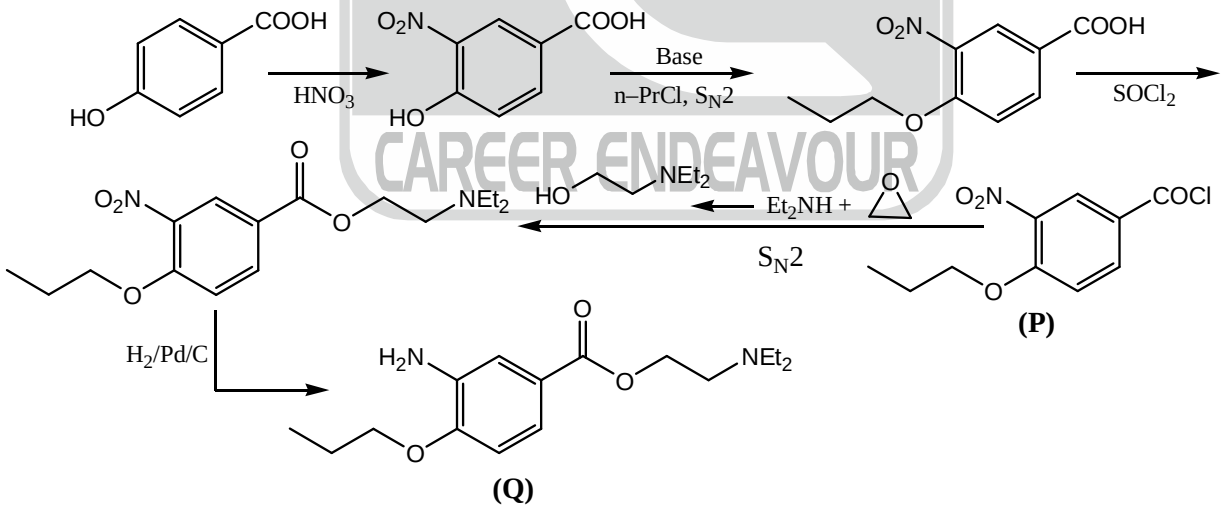
The major product (P and Q) formed in the following reaction sequence, respectively

(a) 

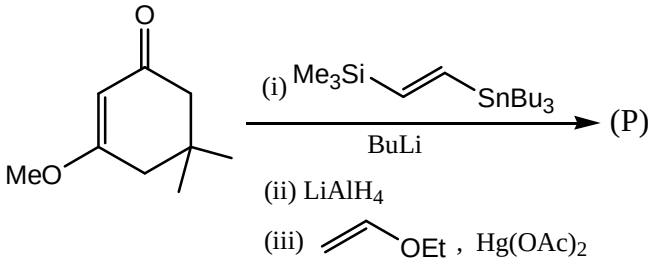
(b) 

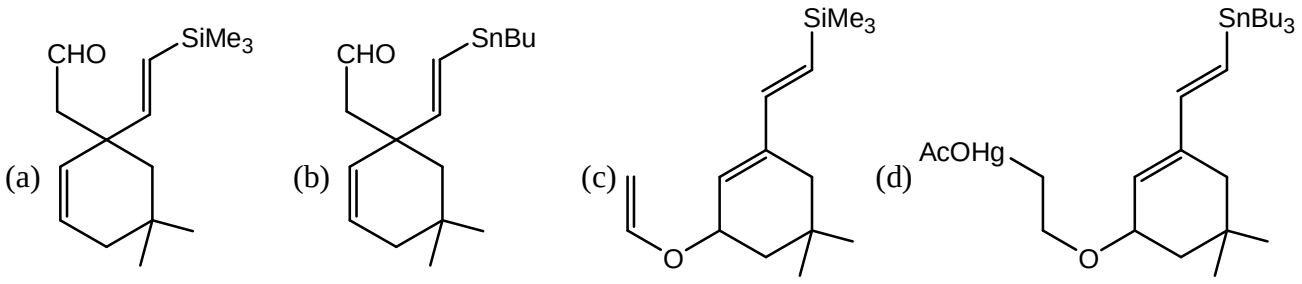
(c) 

