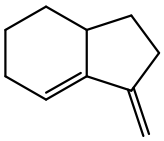
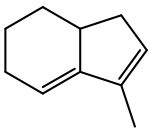
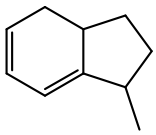
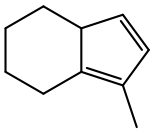
CHEMISTRY-CY

Q.1 – Q.25 : Carry ONE mark each.

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

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

2. An efficient catalyst for hydrogenation of alkenes is $\left[\mathrm{Rh}\left(\mathrm{PPh_3}\right)_3\mathrm{Cl}\right]$. However, $\left[\mathrm{Ir}\left(\mathrm{PPh_3}\right)_3\mathrm{Cl}\right]$ does not catalyze this reaction, because

(a) $\mathrm{PPh_3}$ binds stronger to Ir than to Rh (b) Cl binds stronger to Ir than to Rh
(c) $\mathrm{PPh_3}$ binds stronger to Rh than to Ir (d) Cl binds stronger to Rh than to Ir

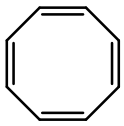
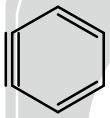
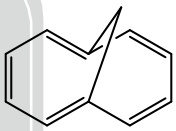
3. Which of the following properties are characteristics of an ideal solution?

(i) $\left(\Delta_{\mathrm{mix}}\mathrm{G}\right)_{\mathrm{T,P}}$ is negative (ii) $\left(\Delta_{\mathrm{mix}}\mathrm{S}\right)_{\mathrm{T,P}}$ is postiive

(iii) $\left(\Delta_{\mathrm{mix}}\mathrm{V}\right)_{\mathrm{T,P}}$ is positive (iv) $\left(\Delta_{\mathrm{mix}}\mathrm{H}\right)_{\mathrm{T,P}}$ is negative.

(a) (i) and (iv) (b) (i) and (ii) (c) (i) and (iii) (d) (iii) and (iv)

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

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

5. Given the E_0 values for the following reaction sequence,

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

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

6. The expression for the equilibrium constant $\left(\mathrm{K_{eq}}\right)$ for the enzyme catalyzed reaction given below, is

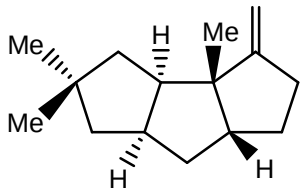
$$\mathrm{E + S \underset{k_2}{\overset{k_1}{\rightleftarrows}} ES \underset{k_4}{\overset{k_3}{\rightleftarrows}} P + E}$$

(a) $\frac{k_1k_3}{k_2k_4}$ (b) $\frac{k_1k_2}{k_3k_4}$ (c) $\frac{k_2k_3}{k_1k_4}$ (d) $\frac{k_1k_4}{k_2k_3}$

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

(a) ligand-to-metal charge transfer (LMCT) (b) metal-to-ligand charge transfer (MLCT)
(a) Jahn-Teller distortion (d) nephelauxetic effect.

8. The compound given below is a



(Hirsutene)

(a) sesterterpene (b) monoterpene (c) sesquiterpene (d) triterpene

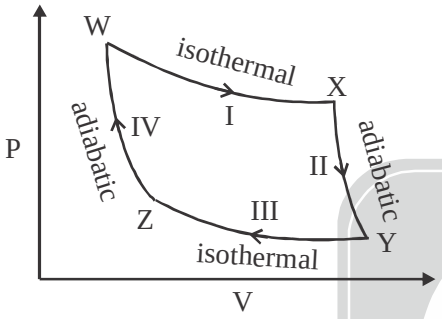
9. The electrical conductivity of a metal
(a) increases with increasing temperature (b) decreases with increasing temperature
(c) is independent of temperature (d) shows oscillatory behaviour with temperature

10. Which one of the following statements is **INCORRECT**?
(a) Frenkel defect is a cation vacancy and a cation interstitial
(b) Frenkel defect is an anion vacancy and a cation interstitial
(c) Density of a solid remains unchanged in case of Frenkel defects.
(d) Density of a solid decreases in case of Schottky defects.

