IIT-JEE 2012

PAPER - 2

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. $NiCl_2\{P(C_2H_5)_2(C_6H_5)\}_2$ exhibits temperature dependent magnetic behaviour (paramagnetic/ diamagnetic) . the coordination geometries of Ni^{2+} in the paramagnetic and diamagnetic states are respectively

(A) tetrahedral and tetrahedral

(B) square planar and square planar

(C) tetrahedral and square planar

(D) square planar and tetrahedral

Ans. **(C)**

Sol. $[NiCl_2\{PEt_2Ph\}]$ contains Ni^{2+} with electronic configuration

$Ni^{2+} = [Ar]\ 3d^8 4s^0$

In high spin state, it is paramagnetic, sp^3 hybridised, tetrahedral.
In low spin state, it is diamagnetic, dsp^2, square planar.

22. The reaction of white phosphorous with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type; the oxidation states of phosphorous 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

Ans. **(C)**

Sol. $P_4(s) + NaOH \longrightarrow \underset{(-3)}{PH_3} + \underset{(+1)}{NaH_2PO_2}(aq)$

$\downarrow \Delta$

$Na_3PO_4 + PH_3$
(+ 5)

Oxidation states of P in Na_3PO_4 & PH_3 are +5 & –3 resp tiv ly. It is a disproportionation rea tion.

23. In the cyanide extraction process of silver from argentite ore, the oxidizing and reducing agents used are

(A) O_2 and CO respectively (B) O_2 and Zn dust respectively

(C) HNO_3 and Zn dust respectively. (D) HNO_3 and CO respectively

Ans. **(B)**

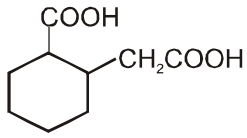
Sol. In extraction of silver, Ag_2S is leached with KCN in presence of air :

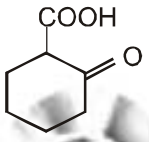
$Ag_2S + NaCN + O_2 \rightleftharpoons Na[Ag(CN)_2] + Na_2S_2O_3$

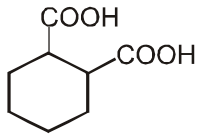
Thus, O_2 is oxidant.

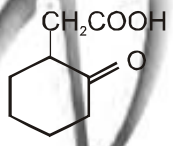
$2Ag(CN)_2^- + Zn \longrightarrow [Zn(CN)_4]^{2-} + 2Ag \downarrow$

24. The compound that undergoes decarboxlylation most readily under mild condition is

(A) 

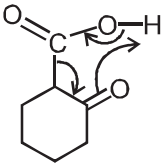
(B) 

(C) 

(D) 

Ans. **(B)**

Sol. In decarboxylation, β-carbon acquires δ– charg . ˘ henever δ– charg is stabilized, decarboxylation ˘ ‹ comes simple. In (B), it is stabilized by –m ˘ –I of C = O, which is best amongst the options offered,



25. Using the data provided, calculate the multiple bond energy (kJ mol^{-1}) of a C≡C bond C_2H_2. That energy is (take the bond energy of a C–H bond as 350 #$ mol^{-1})

$2C(s) + H_2(g) \longrightarrow C_2H_2(g)$ $\Delta H = 225$ kJ mol^{-1}

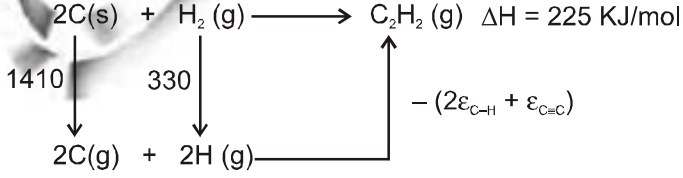
$2C(s) \longrightarrow 2C(g)$ $\Delta H = 1410$ kJ mol^{-1}

$H_2(g) \longrightarrow 2H(g)$ $\Delta H = 330$ kJ mol^{-1}

(A) 1165 (B) 837 (C) 865 (D) 815

Ans. **(D)**

Sol.



$\therefore$ $\Delta H = +1410 + 330 - (35" \ \&'(- \varepsilon_{C\equiv C} = +225$

$\therefore$ $\varepsilon_{C\equiv C} = 1740 -)"" - 225 * + 815 ,\$ -° ol.$

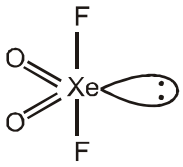
26. The shape of XeO_2F_2 molecule is

(A) trigonal bipyramidal (B) square plannar

(C) tetrahedral (D) see-saw

Ans. **(D)**

Sol. XeO_2F_2 has trigonal bipyramidal geometry. Due to presence of lone pair on equitorial position, the shape is see-saw.