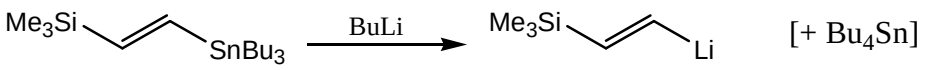
(d) 

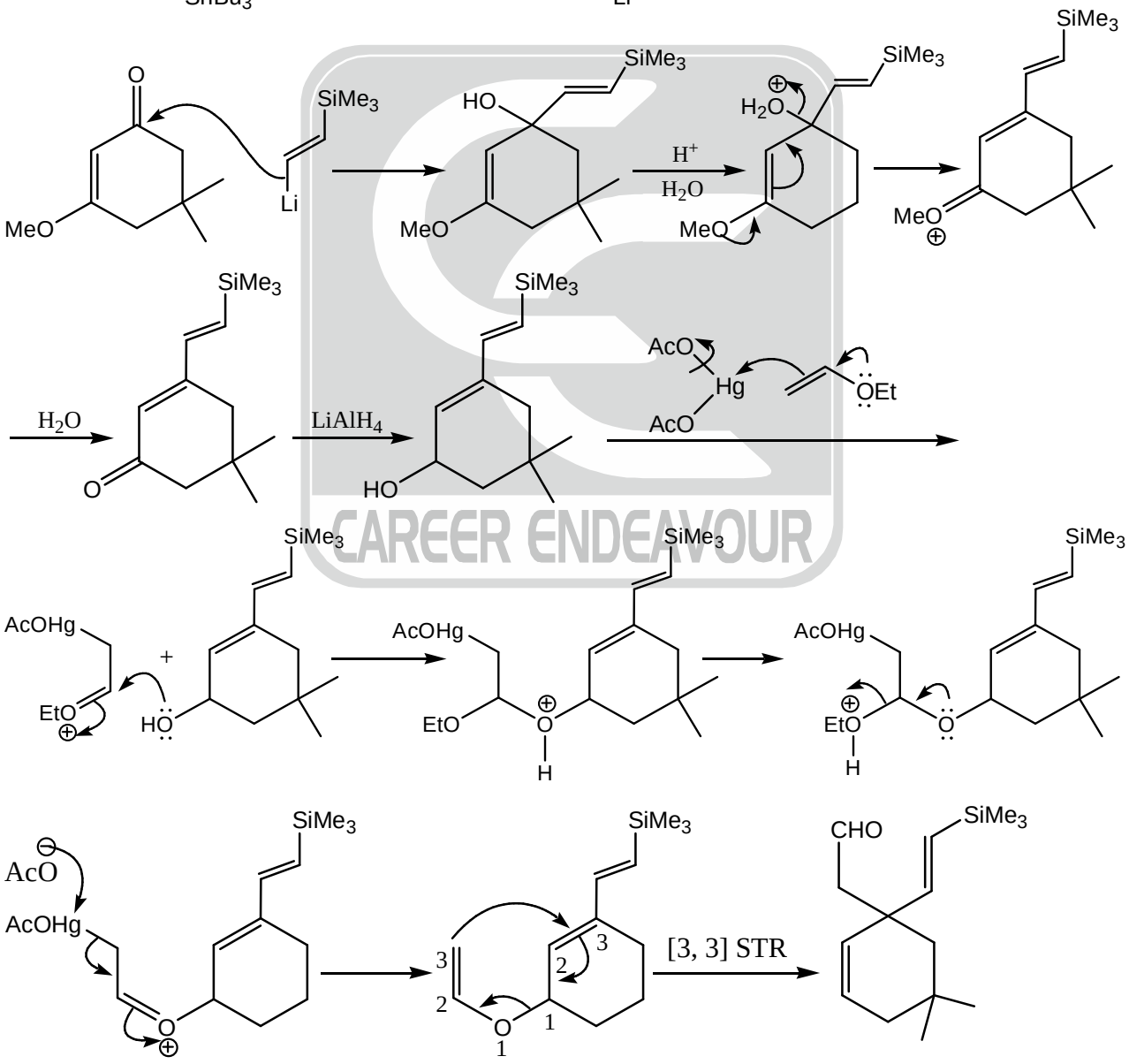
Soln. 