11. Among the given pH values, the O_2 binding efficiency of hemoglobin is maximum at
(a) 6.8 (b) 7.0 (c) 7.2 (d) 7.4

12. When the operator, $-\hbar^2 d^2/dx^2$, operates on the function e^{-ikx}, the result is
(a) $k^2\hbar^2 e^{-ikx}$ (b) $ik^2\hbar^2 e^{-ikx}$ (c) $i\hbar^2 e^{-ikx}$ (d) $\hbar^2 e^{-ikx}$

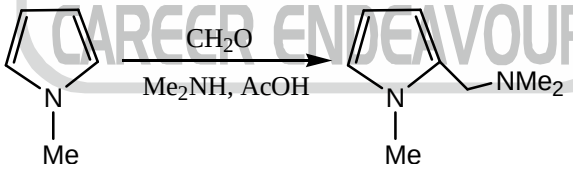
13.



From the above Carnot cycle undergone by an ideal gas, identify the processes in which the change in internal energy is **NON-ZERO.**
(a) I and II (b) II and IV (c) II and III (d) I and IV

14. Which one of the following defines the absolute temperature of a system?
(a) $\left(\frac{\partial U}{\partial S}\right)_V$ (b) $\left(\frac{\partial A}{\partial S}\right)_V$ (c) $\left(\frac{\partial H}{\partial S}\right)_V$ (d) $\left(\frac{\partial G}{\partial S}\right)_V$

15. The following conversion is an example of

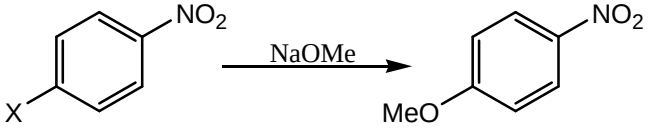


(a) Arndt-Eistert homologation (b) Mannich reaction
(c) Michael addition (d) Chichibabin amination reaction

16. The compound with planar geometry is
(a) $N(t\text{–Bu})_3$ (b) NPh_3 (c) NF_3 (d) $N(SiH_3)_3$

17. Reaction of benzaldehyde and p-methylbenzaldehyde under McMurry coupling conditions ($TiCl_3$ and $LiAlH_4$) gives a mixture of alkenes. The number of alkenes formed is _____

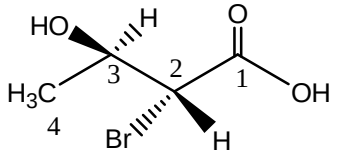
18. The correct order of reactivity of p-halonitrobenzenes in the following reaction is



(X = F, Cl, Br, I)

(a) p-chloronitrobenzene > p-iodonitrobenzene > p-fluoronitrobenzene > p-bromonitrobenzene
(b) p-fluoronitrobenzene > p-chloronitrobenzene > p-bromonitrobenzene > p-iodonitrobenzene
(c) p-iodonitrobenzene > p-bromonitrobenzene > p-chloronitrobenzene > p-fluoronitrobenzene
(d) p-bromonitrobenzene > p-fluoronitrobenzene > p-iodonitrobenzene > p-chloronitrobenzene

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



(a) 2R, 3S (b) 2S, 3R (c) 2S, 3S (d) 2R, 3R

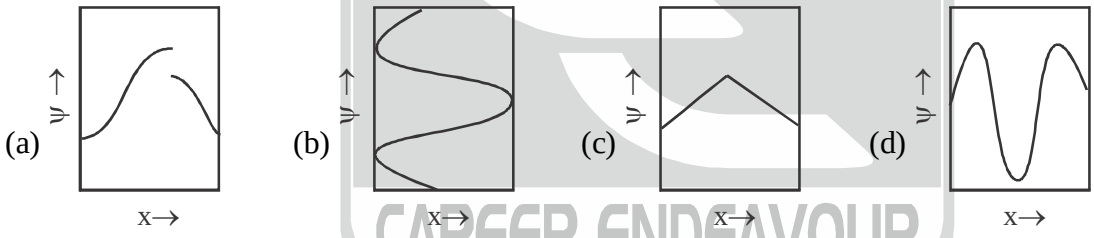
20. For an ideal gas with molar mass *M*, the molar translational entropy at a given temperature is proportional to
(a) $M^{3/2}$ (b) $M^{1/2}$ (c) e^{M} (d) ln(M)

