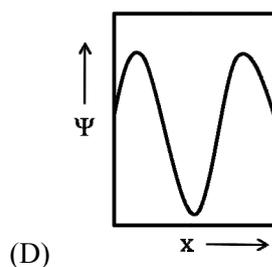
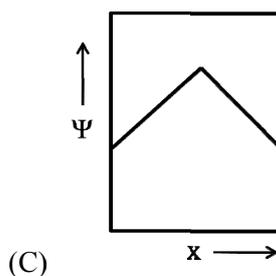
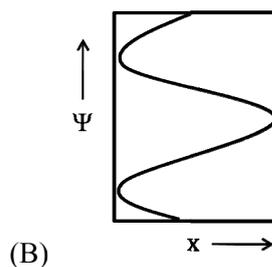
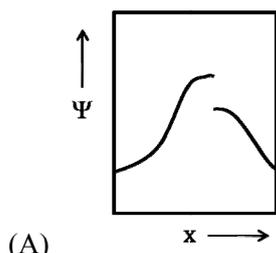


Useful information - CY Chemistry

Avogadro constant	= $6.022 \times 10^{23} \text{ mol}^{-1}$
Planck constant	= $6.626 \times 10^{-34} \text{ J s}$
Mass of an electron	= $9.109 \times 10^{-31} \text{ Kg}$
Charge of an electron	= $1.602 \times 10^{-19} \text{ C}$
Universal gas constant	= $8.314 \text{ J K}^{-1} \text{ mol}^{-1} = 0.0831 \text{ L bar K}^{-1} \text{ mol}^{-1}$
Boltzmann constant	= $1.38 \times 10^{-23} \text{ J K}^{-1}$
1 atm pressure	= 101325 N m^{-2}
Faraday constant	= 96485 C mol^{-1}
2.303 RT/F at 298 K	= 0.059 V

Q. 1 – Q. 25 carry one mark each.

Q.1 Which one of the following plots represents an acceptable wavefunction?



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

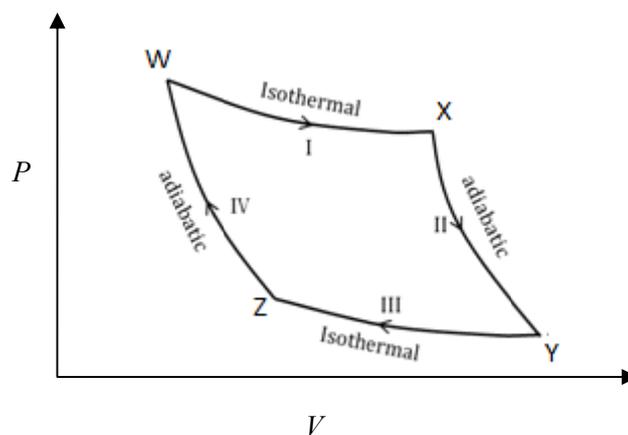
(A) $k^2 \hbar^2 e^{-ikx}$

(B) $ik^2 \hbar^2 e^{-ikx}$

(C) $i\hbar^2 e^{-ikx}$

(D) $\hbar^2 e^{-ikx}$

Q.3



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

Q.4 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) $\ln(M)$

Q.5 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) $\left(\frac{\partial G}{\partial S}\right)_V$

Q.6 Which of the following properties are characteristic of an ideal solution?

- (i) $(\Delta_{\text{mix}}G)_{T,P}$ is negative
 (ii) $(\Delta_{\text{mix}}S)_{T,P}$ is positive
 (iii) $(\Delta_{\text{mix}}V)_{T,P}$ is positive
 (iv) $(\Delta_{\text{mix}}H)_{T,P}$ is negative

- (A) (i) and (iv) (B) (i) and (ii) (C) (i) and (iii) (D) (iii) and (iv)

Q.7 The expression for the equilibrium constant (K_{eq}) for the enzyme catalyzed reaction given below, is



- (A) $\frac{k_1 k_3}{k_2 k_4}$ (B) $\frac{k_1 k_2}{k_3 k_4}$ (C) $\frac{k_2 k_3}{k_1 k_4}$ (D) $\frac{k_1 k_4}{k_2 k_3}$