Correct option is (c)

45. 



Soln. 



Correct option is (a)

46. A substance undergoes the following reaction $Cd^{2+} + 2e^- \longrightarrow Cd(s)$ at dropping mercury electrode, and gives a limiting current of 8.4μA. It has a residual current 0.9 μA. When the potential at the dropping mercury electrode is –0.615 V, the current is 1.5μA. The $E_{1/2}$ (in volt) will be

(a) –0.683 (b) –0.724 (c) –0.383 (d) –0.633

Soln. $i_d = i_e - i_r$

$= 8.4 - 0.9 = 7.5\mu A$

$$E = E_{1/2} - \frac{0.0591}{n}\log\frac{i_d}{i_d - 1}$$

$$-0.615 = E_{1/2} - \frac{0.0591}{2}\log\frac{7.5}{7.5 - 1.5}$$

$E_{1/2} = -0.633$

Correct option is (d)

47. Consider the following reactions,

$$Ag^+(aq) + e^- \longrightarrow Ag(s) \qquad E^0 = 0.80V$$

$$Ag_2SO_4(s) + 2e^- \longrightarrow 2Ag(s) + SO_4^{2-}(aq) \quad E^0 = 0.65$$

The value of K_{sp} for $Ag_2SO_4(s)$ is

(a) 10^{-9} (b) 10^{-8} (c) 10^{-5} (d) 10^{-6}

Soln. $2Ag + Ag_2SO_4(s) \longrightarrow 2Ag^+(aq) + SO_4^{2-} + 2Ag$

$$E^0_{cell} = E^{0\,cathode}_{red} - E^{0\,anode}_{red} = 0.65 - 0.80 = -0.15$$

$$E^0_{cell} = \frac{0.0591}{n}\log K_{sp}$$

$$-0.15 = \frac{0.0591}{2}\log K_{sp}$$

$$-\frac{0.15 \times 2}{0.0591} = \log K_{sp}$$

$$-5.07 = \log K_{sp}$$

$$\log K_{sp} \approx \log 10^{-5}$$

$$\boxed{K_{sp} = 10^{-5}}$$

Correct option is (c)

48. Correct pair of normal and inverse spinels respectively is

(a) Co_3O_4 anad $CoAl_2O_4$ (b) Mn_3O_4 and $NiAl_2O_4$

(c) $NiCr_2O_4$ and $CoAl_2O_4$ (d) $NiAl_2O_4$ and $NiFe_2O_4$

Soln. In case of $NiAl_2O_4$ due to high value of CFSE of $Ni^{2+}(O_h)$, it prefer to occupy O_h voids. Hence, it is inverse spinels.

Correct option is (b)

49. Correct order of rate of water exchange between co-ordination sphere and the bulk is

(a) $Mn^{2+} < Fe^{2+} < Ni^{2+} < Cr^{2+}$ (b) $Ni^{2+} < Fe^{2+} < Mn^{2+} < Cr^{2+}$

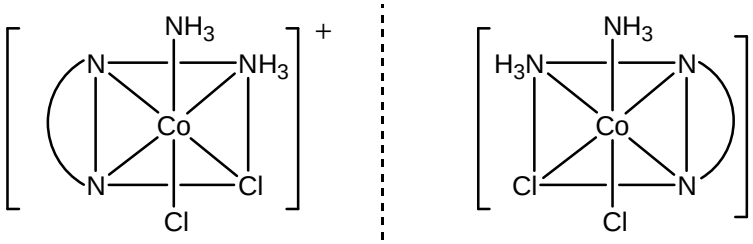
(c) $Ni^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$ (d) $Fe^{2+} < Ni^{2+} < Mn^{2+} < Cr^{2+}$

Soln. Cr^{2+} ion has $t_{2g}^3 e_g^1$ configuration, hence show Jahn Teller distortion. Therefore, it is most labile. In case of other ions high the effective nuclear charge lesser the lability.

