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# CHEMISTRY today

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# CONTENTS

## Competition Edge

Chemistry Musing Problem Set 43	8
JEE Main Model Test Paper	10
NEET Practice Paper	16
JEE Main Practice Paper	23
Concept Booster	25
Advanced Chemistry Bloc	28
Chemistry Musing Solution Set 42	51
Crossword	89

## Class 11

Concept Map	52
MPP-8	62
Ace Your Way CBSE	54
NEET   JEE Essentials	75

## Class 12

MPP-8	30
NEET   JEE Essentials	33
Concept Map	53
Ace Your Way CBSE	67
Crossword	89

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# CHEMISTRY MUSING

Chemistry Musing was started from August '13 issue of Chemistry Today with the suggestion of Shri Mahabir Singh. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET / AIIMS / PMTs with additional study material.

In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.

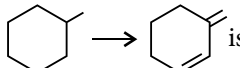
The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue.

We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

## PROBLEM Set 43

### JEE MAIN/NEET

- A vessel is filled with a mixture of oxygen and nitrogen. At what ratio of partial pressures will the mass of gases be identical?
  - $p_{(O_2)} = 0.785p_{(N_2)}$
  - $p_{(O_2)} = 8.75p_{(N_2)}$
  - $p_{(O_2)} = 11.4p_{(N_2)}$
  - $p_{(O_2)} = 0.875p_{(N_2)}$
- An element crystallises into a structure which may be described by a cubic type of unit cell having one atom on each corner of the cube and two atoms on one of its diagonals. If the volume of this unit cell is  $24 \times 10^{-24} \text{ cm}^3$  and density of the element is  $7.2 \text{ g cm}^{-3}$ , calculate the number of atoms present in 200 g of element.
  - $3.5 \times 10^{24}$
  - $5.7 \times 10^{23}$
  - $6.3 \times 10^{20}$
  - $1 \times 10^{10}$
- Consider the given sequence of reactions,
 
$$\text{Cyclohexene} + \text{NBS} \longrightarrow (\text{A}) \xrightarrow[\text{ether}]{\text{Mg}} (\text{B}) \xrightarrow[\text{ii) H}_2\text{O}]{\text{i) CH}_3\text{CN}} (\text{C})$$
 Choose the correct statement about product 'C'
  - It can undergo Cannizzaro reaction.
  - It can participate in aldol reaction.
  - It will not participate in Clemmensen reduction reaction.
  - None of these.
- Select the correct order of number of unpaired electrons in given complexes.
  - A tetrahedral complex with  $d^6$  ion with a weak field ligand.
  - $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
  - A complex compound with magnetic moment  $\sqrt{35}$  B.M.
  - A square planar complex with  $d^7$  ion.
  - III > II > I > IV
  - I > III > II > IV
  - III > I > II > IV
  - IV > II > I > III

- The correct reagents used in the conversion of
 
  - (i)  $\text{LiAlH}_4$  (ii)  $\text{H}_3\text{O}^+$  (iii)  $\text{H}_2/\text{Pd}$
  - (i)  $\text{NaNO}_2/\text{HCl}$  (ii)  $\text{H}_3\text{O}^+$  (iii)  $\Delta$
  - (i)  $\text{Br}_2, h\nu$  (ii)  $\text{NaOCH}_3$  (iii)  $\text{Br}_2$
  - (i)  $(\text{CH}_3)_3\text{CO}^-$  (ii)  $\text{H}_3\text{O}^+$  (iii)  $\Delta$

### JEE ADVANCED

- Assuming the complete dissociation of HCl and the lead salt,  $x$  M HCl is to be added to a 0.001 M lead salt solution to just prevent precipitation when saturated with  $\text{H}_2\text{S}$ . The concentration of  $\text{H}_2\text{S}$  in its saturated solution is 0.1 M. The value of  $x$  is
 

Given that :  $K_a(\text{H}_2\text{S}) = 1.1 \times 10^{-7}$ ;  
 $K_{sp}(\text{PbS}) = 3.4 \times 10^{-28}$

  - more than 1.80 M
  - less than 1.80 M
  - equal to 1.80 M
  - less than 3.80 M.

### COMPREHENSION

$\text{NaBH}_4$  is an ionic compound containing  $\text{BH}_4^-$ , tetrahydridoborate ion and in solid state it has a similar structure as sodium chloride. Not all tetrahydridoborates are ionic. The beryllium, aluminium and transition metal borohydrides become increasingly covalent and volatile. In these type of tetrahydridoborates, the  $\text{BH}_4^-$  ion forms covalent bond with metal ion. One or more H atoms in a  $\text{BH}_4^-$  ion act as a bridging bond to metal, forming a three centre bond with two electrons shared by three atoms. The  $\text{BH}_4^-$  ion is unusual to form one, two or three such three centre bonds with the metal ion while forming covalent bond.

$\text{Be}(\text{BH}_4)_2$  and  $\text{Al}(\text{BH}_4)_3$  are covalent compounds and their structures are given :

.....  
Contd. on Page No. 29



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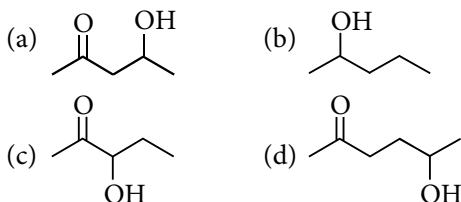
# MODEL TEST PAPER 2017 JEE MAIN

Exam Dates  
OFFLINE : 2<sup>nd</sup> April  
ONLINE : 8<sup>th</sup> & 9<sup>th</sup> April

1. When a liquid X is treated with  $\text{Na}_2\text{CO}_3$  solution, a mixture of two salts Y and Z are produced in the solution. The mixture on acidification with sulphuric acid and distillation, produces the liquid X again. Identify X.

(a)  $\text{Cl}_2$  (b)  $\text{Br}_2$   
(c) Hg (d)  $\text{I}_2$

2. Which of the following will be most readily dehydrated in acidic condition?



3. An element occurs in two crystalline forms  $\alpha$  and  $\beta$ . The  $\alpha$ -form has a *fcc* structure with  $a = 3.68 \text{ \AA}$  and  $\beta$ -form has a *bcc* structure with  $a = 2.92 \text{ \AA}$ . Calculate the ratio of their densities.