27. The major product H in the given reaction sequence is

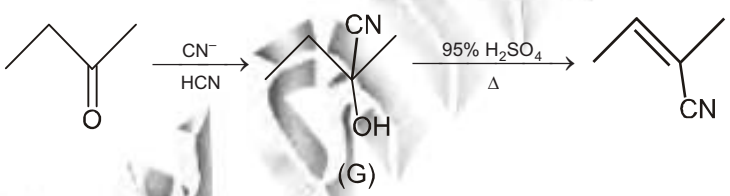
$CH_3–C!_2–CO–.!_3 \xrightarrow{\Theta CN} G \xrightarrow[\text{Heat}]{95\%\ H_2SO_4} H$

(A) $CH_3–CH=C(CH_3)–COOH$ (B) $CH_3–CH=C(CH_3)–CN$

(C) $CH_3–CH_2–C(OH)(CH_3)–COOH$ (D) $CH_3–CH=C(CH_3)–CO–NH_2$

Ans. **(B)**

Sol.



(G)

28. 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 2ºC. Ass2° ing oncentration of sol2t is °2 h low r than the oncentration of solvent, the vapour pressure (mm of Hg) of the solution is (take $K_b = 0.76$ K kg mol^{-1})

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

Ans. **(A)**

Sol. $\Delta T_b = 20.\ 5$ $m_a = 2.5$ g

$m_{solvent} = 100$ g

$K_b = 0.76$ K. kg. mol^{-1}

$P_{solution} = ?$

$\Delta T_b = K_b \&\ °$

$2 = 0.76 \&\ °$ $\therefore\ m = \frac{2}{0.76}$

$\frac{P^0 - P}{P} = m \&\ 66\ \&\ "^{-3}$ $\therefore\ \frac{760 - P}{P} = \frac{2}{0.76} \&\ +\ \&\ "^{-3}$

$760 - 7 * \frac{36}{760}P$ $\quad\quad$ $\therefore\ 760 = \frac{796}{760}P$

$\therefore\ P = 760\left(\frac{796}{760}\right)$ torr = 725.6 torr $\approx$ 724 torr

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 Nos. 29 to 30

The electrochemical cell shown below is a concentration cell.

$M|M^{2+}$ (saturated solution of a sparingly soluble salt,MX_2)|| M^{2+} (0.001 mol dm^{-3}) |M

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

29. The solubility product (K_{sp} ; $mol^3\ dm^{-9}$) of MX_2 at 298 based on the information available the given concentration cell is (take 2.303& 9 &'8+-: * 0.059 ; (

(A) 1 & " $^{-15}$ (B) 4 & " $^{-15}$ (C) 1 & " $^{-}$ ' (D) 4 & " $^{-1'}$

Ans. **(B)**

Sol. $M|M^{2+}(aq) \,||\, M^{2+}(aq)\,|\,M$

0.001 M

Anode : $M \longrightarrow M^{2+}(aq) + 2e^-$

Cathode : $M^{2+}(aq) + 2e^- \longrightarrow M$

$M^{2+}(aq)_c \rightleftharpoons M^{2+}(aq)_a$

$$E_{cell} = 0 - \frac{0.059}{2}\log\left\{\frac{M^{2+}(aq)_a}{10^{-3}}\right\}$$

$$0.059 = -\frac{0.059}{2}\log\left\{\frac{M^{2+}(aq)_a}{10^{-3}}\right\}$$

$$-\ ' * \log\left\{\frac{M^{2+}(aq)_a}{10^{-3}}\right\}$$

10^{-2} & " $^{-3}$ = $M^{2+}(aq)_a$ = solubility = s

$K_{sp} = 4s^3 = 4$ & %" $^{-5})^3 = 4$ & " $^{-15}$

30. The value of ΔG (kJ mol^{-1}) for the given cell is (take 1F = 96500 C mol^{-1})

(A) – 5.7 (B) 5.7 (C) 11.4 (D) –1 .4

Ans. **(D)**

Sol. $\Delta G = -nF\varepsilon_{cell} = -\ '$ & 96500 & 0.059 & " $^{-3}$ kJ/mole

= – .4 #$-° ol

Paragraph for Questions Nos. 31 to 32

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

31. 25 mL of household bleach solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N $Na_2S_2O_3$ was used to reach the end point. The molarity of the household bleach solution is