21. Tollen's test is **NEGATIVE** for
(a) mannose (b) maltose (c) glucose (d) sucrose

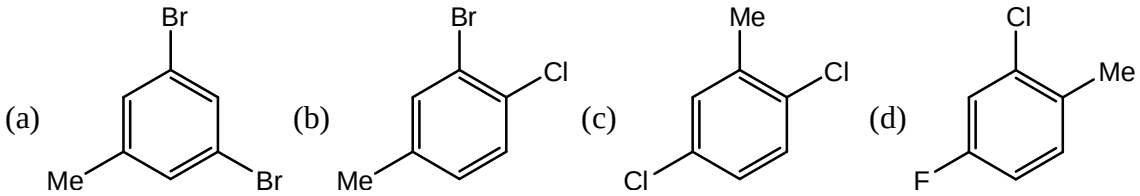
22. The intense red color of $\left[\mathrm{Fe(bpy)_3}\right]^{2+}$ (bpy = 2, 2'-bipyridine) is due to
(a) metal-to-ligand charge transfer (MLCT) (b) ligand-to-metal charge transfer (LMCT)
(c) d-d transition (d) inter-valence charge transfer (IVCT)

23. The ease of formation of the adduct, $NH_3 \cdot BX_3$ (where X = F, Cl, Br) follows the order
(a) $BBr_3 < BCl_3 < BF_3$ (b) $BCl_3 < BF_3 < BBr_3$
(c) $BF_3 < BCl_3 < BBr_3$ (d) $BBr_3 < BF_3 < BCl_3$

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



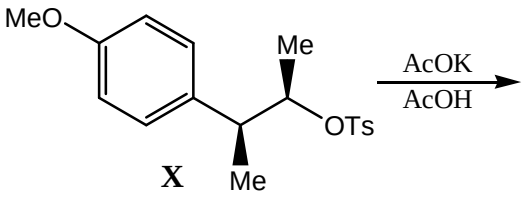
25. The mass spectrum of a dihalo compound shows peaks with relative intensities of 1 : 2 : 1 corresponding to M, M + 2 and M + 4 (M is the mass of the molecular ion), respectively. The compound is



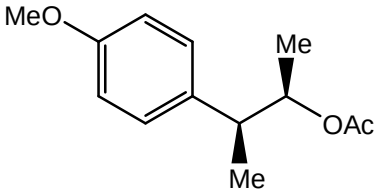
Q.26 – Q.55 : Carry TWO marks each.

26. The value of 'g' and the number of signals observed for the reference standard, diphenylpicrylhydrazyl (DPPH), in the solid state ESR spectrum are, respectively
(a) 2.0036 and 1 (b) 2.0036 and 3 (c) 2.2416 and 1 (d) 2.2416 and 3

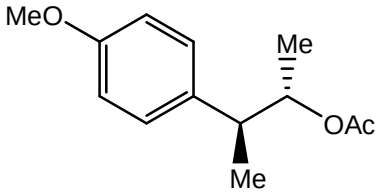
27. Solvolysis of the optically active compound X gives, mainly



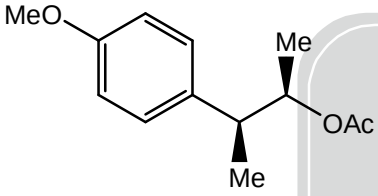
X

(a)


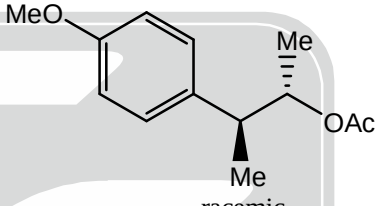
(optically active)

(b)


(optically active)

(c)


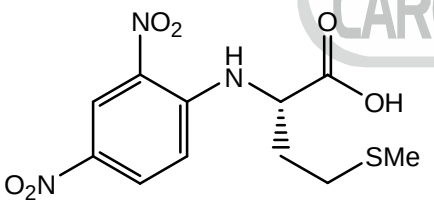
racemic
(optically inactive)

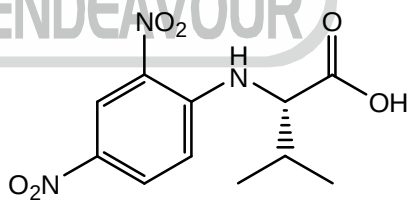
(d)


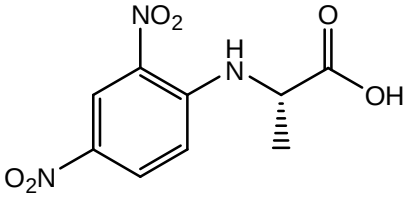
racemic
(optically inactive)