(a) 1 : 1 (b) 1 : 2 (c) 2 : 1 (d) 2 : 3

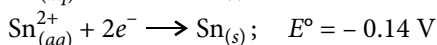
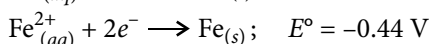
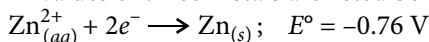
4. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess of KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to deep blue crystalline precipitate. The metal ion is

(a)  $\text{Pb}^{2+}$  (b)  $\text{Hg}^{2+}$  (c)  $\text{Cu}^{2+}$  (d)  $\text{Co}^{2+}$

5. Which of the following statements is wrong?

(a) PVC stands for polyvinyl chloride.  
(b) PTFE stands for teflon.  
(c) PHBV stands for poly  $\beta$ -hydroxybutyrate-co- $\beta$ -hydroxy valerate.  
(d) Buna-S stands for natural rubber.

6.  $E^\circ$  values of three metals are listed below :



Which of the following statements are correct?

- (i) Zinc will be corroded in preference to iron if zinc coating is broken on the surface.  
(ii) If iron is coated with tin and the coating is broken on the surface then iron will be corroded.  
(iii) Zinc is more reactive than iron but tin is less reactive than iron.

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

7.  $\text{SiCl}_4$  is easily hydrolysed but  $\text{CCl}_4$  is not. This is because

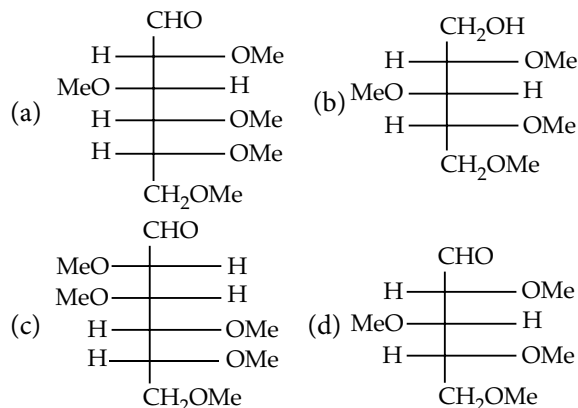
(a) bonding in  $\text{SiCl}_4$  is ionic  
(b) silicon is non-metallic  
(c) silicon can extend its coordination number beyond four but carbon cannot  
(d) silicon can form hydrogen bonds but carbon cannot.

8. In which of the following coordination entities the magnitude of  $\Delta_o$  (CFSE in octahedral field) will be maximum?

(a)  $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$  (b)  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$   
(c)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (d)  $[\text{Co}(\text{CN})_6]^{3-}$

9. D-glucose  $\xrightarrow[\text{HCl}]{\text{CH}_3\text{CH}_2\text{SH}}$   $\xrightarrow[\text{NaOH}]{(\text{CH}_3)_2\text{SO}_4}$   $\xrightarrow[\text{CdCO}_3]{\text{HgCl}_2}$  X

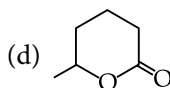
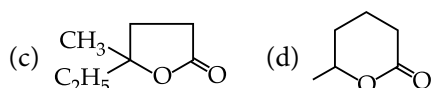
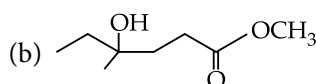
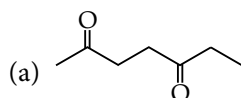
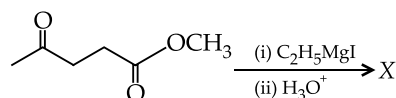
The final product X is



10. An amount of solid  $\text{NH}_4\text{HS}$  is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure. Ammonium hydrogen sulphide decomposes to yield  $\text{NH}_3$  and  $\text{H}_2\text{S}$  gases in the flask. When the decomposition reaction reaches equilibrium, the total pressure in the flask rises to 0.84 atm. The equilibrium constant for  $\text{NH}_4\text{HS}$  decomposition at this temperature is

(a) 0.30 (b) 0.18 (c) 0.17 (d) 0.11

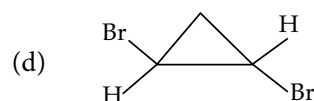
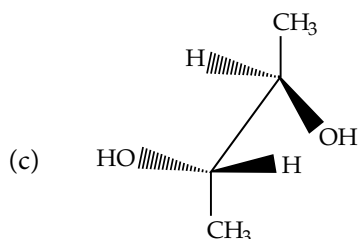
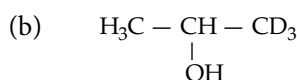
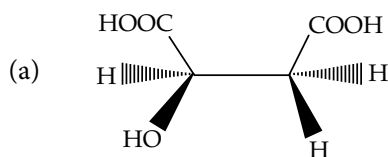
11. Give the structure of the compound X formed in the following reaction :



12. If  $S_1$ ,  $S_2$ ,  $S_3$  and  $S_4$  are the solubilities of  $\text{AgCl}$  in water, in 0.01 M  $\text{CaCl}_2$ , in 0.01 M  $\text{NaCl}$  and in 0.05 M  $\text{AgNO}_3$  respectively at a certain temperature, the correct order of solubility is

(a)  $S_1 > S_2 > S_3 > S_4$  (b)  $S_1 > S_3 > S_2 > S_4$   
(c)  $S_1 > S_2 = S_3 > S_4$  (d)  $S_1 > S_3 > S_4 > S_2$

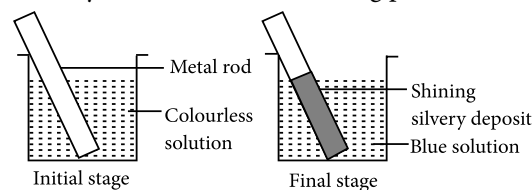
13. Which of the following molecules will not show optical activity?



14. Aqueous solutions of two compounds  $M - O - H$  and  $M' - O - H$  have been prepared in two different beakers. If the electronegativity of  $M = 3.5$ ,  $M' = 1.72$ ,  $O = 3.0$  and  $H = 2.1$ , then the solutions respectively are

(a) acidic, acidic (b) acidic, basic  
(c) basic, basic (d) basic, acidic.