Correct option is (b)

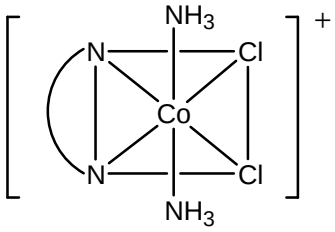
50. Total number of geometrical and optical isomer for $\left[Co(en)(NH_3)_2Cl_2\right]^+$ is/are _____

Soln.

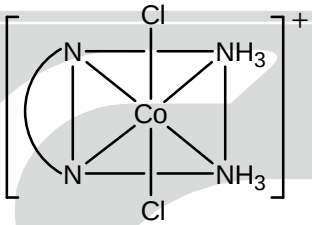


cis Mirror cis

Chiral and optically active



Trans-isomer



Trans-isomer

Correct answer is (4)

51. ^{19}F NMR spectra of $\left[XeF_5\right]^-$ and PF_3Cl_2 will corresponds to

(Assuming Xe and Cl has no effect)

(1) $\left[XeF_5\right]^-$ will give only one signal

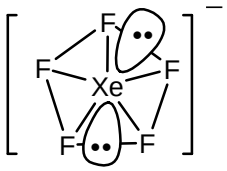
(2) PF_3Cl_2 will give two doublet and two triplet

(3) PF_3Cl_2 will give one doublet

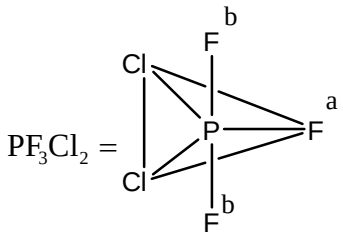
(4) $\left[XeF_5\right]^-$ will give two signal

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

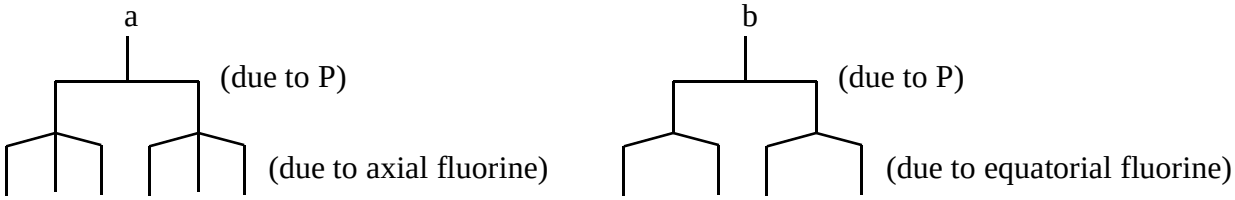
Soln. $\left[XeF_5\right]^- = \dfrac{8+5+1}{2} = 7 \qquad \left(sp^3d^3\right)$



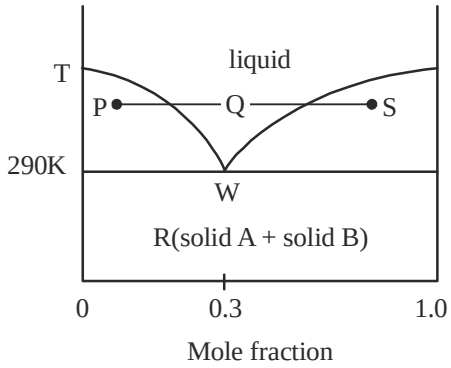
Pentagonal planar. Hence, one NMR signal



a = two triplet
b = two doublet



52. The temperature composition $(T-x)$ phase diagram of two component system made by A and B is given below. At a temperature of 290K and starting at the point P, B is added until the composition reaches S. Which of the following statement is *TRUE*.