Q.8 Given the E^0 values for the following reaction sequence,



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

Q.9 The absorption spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ in solution comprises of a maximum with a shoulder. The reason for the shoulder is

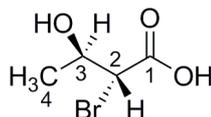
- (A) ligand-to-metal charge transfer (LMCT)
 (B) metal-to-ligand charge transfer (MLCT)
 (C) Jahn-Teller distortion
 (D) nephelauxetic effect

Q.10 The ease of formation of the adduct, $\text{NH}_3 \cdot \text{BX}_3$ (where, X = F, Cl, Br) follows the order

- (A) $\text{BBr}_3 < \text{BCl}_3 < \text{BF}_3$ (B) $\text{BCl}_3 < \text{BF}_3 < \text{BBr}_3$
 (C) $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$ (D) $\text{BBr}_3 < \text{BF}_3 < \text{BCl}_3$

- Q.11 An efficient catalyst for hydrogenation of alkenes is $[\text{Rh}(\text{PPh}_3)_3\text{Cl}]$. However, $[\text{Ir}(\text{PPh}_3)_3\text{Cl}]$ does not catalyze this reaction, because
- (A) PPh_3 binds stronger to Ir than to Rh (B) Cl binds stronger to Ir than to Rh
(C) PPh_3 binds stronger to Rh than to Ir (D) Cl binds stronger to Rh than to Ir
- Q.12 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
- Q.13 The intense red color of $[\text{Fe}(\text{bpy})_3]^{2+}$ ($\text{bpy} = 2,2'$ -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)
- Q.14 The compound with planar geometry is
- (A) $\text{N}(t\text{-Bu})_3$ (B) NPh_3 (C) NF_3 (D) $\text{N}(\text{SiH}_3)_3$
- Q.15 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
- Q.16 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.

- Q.17 The absolute configuration of C2 and C3 in the following compound is

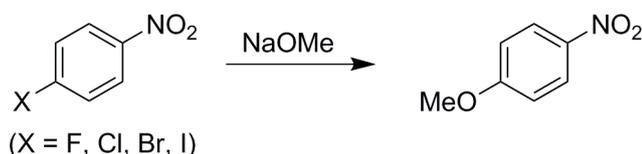


- (A) 2*R*, 3*S* (B) 2*S*, 3*R* (C) 2*S*, 3*S* (D) 2*R*, 3*R*

Q.18 Among the following compounds, the one that is non-aromatic, is



Q.19 The correct order of reactivity of *p*-halonitrobenzenes in the following reaction is

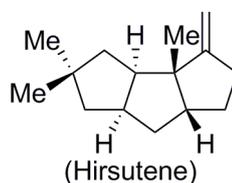


- (A) *p*-chloronitrobenzene > *p*-iodonitrobenzene > *p*-fluoronitrobenzene > *p*-bromonitrobenzene
 (B) *p*-fluoronitrobenzene > *p*-chloronitrobenzene > *p*-bromonitrobenzene > *p*-iodonitrobenzene
 (C) *p*-iodonitrobenzene > *p*-bromonitrobenzene > *p*-chloronitrobenzene > *p*-fluoronitrobenzene
 (D) *p*-bromonitrobenzene > *p*-fluoronitrobenzene > *p*-iodonitrobenzene > *p*-chloronitrobenzene

Q.20 Tollen's test is **NEGATIVE** for

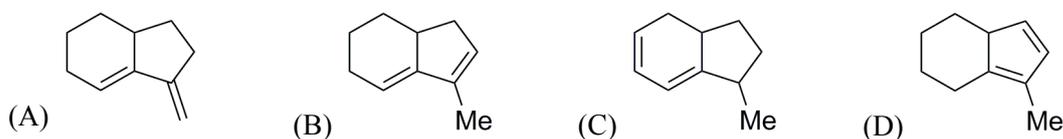
- (A) mannose (B) maltose (C) glucose (D) sucrose

Q.21 The compound given below is a

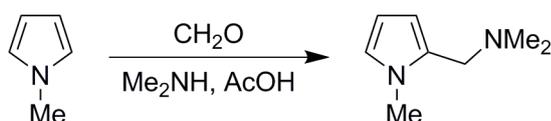


- (A) sesterterpene (B) monoterpene (C) sesquiterpene (D) triterpene

Q.22 Amongst the following, the compound that **DOES NOT** act as a diene in Diels-Alder reaction is