15. Identify the redox reaction taking place in a beaker.

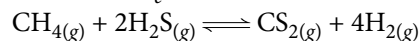


(a)  $\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}$   
(b)  $\text{Cu}_{(s)} + 2\text{Ag}^{+}_{(aq)} \rightarrow \text{Cu}^{2+}_{(aq)} + 2\text{Ag}_{(s)}$   
(c)  $\text{Cu}_{(s)} + \text{Zn}^{2+}_{(aq)} \rightarrow \text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)}$   
(d)  $2\text{Ag}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow 2\text{Ag}^{+}_{(aq)} + \text{Cu}_{(s)}$

16. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron, for Bohr orbits in an atom of hydrogen?

(a)  $3 \rightarrow 2$  (b)  $5 \rightarrow 2$   
(c)  $4 \rightarrow 1$  (d)  $2 \rightarrow 5$

17. At 1400 K,  $K_c = 2.5 \times 10^{-3}$  for the reaction :



A 10 L reaction vessel at 1400 K contains 2.0 mol of  $\text{CH}_4$ , 3.0 mol of  $\text{CS}_2$ , 3.0 mol of  $\text{H}_2$  and 4.0 mol of  $\text{H}_2\text{S}$ . In which direction does the reaction proceed to reach equilibrium?

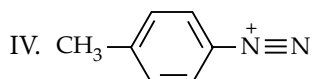
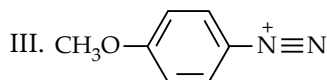
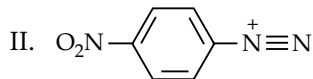
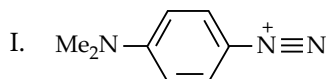
(a) Forward  
(b) Backward  
(c) May be forward or backward  
(d) Reaction is in equilibrium

### MPP-8 CLASS XI

### ANSWER KEY

1. (d) 2. (c) 3. (d) 4. (c) 5. (c)  
6. (a) 7. (a) 8. (b) 9. (d) 10. (d)  
11. (a) 12. (d) 13. (b) 14. (c) 15. (a)  
16. (b) 17. (c) 18. (b) 19. (c) 20. (b,c,d)  
21. (b,c,d) 22. (a,b) 23. (a,b,d) 24. (3) 25. (5)  
26. (3) 27. (c) 28. (b) 29. (d) 30. (b)

18. Consider the following ions :



The reactivity order of these ions towards azo coupling reaction under similar conditions is

- (a) I < IV < II < III    (b) I < III < IV < II  
(c) III < I < II < IV    (d) III < I < IV < II

19. 0.44 g of a monohydric alcohol when added to methylmagnesium iodide in ether liberates 112 cm<sup>3</sup> of methane at S.T.P. With PCC the same alcohol forms a carbonyl compound that answers silver mirror test. The monohydric alcohol is

- (a)  $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_3$   
(b)  $(\text{CH}_3)_3\text{C}-\text{CH}_2\text{OH}$   
(c)  $\text{CH}_3-\underset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CH}_3$   
(d)  $(\text{CH}_3)_2\text{CH}-\text{CH}_2\text{OH}$

20. Which one of the following statements is correct?

- (a) Manganese salts give a violet borax test in the reducing flame.  
(b) From a mixed precipitate of AgCl and AgI, ammonia solution dissolves only AgCl.  
(c) Ferric ions give a deep green precipitate on adding potassium ferrocyanide solution.  
(d) On boiling a solution having K<sup>+</sup>, Ca<sup>2+</sup> and HCO<sub>3</sub><sup>-</sup> ions we get a precipitate of K<sub>2</sub>Ca(CO<sub>3</sub>)<sub>2</sub>.

21. Consider a reaction  $aG + bH \longrightarrow$  products. When concentration of both the reactants  $G$  and  $H$  is doubled, the rate increases eight times. However, when concentration of  $G$  is doubled keeping the concentration of  $H$  fixed, the rate is doubled. The overall order of the reaction is

- (a) 0    (b) 1    (c) 2    (d) 3

22. Which of the following statement(s) is/are correct?

- (i) In octahedral complexes,  $t_{2g}$  orbitals possess low energy as compared to  $e_g$  orbitals.

(ii) In tetrahedral complexes,  $t_{2g}$  orbitals possess high energy as compared to  $e_g$  orbitals.

(iii) In octahedral complexes,  $e_g$  orbitals possess low energy as compared to  $t_{2g}$  orbitals.

- (a) (ii) only    (b) (iii) only  
(c) (i) and (ii)    (d) (i) and (iii)

23. The compound formed in the positive test for nitrogen with the Lassaigne solution of an organic compound is

- (a)  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$     (b)  $\text{Na}_3[\text{Fe}(\text{CN})_6]$   
(c)  $\text{Fe}(\text{CN})_3$     (d)  $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$

24. Match the column I with column II and mark the appropriate choice.

Column I	Column II
(A) Quick lime	(i) Setting fractured bones
(B) Plaster of Paris	(ii) A constituent of chewing gum
(C) Slaked lime	(iii) Manufacture of bleaching power
(D) Limestone	(iv) Manufacture of dyestuffs
(a) (A) → (i), (B) → (iv), (C) → (ii), (D) → (iii)	
(b) (A) → (iv), (B) → (i), (C) → (iii), (D) → (ii)	
(c) (A) → (ii), (B) → (iii), (C) → (i), (D) → (iv)	
(d) (A) → (iii), (B) → (ii), (C) → (iv), (D) → (i)	

25. In an irreversible process taking place at constant  $T$  and  $P$  and in which only pressure-volume work is being done, the change in Gibbs free energy ( $dG$ ) and change in entropy ( $dS$ ), satisfy the criteria

- (a)  $(dS)_{V,E} < 0$ ,  $(dG)_{T,P} < 0$   
(b)  $(dS)_{V,E} > 0$ ,  $(dG)_{T,P} < 0$   
(c)  $(dS)_{V,E} = 0$ ,  $(dG)_{T,P} = 0$   
(d)  $(dS)_{V,E} = 0$ ,  $(dG)_{T,P} > 0$

26. The order of compounds of their reactivity towards HCN is

- (a) acetaldehyde < acetone < methyl *tert*-butyl ketone < di-*tert*-butyl ketone  
(b) di-*tert*-butyl ketone < methyl *tert*-butyl ketone < acetone < acetaldehyde  
(c) di-*tert*-butyl ketone < acetone < methyl *tert*-butyl ketone < acetaldehyde  
(d) acetone < acetaldehyde < di-*tert*-butyl ketone < methyl *tert*-butyl ketone.