(A) 0.48 M (B) 0.96 M (C) 0.24 M (D) 0.024 M

Ans. **(C)**

Sol. milli mole of Hypo = 0.25 & <+

= 2 & ° illi mol of Cl_2

milli mole of Cl_2 = $\frac{0.25 \times 48}{2}$ = 6 milli mole

= milli mole of Cl_2 = milli mole of $CaOCl_2$

So, molarity = $\frac{6}{25}$M = 0.24 M

32. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is

(A) Cl_2O (B) Cl_2O_7 (C) ClO_2 (D) Cl_2O_6

Ans. **(A)**

Sol. $CaOCl_2 = Ca(OCl)Cl$

OCl^- – Hypochlorite ion

which is anion of HOCl

Anhydride of HOCl = Cl_2O

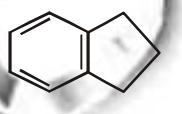
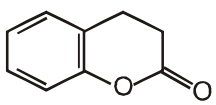
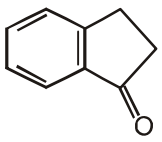
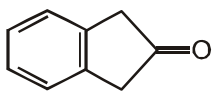
Paragraph for Questions Nos. 33 to 34

In the following reactions sequence, the compound J is an intermediate.

$$I \xrightarrow[CH_3COONa]{(CH_3CO)_2O} J \xrightarrow[\text{(ii) anhyd. } AlCl_3]{\text{(i) } H_2, Pd/C,\ \text{(ii) } SOCl_2} K$$

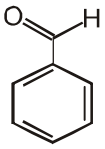
J ($C_9H_8O_2$) gives effervescence on treatment with $NaHCO_3$ and positive Baeyer's test

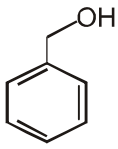
33. The compound K is

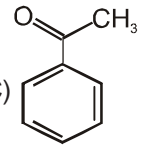
(A)  (B)  (C)  (D) 

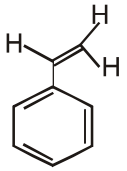
Ans. **(C)**

34. The compound I is

(A) 

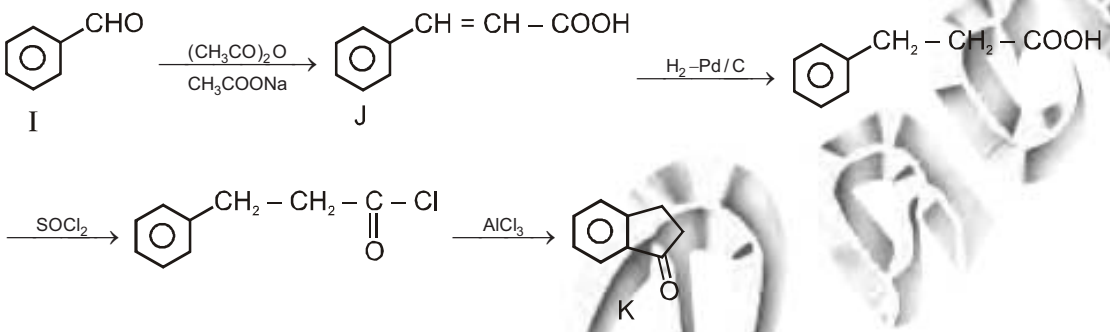
(B) 

(C) 

(D) 

Ans. **(A)**

Sol. **(33 to 34)**



I J

SECTION – III : Multiple Correct Answer(s) Type

This 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. 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 dia° ond

