

# **IIT - JEE ADVANCED - 2012**

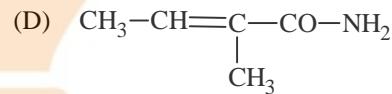
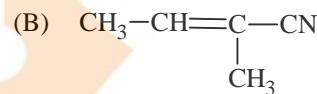
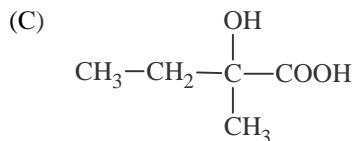
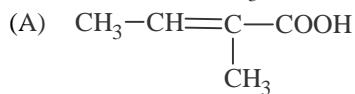
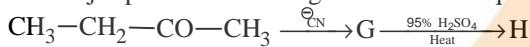
## **PAPER-2 [Code – 8]**

## **PART - II: CHEMISTRY**

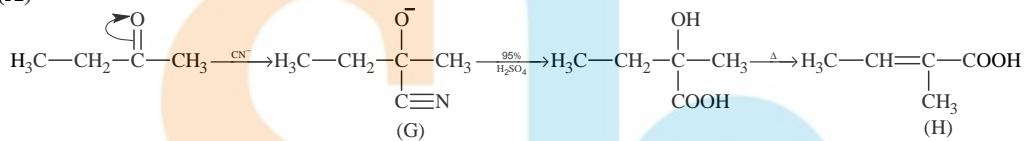
## **SECTION I : Single Correct Answer Type**

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

21. The major product H of the given reaction sequence is



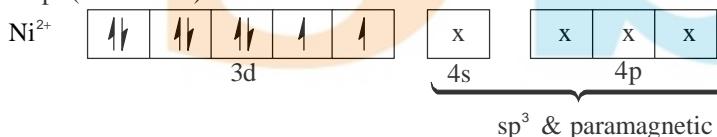
*Sol.* (A)



*Sol.*

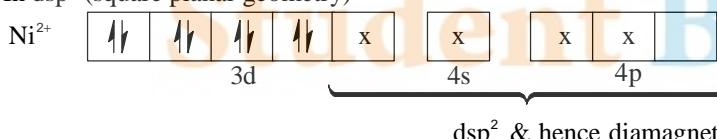
In both complexes Ni exists as  $\text{Ni}^{2+}$ .

### In sp<sup>3</sup> (tetrahedral)



x represents electron pair  
donated by the ligands

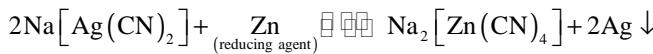
In  $dsp^2$  (square planar geometry)



*Sol.*

**(B)** The reactions involved in cyanide extraction process are:



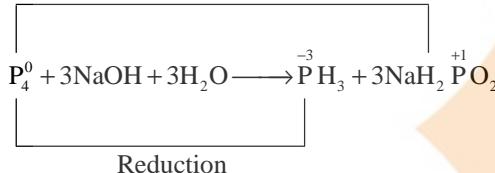


24. The reaction of white phosphorous with aqueous NaOH gives phosphine along with another phosphorous containing compound. The reaction type; the oxidation states of phosphorus in phosphine and the other product are respectively

(A) redox reaction; -3 and -5  
 (B) redox reaction; +3 and +5  
 (C) disproportionation reaction; -3 and +5  
 (D) disproportionation reaction; -3 and +3

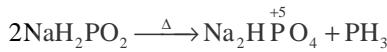
**Sol.** (C)

The balanced disproportionation reaction involving white phosphorus with aq. NaOH is



Reduction

\* However, as the option involving +1 oxidation state is completely missing, one might consider that  $\text{NaH}_2\text{PO}_2$  formed has undergone thermal decomposition as shown below:

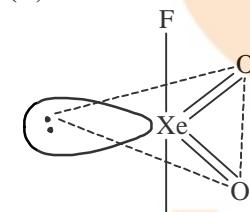


Although heating is nowhere mentioned in the question, the "other product" as per available options seems to be  $\text{Na}_2\text{HPO}_4$  (oxidation state = +5).