27. Which of the following is a correct method to convert *p*-toluidine to *p*-toluic acid?

- (a) Diazotisation, CuCN, H<sub>2</sub>/Pd  
(b) CHCl<sub>3</sub>/NaOH, KCN, Sn/HCl  
(c) Diazotisation, CuCN/KCN, H<sub>2</sub>O/H<sup>+</sup>  
(d) Diazotisation, NaCN, NaOH

28. Which of the following groups is attached at the terminal of a long carbon chain in anionic detergents?

- (a)  $-\text{COOH}$  (b)  $-\text{COONa}$   
 (c)  $-\text{SO}_3\text{Na}$  (d)  $-\text{ONa}$

29. The main reactions occurring in blast furnace during extraction of iron from haematite are

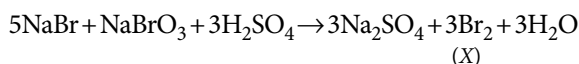
- (I)  $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$   
 (II)  $\text{FeO} + \text{SiO}_2 \longrightarrow \text{FeSiO}_3$   
 (III)  $\text{Fe}_2\text{O}_3 + 3\text{C} \longrightarrow 2\text{Fe} + 3\text{CO}$   
 (IV)  $\text{CaO} + \text{SiO}_2 \longrightarrow \text{CaSiO}_3$   
 (a) I, II and IV (b) I and IV  
 (c) I, III and IV (d) II and III

30. A dihaloalkane 'X' having formula  $\text{C}_3\text{H}_6\text{Cl}_2$ , on hydrolysis gives a compound, that can reduce Tollens' reagent. The compound 'X' is

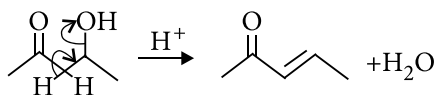
- (a) 1, 2-dichloropropane  
 (b) 1, 1-dichloropropane  
 (c) 1, 3-dichloropropane  
 (d) 2, 2-dichloropropane.

**SOLUTIONS**

1. (b):  $3\text{Br}_2 + 3\text{Na}_2\text{CO}_3 \rightarrow 5\text{NaBr} + \text{NaBrO}_3 + 3\text{CO}_2$   
 (X) Mixture of two salts



2. (a):  $\beta$ -hydroxy ketones or aldols readily undergo dehydration due to the presence of active methylene group.



3. (a): Z for fcc = 4, Z for bcc = 2

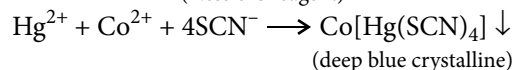
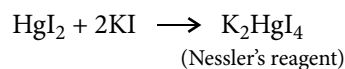
Atomic volume of  $\alpha$ -form =  $\frac{(3.68 \times 10^{-8})^3 \times N_A}{4}$

Atomic volume of  $\beta$ -form =  $\frac{(2.92 \times 10^{-8})^3 \times N_A}{2}$

(As element is same, atomic weight is same), so the density ratio is

$\rho_\alpha : \rho_\beta = V_\beta : V_\alpha = \frac{(2.92)^3}{2} : \frac{(3.68)^3}{4}$   
 $= 12.448 : 12.459 \approx 1 : 1$

4. (b):  $\text{Hg}^{2+} + 2\text{KI} \longrightarrow \text{HgI}_2 \downarrow + 2\text{K}^+$   
 (scarlet red)



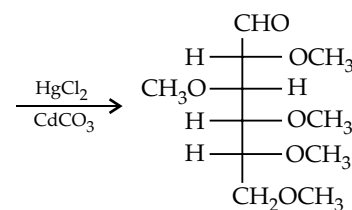
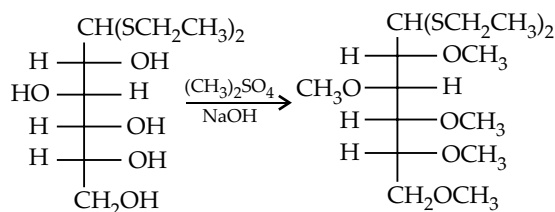
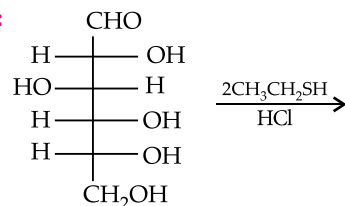
5. (d): In Buna-S, Bu stands for butadiene, na for sodium which is the polymerising agent and S stands for styrene. It is synthetic rubber.

6. (c): Iron coated with zinc does not get rusted even if cracks appear on the surface because Zn will take part in redox reaction not Fe, as Zn is more reactive than Fe. If iron is coated with tin and cracks appear on the surface, Fe will take part in redox reaction because Sn is less reactive than Fe.

7. (c):  $\text{SiCl}_4$  is easily hydrolysed because Si can extend its coordination number beyond four due to the presence of vacant *d*-orbitals but carbon cannot do so, hence it is not hydrolysed.

8. (d): Greater the charge on central metal ion and stronger the field of ligand, greater is the  $\Delta_o$  value (CFSE). According to the spectrochemical series, the increasing order of  $\Delta_o$  is  $\text{C}_2\text{O}_4^{2-} < \text{H}_2\text{O} < \text{NH}_3 < \text{CN}^-$

9. (a):



10. (d):  $\text{NH}_4\text{HS}_{(s)} \rightleftharpoons \text{NH}_{3(g)} + \text{H}_2\text{S}_{(g)}$

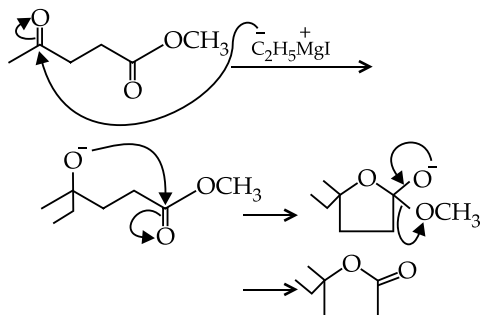
Initial pressure	0	0.5	0
At eq.	0	0.5 + x	x