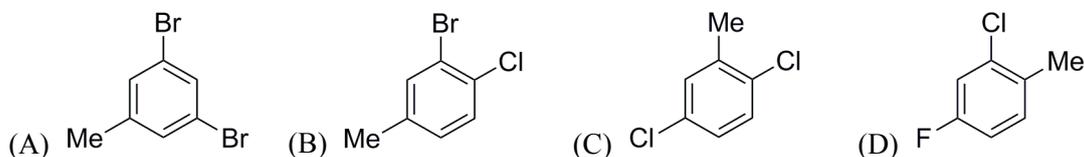


Q.23 The following conversion is an example of



- (A) Arndt-Eistert homologation (B) Mannich reaction
 (C) Michael addition (D) Chichibabin amination reaction

- Q.24 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



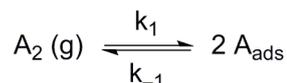
- Q.25 Reaction of benzaldehyde and *p*-methylbenzaldehyde under McMurry coupling conditions (TiCl_3 and LiAlH_4) gives a mixture of alkenes. The number of alkenes formed is _____

Q. 26 – Q. 55 carry two marks each.

- Q.26 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 _____

- Q.27 The mean ionic activity coefficient of 0.001 molal ZnSO_4 (aq) at 298 K according to the Debye-Hückel limiting law is (Debye-Hückel constant is $0.509 \text{ molal}^{-1/2}$) _____

- Q.28 The process given below follows the Langmuir adsorption isotherm.



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) $1/(K_{\text{eq}})^2$ (B) $1/K_{\text{eq}}$ (C) $-1/K_{\text{eq}}$ (D) $1/(K_{\text{eq}})^{1/2}$
- Q.29 For a gas phase unimolecular reaction at temperature 298 K, with a pre-exponential factor of $2.17 \times 10^{13} \text{ s}^{-1}$, the entropy of activation ($\text{J K}^{-1} \text{ mol}^{-1}$) is _____

- Q.30 A liquid has vapor pressure of $2.02 \times 10^3 \text{ N m}^{-2}$ at 293 K and heat of vaporization of 41 kJ mol^{-1} . The boiling point of the liquid (in Kelvin) is _____

Q.31 The rotational partition function of a diatomic molecule with energy levels corresponding to $J = 0$ and 1, is (where, ϵ is a constant)

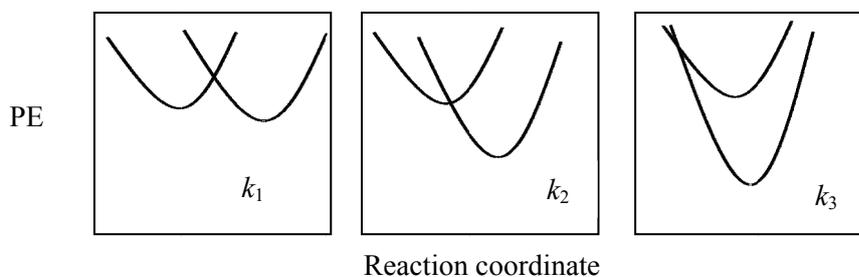
- (A) $1+e^{-2\epsilon}$ (B) $1+3e^{-2\epsilon}$ (C) $1+e^{-3\epsilon}$ (D) $1+3e^{-3\epsilon}$

Q.32 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 $PV^{1.3} = \text{constant}$) _____

Q.33 The solubility product of AgBr(s) is 5×10^{-13} at 298 K. If the standard reduction potential of the half-cell, $E_{\text{Ag}|\text{AgBr(s)}|\text{Br}^-}^0$ is 0.07 V, the standard reduction potential, $E_{\text{Ag}^+|\text{Ag}}^0$ (in volts) is _____.