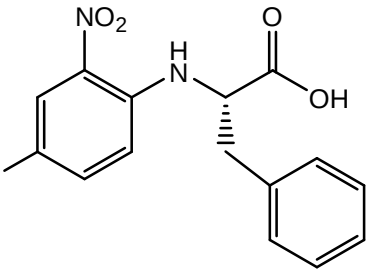
28. The complexes $K_2[NiF_6]$ and $K_3[CoF_6]$ are
(a) both paramagnetic
(b) both diamagnetic
(c) paramagnetic and diamagnetic, respectively
(d) diamagnetic and paramagnetic, respectively

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

(a)


(b)


(c)


(d)


30. For a gas phase unimolecular reaction at temperature 298K, with a pre-exponential factor of $2.17\times10^{13}s^{-1}$, the entropy of activation ($JK^{-1}\,mol^{-1}$) is _____

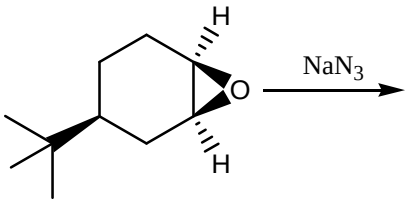
31. The process given below follows the Langmuir adsorption isotherm

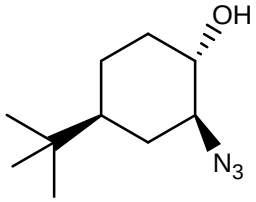
$$A_2(g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2A_{ads}$$

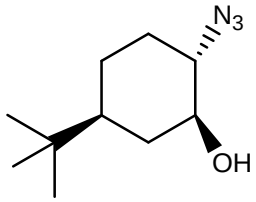
If θ denotes the surface coverage and P denotes the pressure, the slope of the plot of $1/\theta$ versus $1/\sqrt{P}$ is

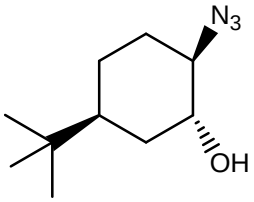
(a) $1/\left(K_{eq}\right)^2$ (b) $1/K_{eq}$ (c) $-1/K_{eq}$ (d) $1/\left(K_{eq}\right)^{1/2}$

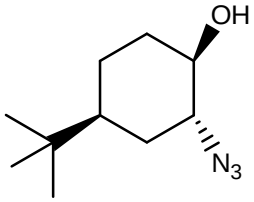
32. The major product formed in the following reaction is



(a) 

(b) 

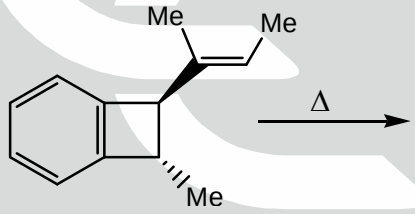
(c) 

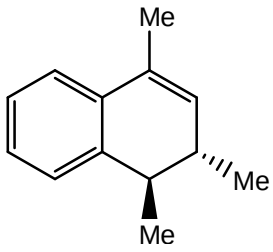
(d) 

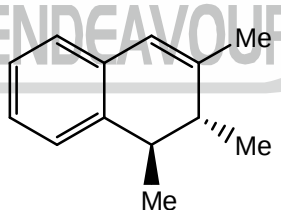
33. A liquid has vapor pressure of 2.02×10^3 N m^{-2} at 293 K and heat of vaporization of 41 kJ mol^{-1}. The boiling point of the liquid (in Kelvin) is _____

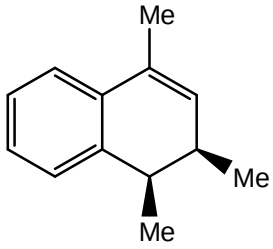
34. The difference in the ground state energies (kJ/mol) of an electron in one-dimensional boxes of lengths 0.2 nm and 2 nm is _____

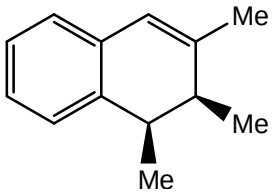
35. The major product formed in the following reaction is



(a) 

(b) 

(c) 