Total pressure =  $0.5 + 2x = 0.84 \Rightarrow x = 0.17 \text{ atm}$

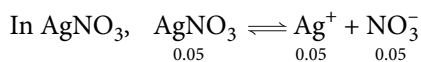
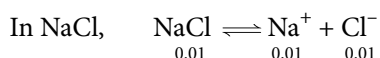
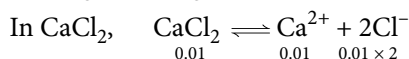
$K_p = p_{\text{NH}_3} \times p_{\text{H}_2\text{S}} = (0.5 + 0.17)(0.17) = 0.11$



11. (c):



12. (b):  $\text{AgCl} \rightleftharpoons \text{Ag}^+ + \text{Cl}^-$

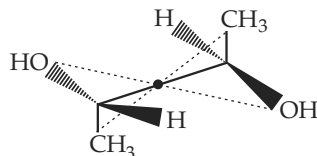


Common ion effect is maximum in  $\text{AgNO}_3$ .

$S_1$  is maximum because of high dielectric constant of water.

Thus, the order is  $S_1 > S_3 > S_2 > S_4$ .

13. (c):



It has a centre of symmetry and hence is optically inactive.

14. (b): In the compound  $M - O - H$ , if the electronegativity of  $M$  is low, the compound will act as a base and if the electronegativity of  $M$  is high, the compound will behave as an acid. Therefore,  $M - O - H$  will act as an acid as electronegativity of  $M$  is high (3.5) and  $M' - O - H$  will act as a base as electronegativity of  $M'$  is low (1.72).

15. (b): Since, copper is more reactive than silver, it displaces  $\text{Ag}^+$  ions from its salt solution which get deposited on the copper rod.

16. (b): The electron has minimum energy in the first orbit and its energy increases as  $n$  increases. Here,  $n$  represents the number of orbit, i.e., 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>. The third line from the red end corresponds to yellow region i.e.,  $n = 5$ . In order to attain less energy, electron tends to come in 1<sup>st</sup> or 2<sup>nd</sup> orbit. So jump may be involved either  $5 \rightarrow 1$  or  $5 \rightarrow 2$ .

17. (b):  $\text{CH}_4(g) + 2\text{H}_2\text{S}(g) \rightleftharpoons \text{CS}_2(g) + 4\text{H}_2(g)$

$$K = \frac{[\text{CS}_2][\text{H}_2]^4}{[\text{CH}_4][\text{H}_2\text{S}]^2} \quad \dots(i)$$

$$[\text{CS}_2] = \left(\frac{3}{10}\right); [\text{H}_2] = \left(\frac{3}{10}\right);$$

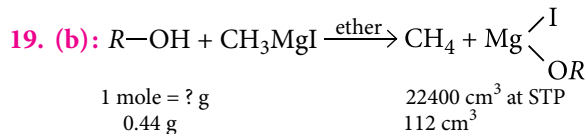
$$[\text{CH}_4] = \left(\frac{2}{10}\right); [\text{H}_2\text{S}] = \left(\frac{4}{10}\right)$$

Substituting all the concentration values in equation (i), we get

$$K = \frac{\left(\frac{3}{10}\right)\left(\frac{3}{10}\right)^4}{\left(\frac{2}{10}\right)\left(\frac{4}{10}\right)^2} = \frac{3^5}{10^5} \times \frac{10^3}{2 \times 4^2} = \frac{243}{3200} \Rightarrow 0.076$$

Therefore,  $K > 2.5 \times 10^{-3}$  ( $K_c$ ). Hence, the reaction will proceed in backward direction.

18. (b): Less stable the diazonium salt more reactive it will be. Since the stability decreases in the order : I > III > IV > II, therefore, reactivity increases in the reverse order, i.e., I < III < IV < II.

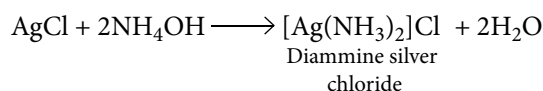


$$\text{Mass of alcohol} = \frac{0.44 \times 22,400}{112} = 88 \text{ g}$$

Alcohol reacts with PCC to give a carbonyl compound which answers silver mirror test. Therefore, alcohol must be a primary alcohol which on oxidation with PCC gives aldehyde (carbonyl compound). Therefore, either (b) or (d) is correct. Out of these, (b) has the mass 88.

20. (b): The solubility product of  $\text{AgCl}$ ,  $\text{AgBr}$  and  $\text{AgI}$  at the room temperature are  $1.8 \times 10^{-10}$ ,  $5.0 \times 10^{-13}$  and  $8.5 \times 10^{-17}$  respectively. Thus,  $\text{AgI}$  is the least soluble silver halide.

The lattice energies of  $\text{AgBr}$  and  $\text{AgI}$  are higher because of greater number of electrons in their anions. Consequently, they are even less soluble than  $\text{AgCl}$ . Due to greater solubility of  $\text{AgCl}$  than  $\text{AgI}$  and  $\text{AgBr}$ , ammonia solution dissolves only  $\text{AgCl}$  and forms a complex.



21. (d):

Exp. No.	[G] mole/lit	[H] mole/lit	Rate mol L <sup>-1</sup> time <sup>-1</sup>
1	<i>a</i>	<i>b</i>	<i>r</i>
2	<i>2a</i>	<i>2b</i>	<i>8r</i>
3	<i>2a</i>	<i>b</i>	<i>2r</i>

Applying  $r = k[G]^x[H]^y$  ... (i)

$$8r = k[2G]^x \cdot [2H]^y$$

$$8r = k \cdot 2^{x+y} [G]^x [H]^y$$

Substituting the value of *r* from eq. (i)

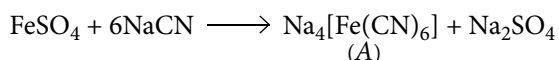
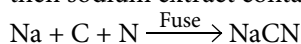
$$8(k [G]^x \cdot [H]^y) = k \cdot 2^{x+y} [G]^x [H]^y$$

$$2^{x+y} = 8 \Rightarrow 2^{x+y} = 2^3 \Rightarrow x + y = 3$$

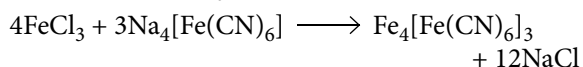
Overall order is 3.