(1) at point P solid A and liquid are present and degree of freedom is 1
(2) at point W, it is a eutectic point and degree of freedom is zero
(3) at point Q, the system is all liquid and degree of freedom is 2
(4) at point R, degree of freedom is 1 and at point S (solid B and liquid) and degree of freedom is 1
(a) 1 is correct and 2 and 3 are incorrect
(b) 2 is correct and 4 is incorrect
(c) 3 is correct and 1, 2, 4 are incorrect
(d) 1, 2, 3 and 4 are correct.

Soln. At point P, solid A and liquid
P = 2
C = 2
F = C–P + 1
F = 2–2 + 1
F = 1
At point S, solid B and liquid
P = 2
C = 2
F = C–P +1
F = 2–2+1
F = 1
At point Q, all liquid
P = 1
C = 2
F = C–P+1 = 2–1 + 1 = 2
At point W, eutectic point
F = C–P+1
F = 2–3+1
F = 0
At point R (solid A, solid B)
F = C–P + 1
F = 2–2+1
F = 1
Correct option is (d)

53. In a rigid rotator of M (mass). If the energy of third excited state is 10 meV, then the fifth excited state energy (in meV) is

(a) 25 (b) 50 (c) 70 (d) 80

Soln. Since we know that the energy of a rigid rotator $E = \frac{\hbar^2}{2I} J(J+1)$, where $J = 0, 1, 2, 3, ...$

$$E_3 = \frac{\hbar^2}{2I} 3(3+1) = \frac{\hbar^2}{2I} 12 = 10 \text{ meV} = \frac{6\hbar^2}{I} = 10 \text{ meV}$$

Energy of fifth the excited state

$$E_5 = \frac{\hbar^2}{2I} 5(5+1) = \frac{30}{2} \frac{\hbar^2}{I} = \frac{5}{2} \times \frac{6\hbar^2}{I} = \frac{5}{2} \times 10 \text{ meV} = 25 \text{ meV}.$$

Correct answer is (25).

54. The moment of inertia of a hetero nuclear diatomic molecule is 8.5×10^{-50} kg/m^2. Its rotational portion function at 1000 K is_____$\times 10^{18}$.

Soln. $q_{rot} = \frac{8\pi^2 I kT}{\sigma h^2}$; σ for heteronuclear diatomic molecule = 1.

$$q_{rot} = \frac{1.38 \times 10^{-23} \text{ J/K} \times 8 \times 3.14 \times 3.14 \times 8.5 \times 10^{-50} \text{ kg} \times \text{m}^2 \times 1000 \text{ K}}{1 \times 6.63 \times 10^{-34} \text{ J} \times \text{s} \times 6.63 \times 10^{-34} \text{ J} \times \text{s}}$$

$$= \frac{1.38 \times 10^{-23} \times 8 \times 3.14 \times 3.14 \times 8.5 \times 10^{-50} \text{ kg} \times \text{m}^2}{1 \times 6.63 \times 10^{-34} \times 6.63 \times 10^{-34} \text{ J} \times \text{s}^2}$$

$$= \frac{925.2 \times 10^{-50} \text{ kg} \times \text{m}^2}{43.95 \times 10^{-68} \frac{\text{kg} \times \text{m}^2}{\text{s}^2} \times \text{s}^2} = 21.05 \times 10^{18} = 20 - 22.$$

Correct answer is (20 – 22).

55. For lithium (BCC) metal the separation of the (100) planes of the metal is 300 pm. The density of the Li (metal) is M(Li) = 6.94 g/mol.