\*25. The shape of  $\text{XeO}_2\text{F}_2$  molecule is

(A) trigonal bipyramidal  
 (B) square planar  
 (C) tetrahedral  
 (D) see-saw

**Sol.** (D)



Hybridization =  $\text{sp}^3\text{d}$   
 Shape = see-saw

26. For a dilute solution containing 2.5 g of a non-volatile non-electrolyte solute in 100 g of water, the elevation in boiling point at 1 atm pressure is 2°C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take  $K_b = 0.76 \text{ K kg mol}^{-1}$ )

(A) 724  
 (B) 740  
 (C) 736  
 (D) 718

**Sol.** (A)

B  $\rightarrow$  Solute; A  $\rightarrow$  Solvent

$$W_B = 2.5 \text{ g}, W_A = 100 \text{ g}$$

$$\Delta T_b = 2^\circ$$

$$\frac{p^o - p_s}{p^o} = X_B = \frac{n_B}{n_B + n_A}$$

$$\frac{p^o - p_s}{p^o} = \frac{n_B}{n_A} \quad \because n_B \ll n_A$$

$$\frac{p^o - p_s}{p^o} = \frac{n_B}{n_A}$$

$$\frac{760 - P_{\text{soln}}}{760} = \frac{2.5 / M}{100 \times \frac{1000}{18 \times 1000}} = \frac{m \times 18}{1000} \quad \dots \text{(i)}$$

and from boiling point elevation,

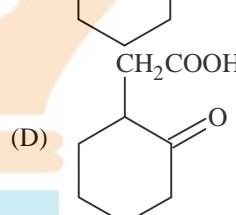
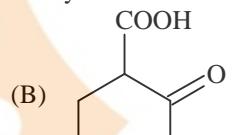
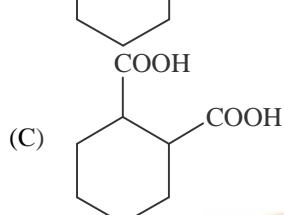
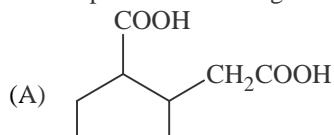
$$2 = 0.76 \times m$$

$$m = \frac{2}{0.76} \quad \dots \text{(ii)}$$

on equating (i) and (ii)

$$P_{\text{soln}} = 724 \text{ mm}$$

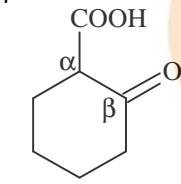
27. The compound that undergoes decarboxylation most readily under mild condition is



**Sol.**

**(B)**

$\beta$  - keto acids undergoes decarboxylation easily.



( $\beta$  - keto acid)

\*28. Using the data provided, calculate the multiple bond energy ( $\text{kJ mol}^{-1}$ ) of a  $\text{C}\equiv\text{C}$  bond in  $\text{C}_2\text{H}_2$ . That energy is (take the bond energy of a  $\text{C}-\text{H}$  bond as  $350 \text{ kJ mol}^{-1}$ )



(A) 1165

(B) 837

(C) 865

(D) 815

**Sol.**

**(D)**



From equation (i):

$$225 = \left[ 2 \times \Delta H_{\text{C(s)} \longrightarrow \text{C(g)}} + 1 \times \text{BE}_{\text{H-H}} \right] - \left[ 2 \times \text{BE}_{\text{C-H}} + 1 \times \text{BE}_{\text{C}\equiv\text{C}} \right]$$

$$225 = [1410 + 1 \times 330] - [2 \times 350 + 1 \times \text{BE}_{\text{C}\equiv\text{C}}]$$

$$225 = [1410 + 330] - [700 + \text{BE}_{\text{C}\equiv\text{C}}]$$

$$225 = 1740 - 700 - \text{BE}_{\text{C}\equiv\text{C}}$$

$$225 = 1040 - \text{BE}_{\text{C}\equiv\text{C}}$$

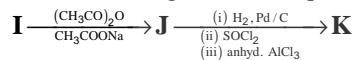
$$\text{BE}_{\text{C}\equiv\text{C}} = 1040 - 225 = 815 \text{ kJ mol}^{-1}$$