22. (c): In octahedral complexes, *t<sub>2g</sub>* orbitals possess lower energy as compared to *e<sub>g</sub>* orbitals while in tetrahedral complexes *t<sub>2g</sub>* orbitals possess higher energy as compared to *e<sub>g</sub>* orbitals.

23. (a): If nitrogen is present in an organic compound then sodium extract contains NaCN.



(A) changes to Prussian blue  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$  on reaction with  $\text{FeCl}_3$ .



24. (b): Quick lime is used for the manufacture of dyestuffs.

Plaster of Paris is used for setting of fractured bones.

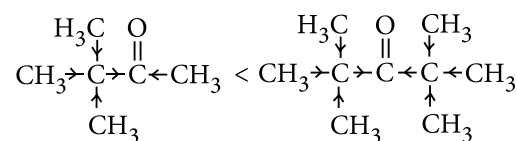
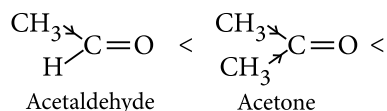
Slaked lime is used for the manufacture of bleaching powder.

Limestone is a constituent of chewing gum.

25. (b): For spontaneity, change in entropy (*dS*) must be positive, means it should be greater than zero.

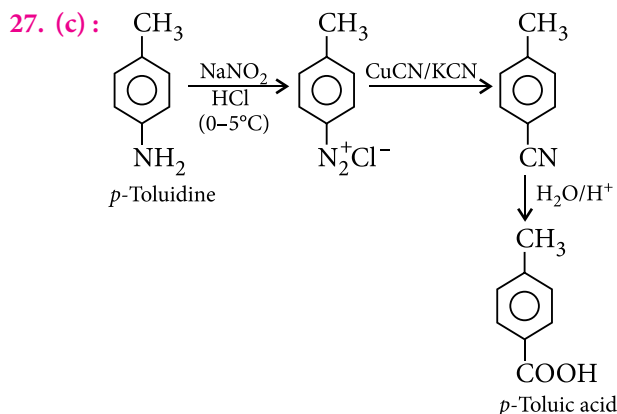
Change in Gibbs free energy (*dG*) must be negative means that it should be lesser than zero. Hence, (*dS*)<sub>V, E</sub> > 0, (*dG*)<sub>T, P</sub> < 0.

26. (b): In the given compounds, the +I effect as well as steric hindrance increases in the same order :



Hence, the given compounds can be arranged according to their increasing reactivities toward HCN as :

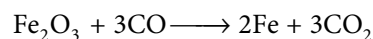
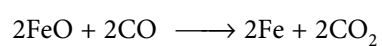
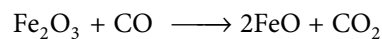
Di-*tert*-butyl ketone < Methyl *tert*-butyl ketone < Acetone < Acetaldehyde



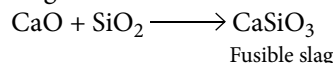
28. (c): Anionic detergents are sodium salts of sulphonated long chain alcohols. Hence, they consist of a large hydrocarbon chain which is non-ionic in nature and a sulphonate ( $\text{SO}_4^- \text{Na}^+$ ) or ( $\text{SO}_3^- \text{Na}^+$ ) group, which is ionic in nature. For example, sodium-*n*-dodecylbenzenesulphonate, sodium lauryl sulphate, etc.

29. (b): In the blast furnace during extraction of iron, following are the main reactions :

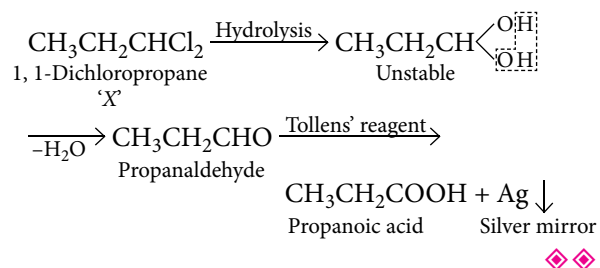
(i) Reduction of  $\text{Fe}_2\text{O}_3$  and CO :



(ii) Slag formation :

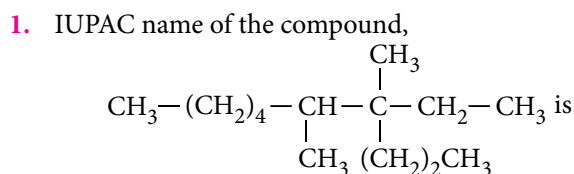


30. (b): As the obtained compound reduces Tollens' reagent, it must be an aldehyde. Thus, it is obvious that both the —Cl atoms are present at C - 1. Hence, the compound 'X' is 1, 1-dichloropropane and the reactions are as follows :



# PRACTICE PAPER 2017

# NEET



- (a) 3,4-dimethyl-3-*n*-propylnonane  
 (b) 4-ethyl-4,5-dimethyldecane  
 (c) 6,7-dimethyl-7-*n*-propylnonane  
 (d) 6,7-dimethyl-7-ethyldecane.

2. Which of the following increasing order is not correct as mentioned in the property with it?

- (a)  $\text{HClO} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$   
 (thermal stability)  
 (b)  $\text{HClO}_4 < \text{HClO}_3 < \text{HClO}_2 < \text{HClO}$   
 (oxidising power)  
 (c)  $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^-$  (reducing nature)  
 (d)  $\text{HIO}_4 < \text{ICl} < \text{I}_2 < \text{HI}$   
 (oxidation number of iodine)

3. Which of the following pairs of isomers is not correctly matched with its type of isomerism?

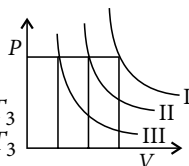
- (a)  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$  and  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$   
 - Coordination isomerism  
 (b)  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$  and  $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$   
 - Linkage isomerism  
 (c)  $[\text{Co}(\text{py})_2(\text{H}_2\text{O})_2\text{Cl}_2]\text{Cl}$  and  $[\text{Co}(\text{py})_2(\text{H}_2\text{O})\text{Cl}_3]\text{H}_2\text{O}$   
 - Coordination isomerism  
 (d)  $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$  and  $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$   
 - Ionisation isomerism