Q.34 One mole of a substance is heated from 300 K to 400 K at constant pressure. The C_p of the substance is given by, $C_p (\text{J K}^{-1}\text{mol}^{-1}) = 5 + 0.1 T$. The change in entropy, in $\text{J K}^{-1}\text{mol}^{-1}$, of the substance is _____

Q.35 The potential energy (PE) versus reaction coordinate diagrams for electron transfer reactions with rate constants k_1 , k_2 and k_3 , are given below. The increasing order of the rate constants is



- (A) $k_2 < k_3 < k_1$ (B) $k_2 < k_1 < k_3$ (C) $k_3 < k_2 < k_1$ (D) $k_3 < k_1 < k_2$

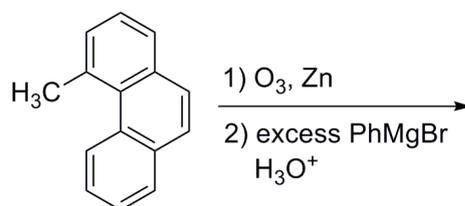
Q.36 The distance between two successive (110) planes in a simple cubic lattice with lattice parameter ' a ' is

- (A) $\sqrt{2} a$ (B) $\sqrt{3} a$ (C) $2\sqrt{2} a$ (D) $\frac{a}{\sqrt{2}}$

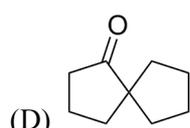
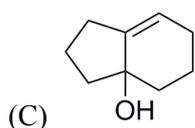
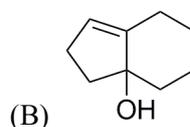
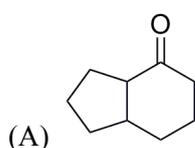
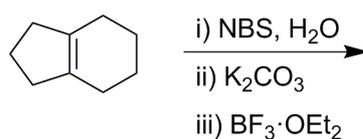
- Q.37 The percent transmittance of 8×10^{-5} M solution of KMnO_4 is 39.8 when measured at 510 nm in a cell of path length of 1 cm. The absorbance and the molar extinction coefficient (in $\text{M}^{-1} \text{cm}^{-1}$) of this solution are, respectively,
- (A) 0.30 and 4500 (B) 0.35 and 4800 (C) 0.4 and 5000 (D) 0.48 and 5200
- Q.38 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
- Q.39 Ammonolysis of S_2Cl_2 in an inert solvent gives
- (A) S_2N_2 (B) $\text{S}_2\text{N}_2\text{Cl}_2$ (C) $\text{S}_2\text{N}_2\text{H}_4$ (D) S_4N_4
- Q.40 The complexes $\text{K}_2[\text{NiF}_6]$ and $\text{K}_3[\text{CoF}_6]$ are
- (A) both paramagnetic (B) both diamagnetic
(C) paramagnetic and diamagnetic, respectively (D) diamagnetic and paramagnetic, respectively
- Q.41 The point group of IF_7 is
- (A) D_{6h} (B) D_{5h} (C) C_{6v} (D) C_{5v}
- Q.42 When one CO group is replaced by PPh_3 in $[\text{Cr}(\text{CO})_6]$, which one of the following statements is **TRUE**?
- (A) The Cr-C bond length increases and CO bond length decreases
(B) The Cr-C bond length decreases and CO bond length decreases
(C) The Cr-C bond length decreases and CO bond length increases
(D) The Cr-C bond length increases and CO bond length increases
- Q.43 Identify X in the reaction, $[\text{Pt}(\text{NH}_3)_4]^{2+} + 2 \text{HCl} \rightarrow \text{X}$
- (A) *cis*- $[\text{PtCl}_2(\text{NH}_3)_2]$ (B) *trans*- $[\text{PtCl}_2(\text{NH}_3)_2]$
(C) $[\text{PtCl}(\text{NH}_3)_3]^+$ (D) $[\text{PtCl}_3(\text{NH}_3)]^-$
- Q.44 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

Q.45 The limiting current (in μA) from the reduction of $3 \times 10^{-4} \text{ M Pb}^{2+}$, using a dropping mercury electrode (DME) with characteristics, $m = 3.0 \text{ mg s}^{-1}$ and $t = 3\text{s}$, is (diffusion coefficient of $\text{Pb}^{2+} = 1.2 \times 10^{-5} \text{ cm}^2 \text{ s}^{-1}$) _____