## SECTION II : Paragraph Type

This section contains 6 **multiple choice questions** relating to three paragraphs with **two questions on each paragraph**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

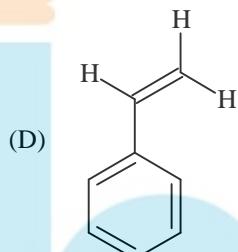
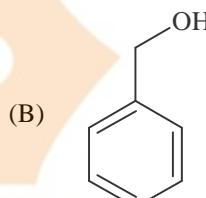
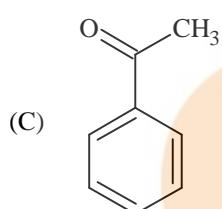
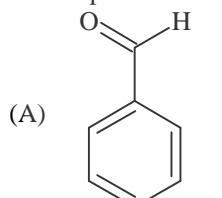
### Paragraph for Questions 29 and 30

In the following reaction sequence, the compound **J** is an intermediate.



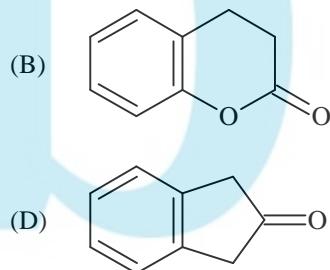
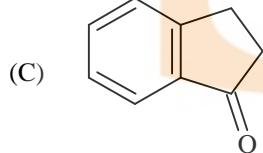
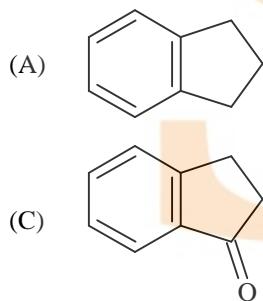
**J** ( $\text{C}_9\text{H}_8\text{O}_2$ ) gives effervescence on treatment with  $\text{NaHCO}_3$  and a positive Baeyer's test.

29. The compound **I** is



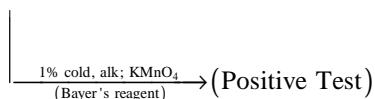
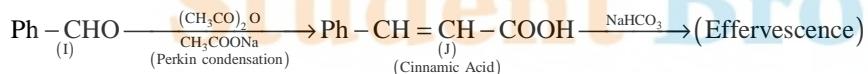
Ans. (A)

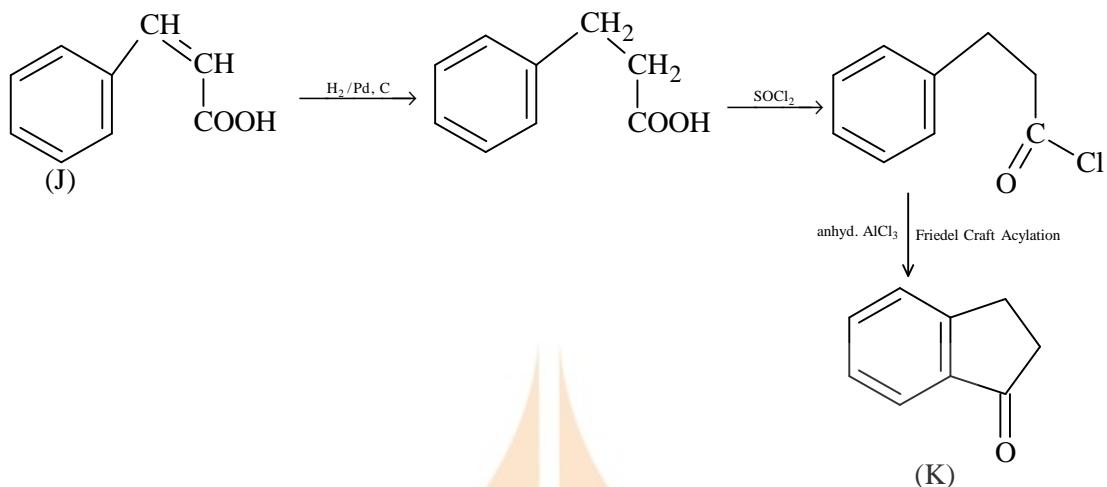
30. The compound **K** is



Ans. (C)

Sol. 29-30





### **Paragraph for Questions 31 and 32**

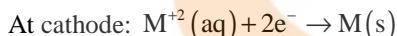
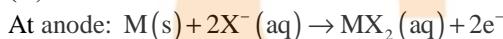
The electrochemical cell shown below is a concentration cell.