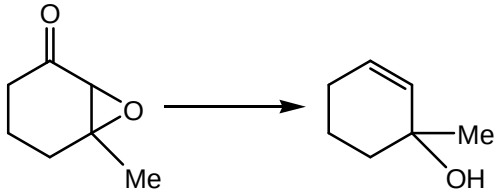
(d) 

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

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

38. The solubility product of AgBr(s) is 5×10^{-13} at 298K. If the standard reduction potential of the half-cell, $E^0_{Ag|AgBr(s)|Br^-}$ is 0.07V, the standard reduction potential, $E^0_{Ag^+|Ag}$ (in volts) is _____

39. The most suitable reagent (s) to effect the following transformed is



(a) N_2H_4, KOH heat
(b) $TsNHNH_2$, CF_3COOH
(c) $LiAlH_4$
(d) Na, liq. NH_3

40. Ammonolysis of S_2Cl_2 in an inert solvent gives
(a) S_2N_2 (b) S_2N_2Cl (c) $S_2N_2H_4$ (d) S_4N_4

41. The mean ionic activity coefficient of 0.001 molal $ZnSO_4$ (aq) at 298K according to the Debye-Huckel limiting law is (Debye-Huckel constant is 0.509 $molal^{-½}$) _____

42. Identify the function of hemocyanin and the metal responsible for it
(a) O_2 transport and Fe
(b) O_2 transport and Cu
(c) electron transport and Fe
(d) electron transport and Cu

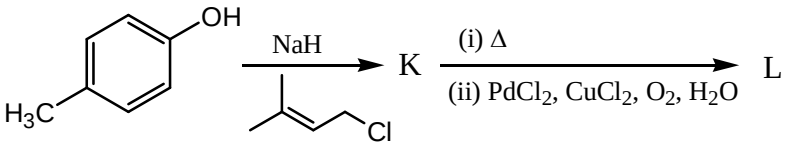
43. The point group of IF_7 is
(a) D_{6h} (b) D_{5h} (c) C_{6v} (d) C_{5v}

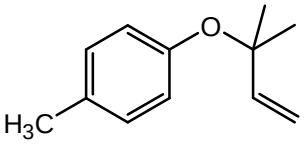
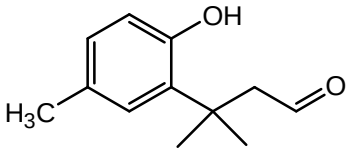
44. The limiting current (in μA) from the reduction of 3×10^{-4} M Pb^{2+}, using a dropping mercury electrode (DMF) with characteristics, *m* = 3.0 mg s^{-1} and *t* = 3s, is (diffusion coefficient of $Pb^{2+} = 1.2\times10^{-5}$ cm^2s^{-1}) _____

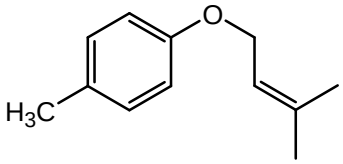
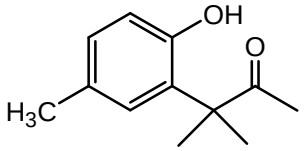
45. Identify X in the reaction, $\left[Pt\left(NH_3\right)_4\right]^{2+} + 2HCl \rightarrow X$

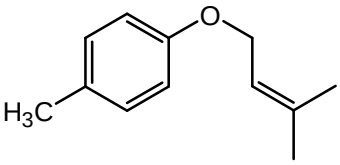
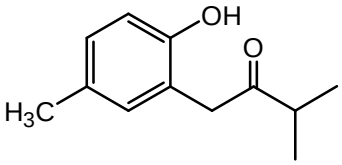
(a) $cis-\left[PtCl_2\left(NH_3\right)_2\right]$
(b) $trans-\left[PtCl_2\left(NH_3\right)_2\right]$
(c) $\left[PtCl\left(NH_3\right)_3\right]^+$
(d) $\left[PtCl_3\left(NH_3\right)\right]^-$

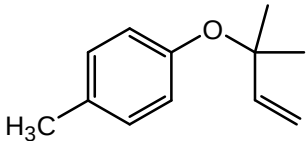
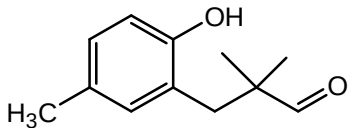
46. The major products, K and L formed in the following reactions are