Ans. **(BD)**

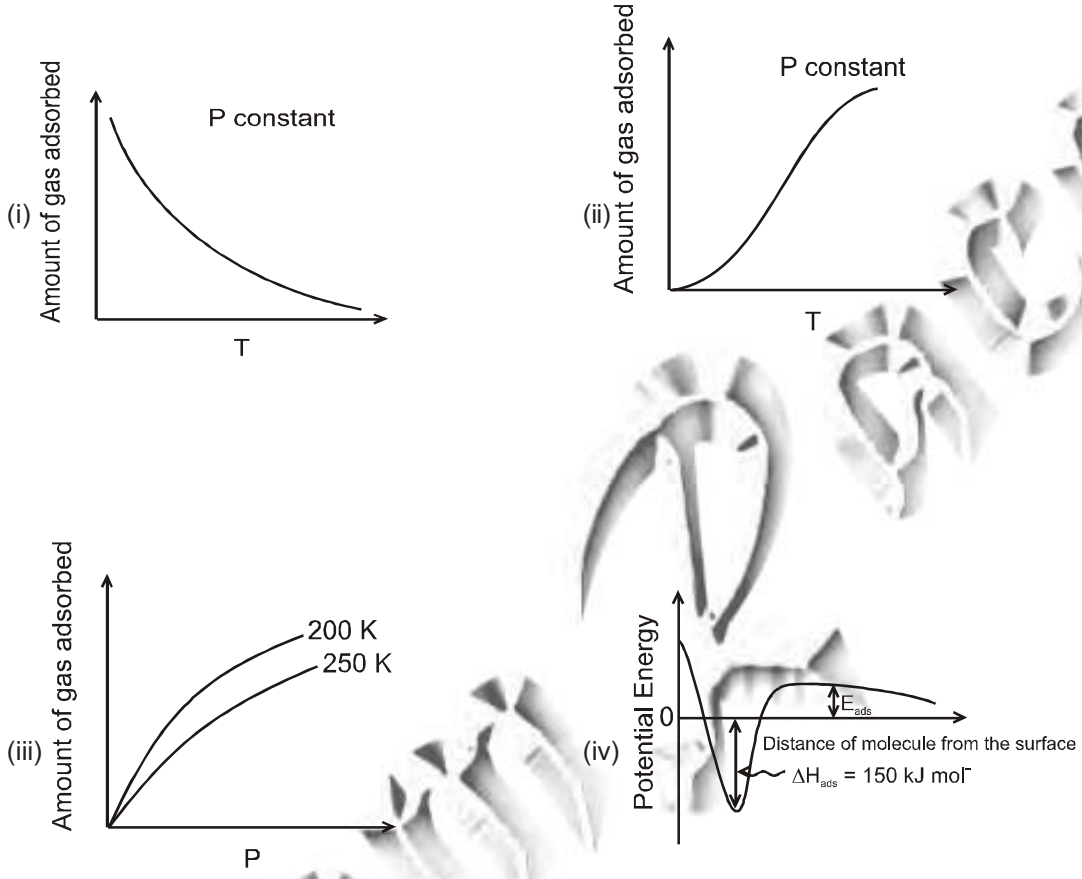
Sol. (A) Diamond is harder than graphite.

(B) Graphite is better conductor of electricity than diamond.

(C) Diamond is better conductor of heat than graphite.

(D) Bond order of graphite (≃ 1.5) > Bond order of diamond (= 1)

36. The given graph / 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
(B) I is physisorption and III is chemisorption
(C) IV is chemisorption and II is chemisorption
(D) IV is chemisorption and III is chemisorption

Ans. **(AC)**

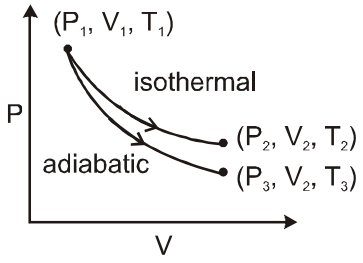
Sol. In physisorption on increasing temperature at constant pressure, adsorption decreases while in chemical adsorption on increasing temperature due to requirement of activation energy adsorption will increase at same pressure. So, I is physisorption while II is chemisorption.

III is physical adsorption as on increasing temperature, extent of adsorption is decreasing .

IV is representing enthalpy change (which is high) during chemical adsorption (due to bond formation) So, is valid for chemical adsorption.

So, answer is (A) and (C)

37. 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) $T_1 = T_2$

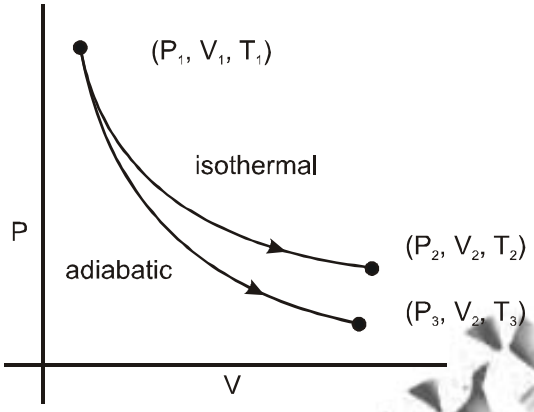
(B) $T_3 > T_1$

(C) $w_{isothermal} > w_{adiabatic}$

(D) $\Delta U_{isothermal} > \Delta U_{adiabatic}$

Ans. **(AD)**

Sol.