The electrochemical cell shown below is a concentration cell.

The emf of the cell depends on the difference in concentrations of  $M^{2+}$  ions at the two electrodes. The emf of the cell at 298 K is 0.059 V.

31. The value of  $\Delta G$  (kJ mol<sup>-1</sup>) for the given cell is (take 1F = 96500 C mol<sup>-1</sup>)  
(A) -5.7 (B) 5.7  
(C) 11.4 (D) -11.4

*Sol.* (D)

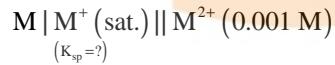


n-factor of the cell reaction is 2.

$$\Delta G = -nFE_{\text{cell}} = -2 \times 96500 \times 0.059 = -113873 \text{ J/mole} = -11.387 \text{ KJ/mole} \approx -11.4 \text{ KJ/mole}$$

32. The solubility product ( $K_{sp}$ ;  $\text{mol}^3 \text{ dm}^{-9}$ ) of  $\text{MX}_2$  at 298 K based on the information available for the given concentration cell is (take  $2.303 \times R \times 298/F = 0.059 \text{ V}$ )  
 (A)  $1 \times 10^{-15}$  (B)  $4 \times 10^{-15}$   
 (C)  $1 \times 10^{-12}$  (D)  $4 \times 10^{-12}$

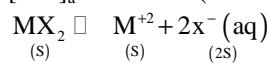
*Sol.* (B)



emf of concentration cell,

$$E_{cell} = \frac{-0.059}{n} \log \frac{[M^{+2}]_a}{[M^{+2}]_c}$$

$$[M^{+2}]_a = 10^{-5} = S \text{ (solubility of salt in saturated solution)}$$

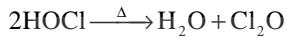
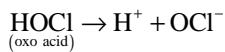
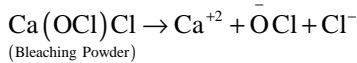


$$K_{sp} = 4S^3 = 4 \times (10^{-5})^3 = 4 \times 10^{-15}$$

### **Paragraph for Questions 33 and 34**

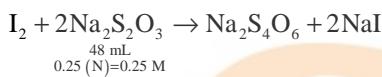
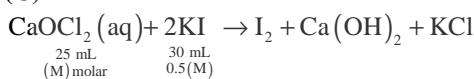
Bleaching powder and bleach solution are produced on a large scale and used in several household products. The effectiveness of bleach solution is often measured by iodometry.

*Sol.* (A)



Anhydride of oxoacid ( $\text{HOCl}$ ) is  $\text{Cl}_2\text{O}$ .

*Sol.* (C)



$$\text{So, number of millimoles of I}_2\text{ produced} = 48 \times \frac{0.25}{2} = 24 \times 0.25 = 6$$

In reaction;

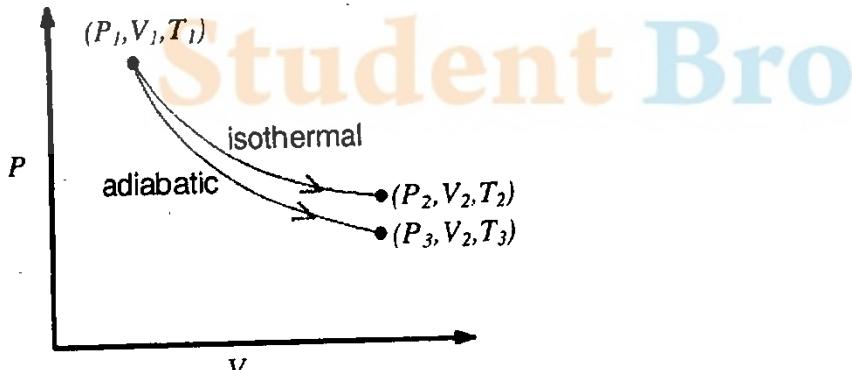
$$\text{Number of millimoles of bleaching powder } (n_{\text{CaOCl}_2}) = n_{\text{I}_2\text{-produced}} = \frac{1}{2} \times n_{\text{Na}_2\text{S}_2\text{O}_3} \text{ used} = 6$$

$$\text{So, (M)} = \frac{n_{\text{CaOCl}_2} \text{ (millimoles)}}{V \text{ (in mL)}} = \frac{6 \text{ millimoles}}{25 \text{ mL}} = 0.24$$

### SECTION III : Multiple Correct Answer(s) Type

The section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

\*35. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?