4. Proteins are denatured in

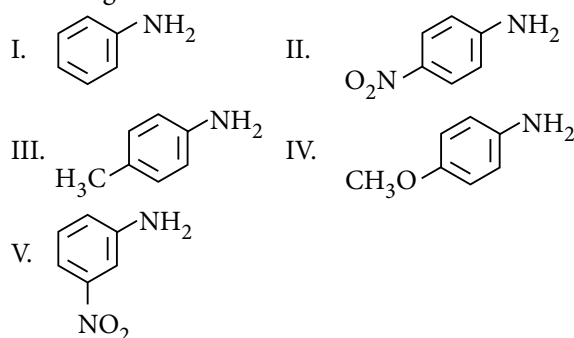
- (a) mouth (b) stomach  
 (c) small intestine (d) large intestine.

5. I, II, III are three isotherms respectively at  $T_1$ ,  $T_2$  and  $T_3$ . Temperature will be in order

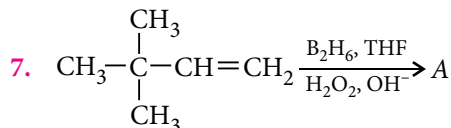
- (a)  $T_1 = T_2 = T_3$  (b)  $T_1 < T_2 < T_3$   
 (c)  $T_1 > T_2 > T_3$  (d)  $T_1 > T_2 = T_3$



6. The correct order of increasing basic nature of the following bases is



- (a)  $\text{II} < \text{V} < \text{I} < \text{III} < \text{IV}$  (b)  $\text{V} < \text{II} < \text{I} < \text{III} < \text{IV}$   
 (c)  $\text{II} < \text{V} < \text{I} < \text{IV} < \text{III}$  (d)  $\text{V} < \text{II} < \text{I} < \text{IV} < \text{III}$



The product A is

- (a)  $\text{CH}_3-\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}}-\underset{\text{CH}_3}{\overset{\text{OH}}{\text{C}}}-\text{CH}_3$   
 (b)  $\text{CH}_3-\underset{\text{CH}_3}{\overset{\text{OH}}{\text{C}}}-\underset{\text{CH}_3}{\text{C}}-\text{CH}_3$   
 (c)  $\text{CH}_3-\underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{CH}_2\text{OH}$   
 (d)  $\text{CH}_2-\underset{\text{OH}}{\overset{\text{CH}_3}{\text{C}}}-\underset{\text{CH}_3}{\text{C}}-\text{CH}_2-\text{CH}_3$

8. Phenol associates in benzene to a certain extent to form dimer. A solution containing  $2.0 \times 10^{-2}$  kg of

phenol in 1.0 kg of benzene has its freezing point decreased by 0.69 K. The degree of association of phenol is ( $K_f$  for benzene =  $5.12 \text{ K kg mol}^{-1}$ )

- (a) 73.4% (b) 50.1% (c) 42.3% (d) 25.1%

9. Which of the following is not correct for ideal gas?

- (a)  $\left(\frac{\partial U}{\partial V}\right)_T = 0$  (b)  $\left(\frac{\partial H}{\partial P}\right)_T = 0$   
 (c)  $\left(\frac{\partial T}{\partial P}\right)_H = 0$  (d)  $\left(\frac{\partial P}{\partial T}\right)_V = 0$

10. Among the following series of transition metal ions, the one where all metal ions have  $3d^2$  electronic configuration is

- (a)  $\text{Ti}^{3+}, \text{V}^{2+}, \text{Cr}^{3+}, \text{Mn}^{4+}$   
 (b)  $\text{Ti}^+, \text{V}^{4+}, \text{Cr}^{6+}, \text{Mn}^{7+}$   
 (c)  $\text{Ti}^{4+}, \text{V}^{3+}, \text{Cr}^{2+}, \text{Mn}^{3+}$   
 (d)  $\text{Ti}^{2+}, \text{V}^{3+}, \text{Cr}^{4+}, \text{Mn}^{5+}$

11. If the equilibrium constants of the following equilibria,

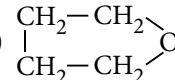
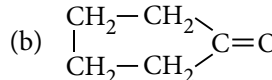
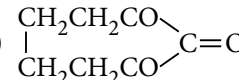
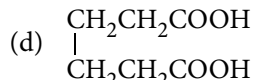
$\text{SO}_2 + \frac{1}{2} \text{O}_2 \rightleftharpoons \text{SO}_3$  and  $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2$   
 are given by  $K_1$  and  $K_2$  respectively, which of the following relation is correct?

- (a)  $K_2 = \left(\frac{1}{K_1}\right)^2$  (b)  $K_1 = \left(\frac{1}{K_2}\right)^3$   
 (c)  $K_2 = \left(\frac{1}{K_1}\right)$  (d)  $K_2 = (K_1)^2$

12. Which of the following is an optically active compound?

- (a) 1-Butanol (b) 1-Propanol  
 (c) 2-Chlorobutane (d) 4-Hydroxyheptane

13. Which one of the following products is formed when calcium salt of adipic acid is heated?

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

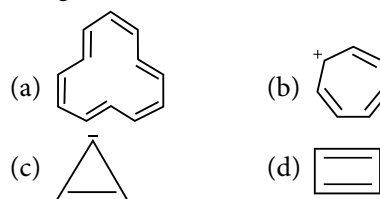
14. Which one of the following represents smallest quantity?

- (a) 1850 ng (b)  $1.85 \times 10^{-4} \text{ g}$   
 (c)  $1.85 \times 10^3 \mu\text{g}$  (d)  $1.85 \times 10^{-6} \text{ kg}$

15. Which of the following systems is most stable for a chelate?

- (a) Two fused cyclic system  
 (b) Three fused cyclic system  
 (c) Four fused cyclic system  
 (d) Five fused cyclic system

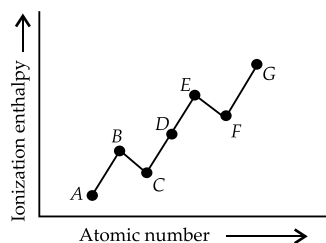
16. Which of the following exhibits aromaticity by using Huckel's rule?