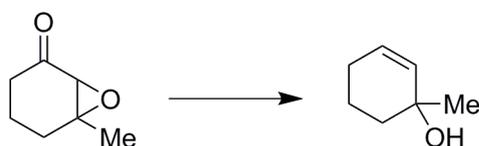
Q.46 The number of possible stereoisomers obtained in the following reaction is _____



Q.47 The major product formed in the following reaction is



Q.48 The most suitable reagent(s) to effect the following transformation is



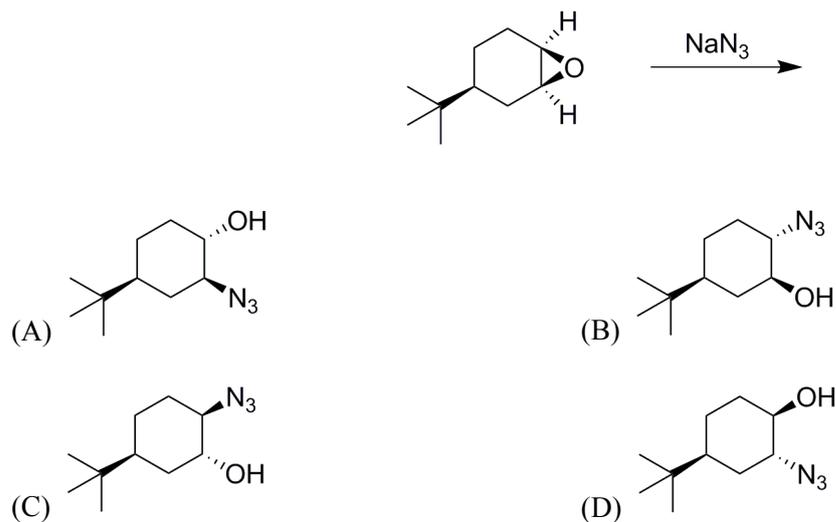
(A) N_2H_4 , KOH , heat

(B) TsNHNH_2 , CF_3COOH

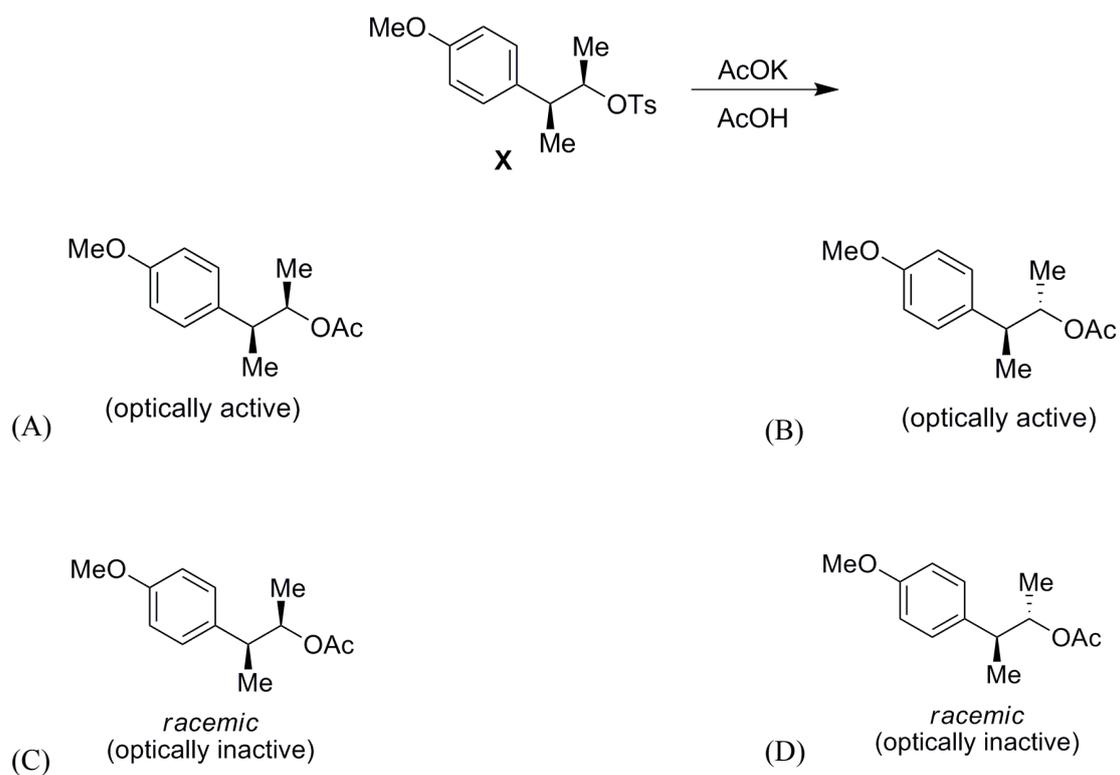
(C) LiAlH_4

(D) Na , liq. NH_3

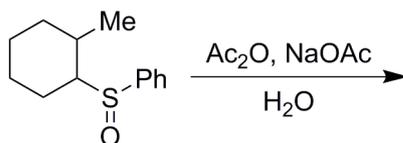
Q.49 The major product formed in the following reaction is



Q.50 Solvolysis of the optically active compound X gives, mainly



Q.51 The major product formed in the following reaction is

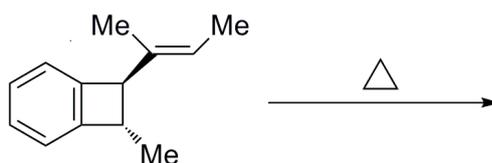


- (A) (B) (C) (D)

Q.52 The tetrapeptide, Ala-Val-Phe-Met, on reaction with Sanger's reagent, followed by hydrolysis gives