(a) 900 kg cm^{-3} (b) 853 kg m^{-3} (c) 800 kg m^{-3} (d) 853 kg cm^{-3}

Soln. For cubic system

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}} \; ; \; d_{100} = \frac{a}{\sqrt{1^2 + 0^2 + 0^2}}$$

$300 \text{ pm} = a$; $a = 300 \times 10^{-12}$ m

$$\rho = \frac{ZM}{N_A a^3} = \frac{2 \times 6.94 \times 10^{-3} \text{ kg mol}^{-1}}{6.023 \times 10^{23}/\text{mol} \times 300 \times 300 \times 300 \times 10^{-36} \text{ m}^3}$$

$$= \frac{2 \times 6.94 \times 10^{-3} \times 10^{-23} \times 10^{36} \text{ kg m}^{-3} \times 10^{-3}}{6.023 \times 30 \times 30 \times 30}$$

$$= \frac{2 \times 6.94 \times 10^{-3} \times 10^{-23} \times 10^{36} \times 10^{-3} \times 10^{-3} \text{ kg m}^{-3}}{6.023 \times 3 \times 3 \times 3}$$

$$= \frac{13.88 \times 10^4}{162.621} = .0853 \times 10^4 \text{ kg m}^{-3} = 853 \text{ kg m}^{-3}.$$

Correct option is (b).

56. The relaxation time for the fast reaction $A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$ is 100 μs (i.e. microseconds) and the equilibrium constant is 1.0×10^{-6}. The ratio of reverse and forward rate constant in the given reaction is 10^x. The value of x is

(a) 6 (b) 8 (c) 10 (d) 4

Soln. $\tau = \dfrac{1}{k_1 + k_{-1}} = 100 \times 10^{-6} \text{ s} = 10^{-4} \text{ s}$ ... (i)

$$K = \frac{k_1}{k_{-1}} = 1 \times 10^{-6} \; ; \; k_1 = 1 \times 10^{-6} \, k_{-1}$$

Since, $k_{-1} \ll k_1$, it can be neglected in comparison with k_1 in equation (i)

So, that $\dfrac{1}{k_1} = 10^{-4} \text{s}$ or $k_1 = 10^4 \text{ s}^{-1}$

$$k_{-1} = \frac{10^4 \text{s}^{-1}}{10^{-6}} = k_{-1} = 10^{10} \text{ s}^{-1}$$

$$= \frac{10^{10}}{10^4} = 10^6.$$

Correct answer is (6).

57. In the Michaeli's-Menton mechanism for enzyme kinetics the expression obtained is

$$\frac{V}{[E]_0[S]} = 2.5 \times 10^{20} - \frac{10^8 V}{[E]_0}$$

The ratio of values K(Michaeli's constant mol L^{-1}) and k_3 (k_{exp}, mol $L^{-1}s^{-1}$) is

(a) 2.5×10^{-20} (b) 2.5×10^{20} (c) 4×10^{-20} (d) 4×10^{-21}

Soln. $\dfrac{k_3}{k_m} = 2.5 \times 10^{20}$

$$\frac{1}{k_m} = 10^8 \; ; \; k_m = 10^{-8} \; ; \; \frac{k_3}{10^{-8}} = 2.5 \times 10^{20} \; ; \; k_3 = 2.5 \times 10^{12}$$

$$\frac{k_m}{k_3} = \frac{10^{-8}}{2.5 \times 10^{12}} = \frac{10}{2.5} \times 10^{-20} = 0.4 \times 10^{-20} = 4 \times 10^{-21}.$$

Correct option is (d).

58. The difference in the ground state energies (kJ/mol) of an electron in one dimensional boxes of lengths 0.5 nm and 5 nm is_____.