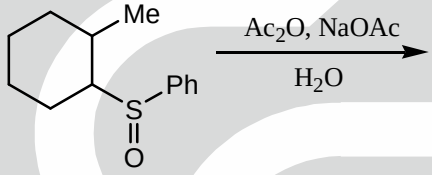
(a) K =  L = 

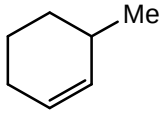
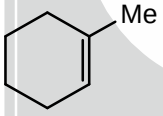
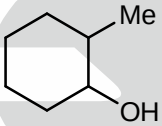
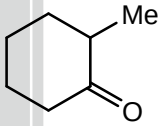
(b) K =  L = 

(c) K =  L = 

(d) K =  L = 

47. The major product formed in the following reaction is



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

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

(a) 0.30 and 4500 (b) 0.35 and 4800 (c) 0.4 and 5000 (d) 0.48 and 5200

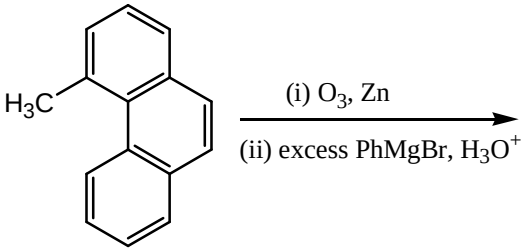
49. The rotational partition function of a diatomic molecule with energy levels corresponding to J = 0, 1, is (where , ε is a constant)

(a) $1+e^{-2\varepsilon}$ (b) $1+3e^{-2\varepsilon}$ (c) $1+e^{-3\varepsilon}$ (d) $1+3e^{-3\varepsilon}$

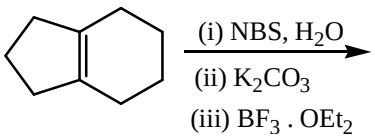
50. When one CO group is replaced by PPh_3 in $[Cr(CO)_6]$, which one of the following statement is TRUE?

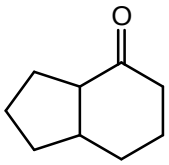
(a) The Cr-C bond length increases and CO bond length decreases
(b) The Cr-C bond length decreases and CO bond length decreases
(c) The Cr-C bond length decreases and CO bond length increases
(d) The Cr-C bond length increases and CO bond length increases

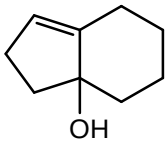
51. The number of possible stereoisomers obtained in the following reaction is _____

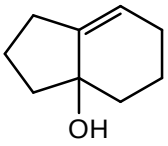


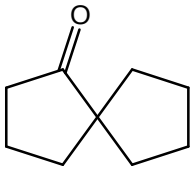
52. The major product formed in the following reaction is



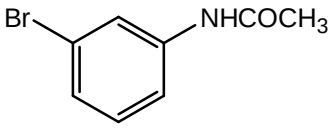
(a) 

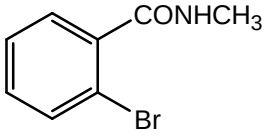
(b) 

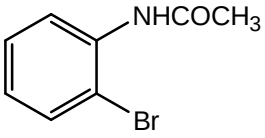
(c) 

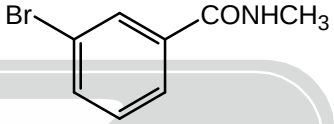
(d) 

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

(a) 

(b) 

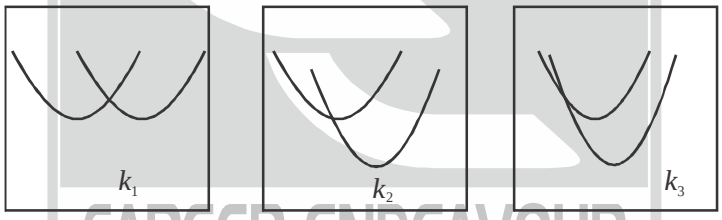
(c) 

(d) 

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

(a) $\sqrt{2}$ a (b) $\sqrt{3}$ a (c) $2\sqrt{2}$ a (d) $\frac{a}{\sqrt{2}}$

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



(a) $k_2 < k_3 < k_1$ (b) $k_2 < k_1 < k_3$ (c) $k_3 < k_2 < k_1$ (d) $k_3 < k_1 < k_2$

***** END OF THE QUESTION PAPER *****