(A)  $T_1 = T_2$       (B)  $T_3 > T_1$   
 (C)  $w_{\text{isothermal}} > w_{\text{adiabatic}}$       (D)  $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

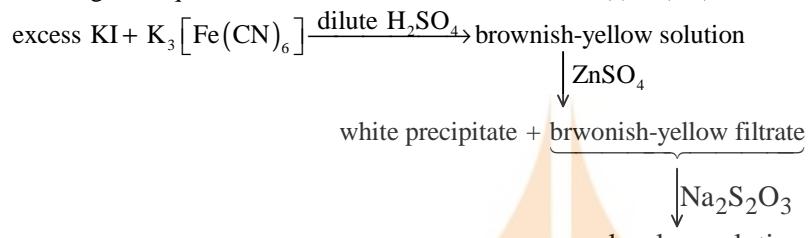
*Sol.* (A, C, D)

$T_1 = T_2$  because process is isothermal.

Work done in adiabatic process is less than in isothermal process because area covered by isothermal curve is more than the area covered by the adiabatic curve.

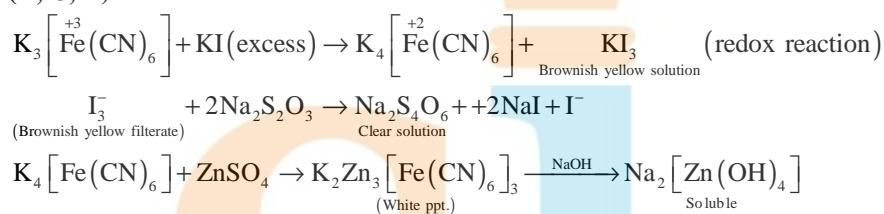
In adiabatic process expansion occurs by using internal energy hence it decreases while in isothermal process temperature remains constant that's why no change in internal energy.

36. For the given aqueous reactions, which of the statement(s) is (are) true?

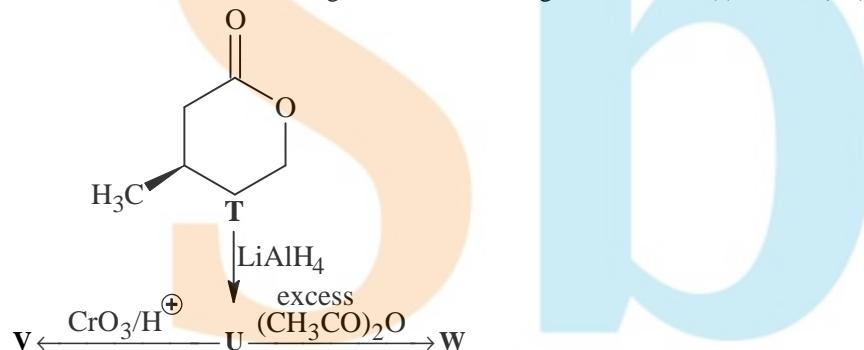


- (A) The first reaction is a redox reaction.
- (B) White precipitate is  $Zn_3[Fe(CN)_6]_2$ .
- (C) Addition of filtrate to starch solution gives blue colour.
- (D) White precipitate is soluble in NaOH solution.