Soln. $\Delta E = \frac{n^2h^2}{8ml^2}$; $\Delta E = \frac{h^2}{8m}\left[\frac{1}{l_1^2} - \frac{1}{l_2^2}\right] = \frac{h^2}{8m}\left[\frac{1}{(0.5)^2 nm^2} - \frac{1}{(5)^2 nm^2}\right]$

$$= \frac{6.63\times 6.63\times 10^{-68}\ \text{J}\cdot\text{s}\ \ \text{J}\cdot\text{s}}{8\times 9.1\times 10^{-31}\ \text{kg}\,(\text{nm})^2}\left[\frac{1}{0.25} - \frac{1}{25}\right]$$

$$= \frac{6.63\times 6.63\times 10^{-68}\ \text{J}\cdot\text{s}\ \ \text{J}\cdot\text{s}}{8\times 9.1\times 10^{-31}\ \text{kg}\times 10^{-9}m\times 10^{-9}m}\left[\frac{100}{25} - \frac{1}{25}\right]$$

$$= \frac{6.63\times 6.63\times 10^{-68}\ \text{J}\cdot\text{s}\ \ \text{J}\cdot\text{s}}{8\times 9.1\times 10^{-31}\times 10^{-18}\times \text{mtr}\times \text{mtr}}\times\frac{99}{25}$$

$$= \frac{6.63\times 6.63\times 10^{-68}\times 10^{31}\times 10^{18}\times 99}{8\times 9.1\times 25}$$

$$= \frac{4351.7}{1820}\times 10^{-19}\times 6.023\times 10^{23}\ \text{J/mol}$$

$$= \frac{6.023\times 4351.7}{1820}\times 10^4 = 14.40\times 10^4 = 144\ \text{kJ/mol.}$$

Correct answer is (144).

59. The ground state energy of hydrogen atom is –13.598 eV. The expectation value of potential energy in units of eV is_____.

Soln. For hydrogen atom $2\langle T\rangle = -\langle V\rangle$; $2\langle 13.598\rangle = -\langle V\rangle$; $27.196 = -\langle V\rangle$; $\langle V\rangle = -27.196$.

Correct answer is (–27.196).

60. If $\psi = 0.5\,\phi_A + 0.8\,\phi_B$ is a normalized molecular orbital of a diatomic molecule AB constructed from ϕ_A and ϕ_B which are also normalized. The overlap between ϕ_A and ϕ_B is _____.

Soln. $C_1^2 + C_2^2 + 2C_1C_2S = 1$

$(0.5)^2 + (0.8)^2 + 2\times 0.5\times 0.8\times S = 1$

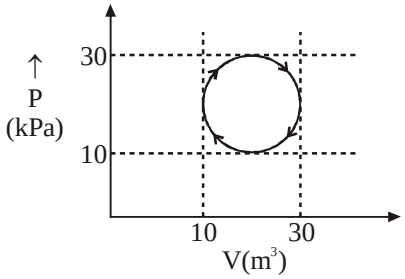
$0.25 + 0.64 + 0.8S = 1$

$0.89 + 0.8S = 1$

$0.8S = 0.11$; $S = \frac{0.11}{0.8}$; $S = 0.137$.

Correct answer is (0.137).

61. Which one is not correct for a cyclic process as shown in the figure ?



(a) dU = 0 (b) $q = -\omega$ (c) $q = 314\,\text{J}$ (d) $q = 31.4\,\text{J}$

Soln. For cyclic process, $\Delta U = 0$

$\Rightarrow \quad q = -w$

$w =$ Area covered by sphere

$$= \pi r^2 = \pi\left(\frac{v_2 - v_1}{2}\right) = \pi\frac{20^2}{2} = 314\,J$$

Correct option is (d)

62. Correct order of reactivity of complexes with HCl is

(a) $IrCl(CO)(PPh_3)_2 > IrCl(CO)(PMe_3)_2 > IrMe(CO)(PMe_3)_2 > IrPh(CO)(PMe_3)_2$

(b) $IrCl(CO)(PMe_3)_2 > IrCl(CO)(PPh_3)_2 > IrMe(CO)(PMe_3)_2 > IrPh(CO)(PMe_3)_2$

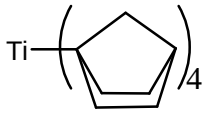
(c) $IrMe(PMe_3)_2 > IrPh(CO)(PMe_3)_2 > IrCl(CO)(PMe_3)_2 > IrCl(CO)(PPh_3)_2$