(A) $T_1 = T_2$ (due to isothermal)

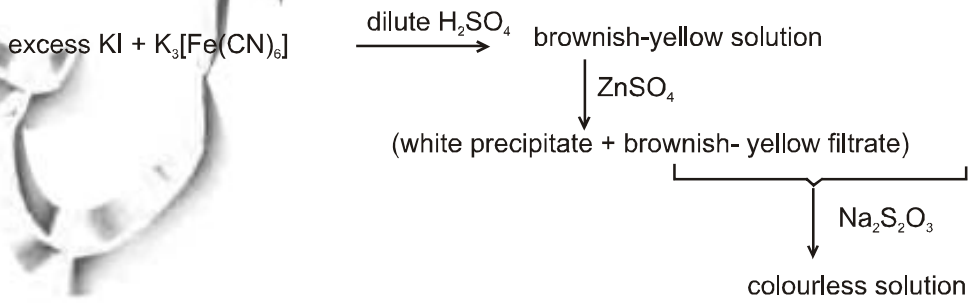
(B) $T_3 > T_1$ (incorrect) cooling will take place in adiabatic expansion)

(C) $W_{isothermal} > W_{adiabatic}$ { with sign, this is incorrect}

(D) $\Delta U_{isothermal} = 0 > \Delta U_{adiabatic} = -ve$

So, answer is (A) and (D)

38. For the given aqueous reaction 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

Ans. **(ACD)**

Sol. $KI\,(aq) + K_3[Fe(CN)_6](aq) \longrightarrow \underset{\text{Brownish - yellow}}{KI_3\,(aq)} + K_4[Fe(CN)_6\,(aq)$

$\downarrow + ZnSO_4\,(aq)$

$K_2Zn_3[Fe(CN)_6]_2\downarrow$ (white ppt) $+ KI_3\,(aq)$

OR

$\{K_2Zn[Fe(CN)_6]\downarrow\}$

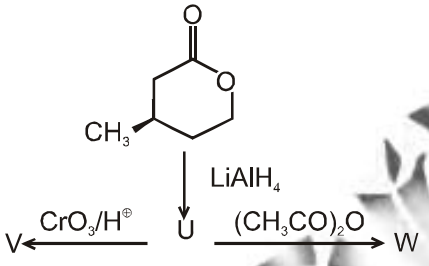
$\downarrow Na_2S_2O_3$

$I^-\,(aq) + S_4O_6^{2-}\,(aq)$ (Colourless)

(D) with NaOH

$K_2Zn\,[Fe(CN)_6] + NaOH \longrightarrow [Zn(OH)_4]^{2-}\,(aq) + [Fe(CN)_6]^{4-}\,(aq)$

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

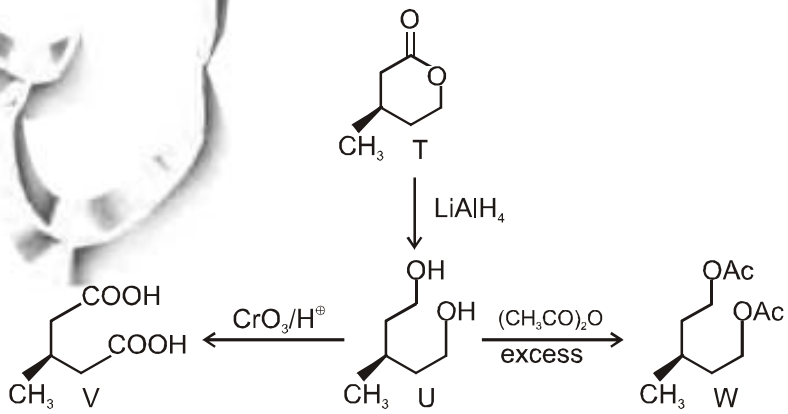


(A) T is soluble in hot aqueous NaOH (B) U is optically active

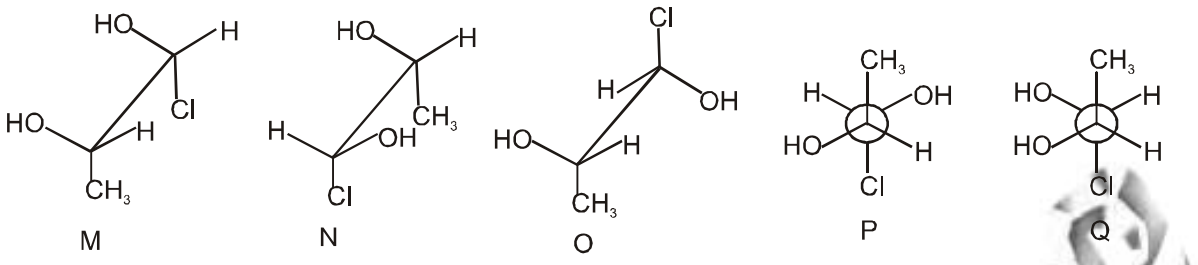
(C) Molecular formula of W is $C_{10}H_{18}O_4$ (D) V gives effervescence on treatment with aqueous $NaHCO_3$

Ans. **(ACD)**

Sol.



40. 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

Ans. **(ABC)**

Sol.