*Sol.* (A, C, D)

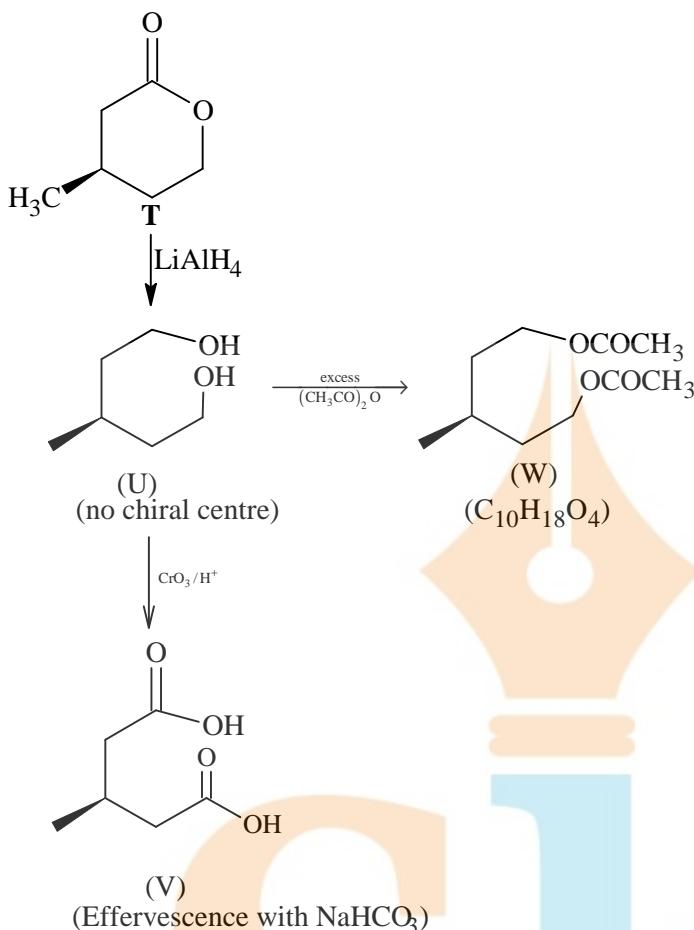


37. With reference to the scheme given, which of the given statement(s) about T, U, V and W is (are) correct?

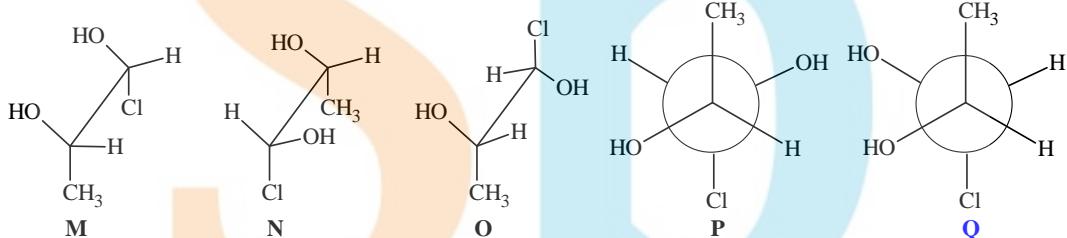


- (A) T is soluble in hot aqueous NaOH
- (B) U is optically active
- (C) Molecular formula of W is  $C_{10}H_{18}O_4$
- (D) V gives effervescence on treatment with aqueous  $NaHCO_3$

*Sol.* (A, C, D)



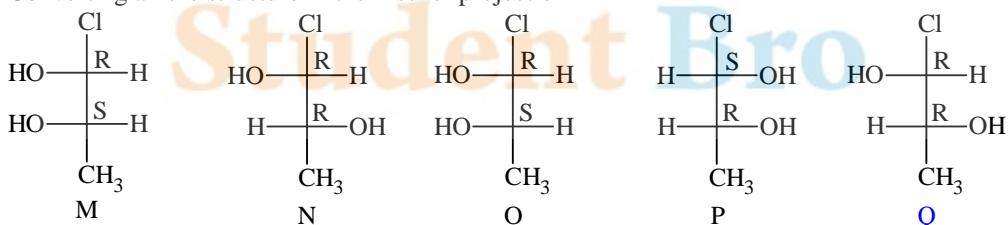
38. Which of the given statement(s) about **N**, **O**, **P** and **Q** with respect to **M** is (are) correct?