(d) $IrPh(PMe_3)_2 > IrMe(PMe_3)_2 > IrCl(CO)(PMe_3)_2 > IrCl(CO)(PPh_3)_2$

Soln. More the electron density on the metal more will be rate of oxidative addition.
Correct option is (c)

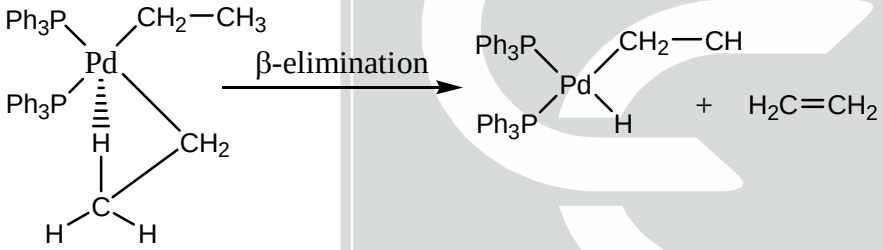
63. The least stable metal alkyl complex is

(a) $\left[Ti(Me_2PCH_2 - CH_2 - PMe_2)Cl_3(CH_2CH_3)\right]$

(b) 

(c) $Cp(CO)_2Fe(CH_2CH_3)$ (d) $Pd(PPh_3)_2(CH_2 - CH_3)_2$

Soln.



In other complexes β -elimination is not easy either due to symmetry of group attached to metal or due to unavailability of vacant site.

64. In a solid 'AB' having the NaCl structure, 'A' atoms occupy the corners of the cubic unit cell. If all the face-centered atoms along one of the axis are removed, then the resultant stoichiometry of the solid is

(a) AB_2 (b) A_2B (c) A_4B_3 (d) A_3B_4

Soln. Correct structure of the solid is A_3B_4.
Correct option is (d)

65. The specices ^{19}Ne and ^{14}C emit a positron and β-particles respectively. The correct statement about formed the resulting species are

(1) when emits a positron formed ^{19}Na species
(2) when emit a β-particle formed ^{14}B species
(3) when emit a positron formed $^{19}_{9}F$ species
(4) when emit a β-particle formed $^{14}_{7}N$ species

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

$$^{19}_{10}Ne \xrightarrow{-e^0_{+1}\,(positron)} {}^{19}_{9}F\,; \quad {}^{14}_{6}C \xrightarrow{-e^0_{-1}\,(\beta\text{-particle})} {}^{14}_{7}N$$

Correct option is (b).

CHEMISTRY - CY

Date: 20-01-2017

GATE TEST SERIES-B

ANSWER KEY

1. (c)	**2.** (b)	**3.** (a)	**4.** (a)	**5.** (b)
6. (c)	**7.** (a)	**8.** (c)	**9.** (b)	**10.** (d)
11. (a)	**12.** (a)	**13.** (d)	**14.** (c)	**15.** (b)
16. (3 to 3)	**17.** (b)	**18.** (b)	**19.** (b)	**20.** (2)
21. (d)	**22.** (c)	**23.** (30)	**24.** (c)	**25.** (c)
26. (200 to 200)	**27.** (102 to 104)	**28.** (d)	**29.** (0.6 to 0.7)	**30.** (172)
31. (b)	**32.** (a)	**33.** (c)	**34.** (b)	**35.** (d)
36. (b)	**37.** (d)	**38.** (c)	**39.** (c)	**40.** (c)
41. (b)	**42.** (b)	**43.** (c)	**44.** (c)	**45.** (a)
46. (d)	**47.** (c)	**48.** (b)	**49.** (b)	**50.** (4)
51. (c)	**52.** (d)	**53.** (25 to 25)	**54.** (20 to 22)	**55.** (b)
56. (6 to 6)	**57.** (d)	**58.** (142 to 146)	**59.** (–27 to –28)	
60. (0.1 to 0.2)	**61.** (d)	**62.** (c)	**63.** (c)	**64.** (d)
65. (b)				