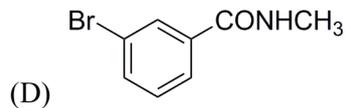
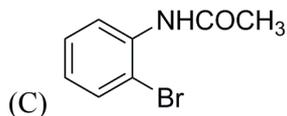
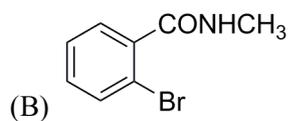
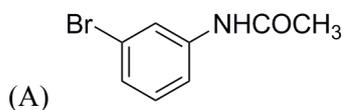
- (A) (B) (C) (D)

Q.53 The major product formed in the following reaction is

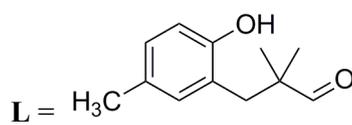
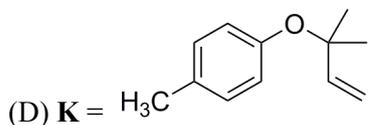
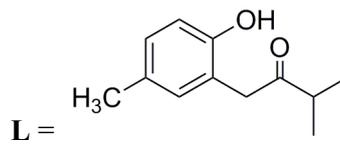
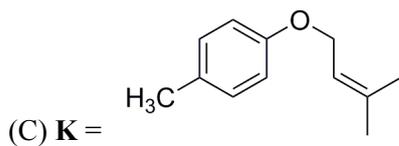
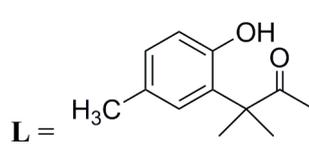
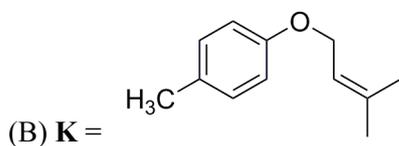
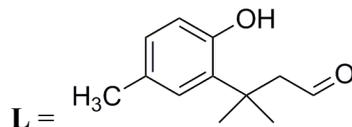
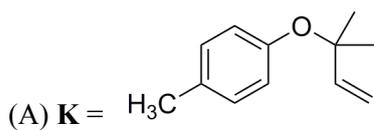
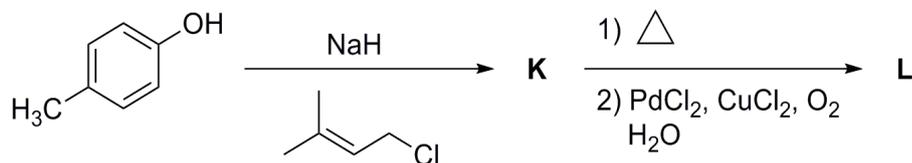


- (A) (B) (C) (D)

Q.54 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



Q.55 The major products, **K** and **L** formed in the following reactions are



END OF THE QUESTION PAPER