(A) **M** and **N** are non-mirror image stereoisomers      (B) **M** and **O** are identical  
(C) **M** and **P** are enantiomers      (D) **M** and **Q** are identical

*Sol.* (A, B, C)

## Converting all the structure in the Fischer projection



M and N are diastereoisomers

M and O are identical

M and P are enantiomers

M and Q are diastereoisomers

Hence, the correct options are A, B, C.

Hence, the correct options are A, B, C.

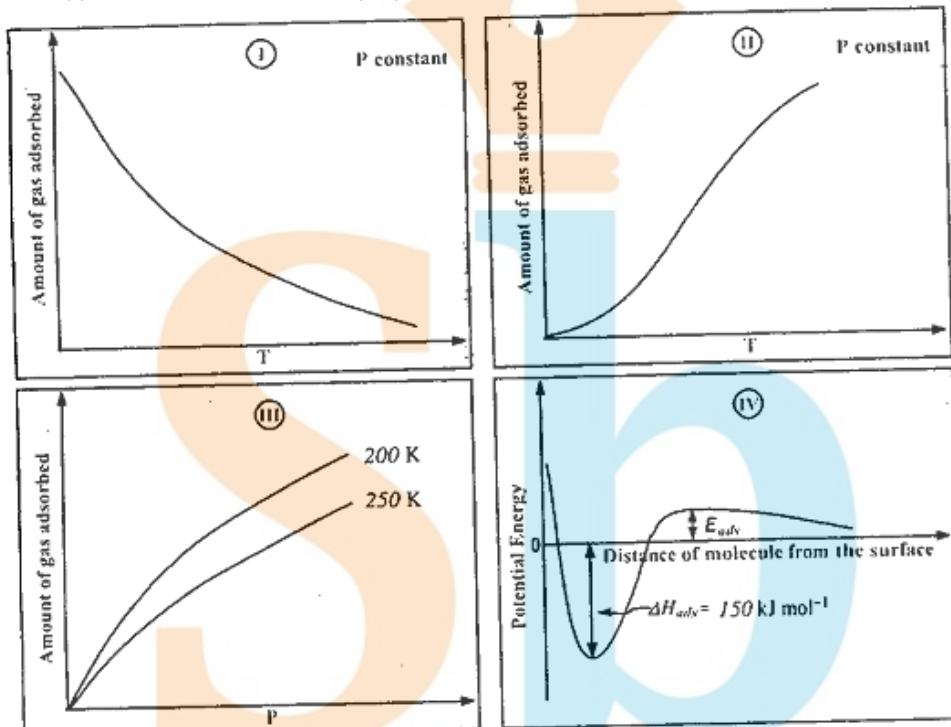
39. With respect to graphite and diamond, which of the statement(s) given below is (are) correct?

(A) Graphite is harder than diamond.  
 (B) Graphite has higher electrical conductivity than diamond.  
 (C) Graphite has higher thermal conductivity than diamond.  
 (D) Graphite has higher C–C bond order than diamond.

**Sol.** (B, D)

- ⇒ Diamond is harder than graphite.
- ⇒ Graphite is good conductor of electricity as each carbon is attached to three C-atoms leaving one valency free, which is responsible for electrical conduction, while in diamond, all the four valencies of carbon are satisfied, hence insulator.
- ⇒ Diamond is better thermal conductor than graphite. Whereas electrical conduction is due to availability of free electrons; thermal conduction is due to transfer of thermal vibrations from atom to atom. A compact and precisely aligned crystal like diamond thus facilitates fast movement of heat.
- ⇒ In graphite, C–C bond acquires double bond character, hence higher bond order than in diamond.

40. The given graphs / data I, II, III and IV represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice(s) about I, II, III and IV is (are) correct?



(A) I is physisorption and II is chemisorption  
 (C) IV is chemisorption and II is chemisorption

(B) I is physisorption and III is chemisorption  
 (D) IV is chemisorption and III is chemisorption

**Sol.** (A, C)

Graph (I) and (III) represent physisorption because, in physisorption, the amount of adsorption decreases with the increase of temperature and increases with the increase of pressure.

Graph (II) represent chemisorption, because in chemisorption amount of adsorption increase with the increase of temperature. Graph (IV) is showing the formation of a chemical bond, hence chemisorption.