17. The order of reactivity of methyl halides in the formation of Grignard reagent is

- (a)  $\text{CH}_3\text{I} > \text{CH}_3\text{Br} > \text{CH}_3\text{Cl}$   
 (b)  $\text{CH}_3\text{Cl} > \text{CH}_3\text{Br} > \text{CH}_3\text{I}$   
 (c)  $\text{CH}_3\text{Br} > \text{CH}_3\text{Cl} > \text{CH}_3\text{I}$   
 (d)  $\text{CH}_3\text{Br} > \text{CH}_3\text{I} > \text{CH}_3\text{Cl}$

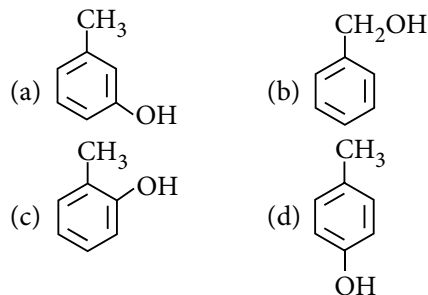
18. The ionization enthalpies of second period elements vary with atomic numbers as



The elements present at points B and E are

- (a) Be, C (b) B, N (c) Be, O (d) Be, N

19. The structure of the compound that gives a tribromo derivative on treatment with bromine water is



20. Two solutions of X and Y electrolytes are taken in two beakers and diluted by adding 500 mL of water.  $\Lambda_m$  of X increases by 1.5 times while that of Y increases by 20 times, what could be the electrolytes X and Y?

- (a) X - NaCl, Y - KCl  
 (b) X - NaCl, Y -  $\text{CH}_3\text{COOH}$   
 (c) X - KOH, Y - NaOH  
 (d) X -  $\text{CH}_3\text{COOH}$ , Y - NaCl

21. During adsorption the change in enthalpy is negative and the magnitude of negative value

- (a) goes on increasing  
 (b) goes on decreasing  
 (c) remains same  
 (d) first increases then decreases.

22.  $C_2H_5OH$  and  $C_6H_5OH$  can be distinguished by

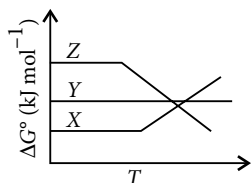
- (a)  $Br_2 + H_2O$  (b)  $FeCl_3$   
 (c)  $I_2 + NaOH$  (d) both (b) and (c).

23. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition,  $n = 4$  to  $n = 2$  of  $He^+$  spectrum?

- (a)  $n = 4$  to  $n = 3$  (b)  $n = 3$  to  $n = 2$   
 (c)  $n = 4$  to  $n = 2$  (d)  $n = 2$  to  $n = 1$

24. In the following Ellingham diagram X, Y and Z represents graph for metal oxides. Select the correct option.

- (a) Y will reduce oxide Z.  
 (b) Y will reduce oxide X.  
 (c) Z will reduce oxide X.  
 (d) Z will reduce oxide Y.



25. A salt on treatment with dilute HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green-flame test and a yellow precipitate with potassium chromate. The salt is

- (a)  $NiSO_4$  (b)  $BaS_2O_3$  (c)  $PbS_2O_3$  (d)  $CuSO_4$

26. Match the column I with column II and mark the appropriate choice.

**Column I**

**Column II**

- (A) Electrical industry (i) Zinc  
 (B) Batteries (ii) Steel  
 (C) Gutter pipes (iii) Copper  
 (D) Gas stoves (iv) Cast iron

- (a) (A) → (i), (B) → (ii), (C) → (iii), (D) → (iv)  
 (b) (A) → (ii), (B) → (iii), (C) → (iv), (D) → (i)  
 (c) (A) → (iv), (B) → (iii), (C) → (ii), (D) → (i)  
 (d) (A) → (iii), (B) → (i), (C) → (iv), (D) → (ii)

27. An organic compound 'A' having molecular formula,  $C_2H_3N$  on reduction gave another compound 'B'. Upon treatment with nitrous acid 'B' gave ethyl alcohol. On warming with chloroform and alcoholic KOH, 'B' forms an offensive smelling compound 'C'. The compound 'C' is

- (a)  $CH_3CH_2NH_2$  (b)  $CH_3CH_2N \equiv C$   
 (c)  $CH_3C \equiv N$  (d)  $CH_3CH_2OH$

28. Match the plots given in List I with their slopes given in List II and select the correct answer using the codes given below the lists :

**List I**

**List II**

- P.  $C$  vs  $t$  (abscissa) for zero order reaction 1. Unity  
 Q.  $\log C$  vs  $t$  (abscissa) for first order reaction 2. Zero  
 R.  $\left(-\frac{dC}{dt}\right)$  vs  $C$  for zero order reaction 3.  $-k$   
 S.  $\ln\left(-\frac{dC}{dt}\right)$  vs  $\ln C$  for first order reaction 4.  $-\frac{k}{2.303}$

**P Q R S**

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

29. The decreasing order of boiling points of the following hydrides is

- (a)  $H_2O > SbH_3 > AsH_3 > PH_3 > NH_3$   
 (b)  $H_2O > NH_3 > SbH_3 > AsH_3 > PH_3$   
 (c)  $H_2O > SbH_3 > NH_3 > AsH_3 > PH_3$   
 (d)  $H_2O > PH_3 > AsH_3 > SbH_3 > NH_3$

30. Which of the following enzymes are used to convert starch into alcohol?

- (a) Maltase, diastase (b) Invertase, zymase  
 (c) Diastase, maltase, zymase  
 (d) Invertase, diastase, zymase

31. Which of the following represents the correct decreasing order of relative reactivity towards an electrophile,  $E^+$  ?

- (a)  $C_6H_5 - CH_3, p-CH_3 - C_6H_4 - CH_3, p-CH_3 - C_6H_4 - NO_2, p-NO_2 - C_6H_4 - NO_2$   
 (b)  $p-CH_3 - C_6H_4 - CH_3, p-CH_3 - C_6H_4 - NO_2, p-NO_2 - C_6H_4 - NO_2, C_6H_5 - CH_3$   
 (c)  $p-CH_3 - C_6H_4 - NO_2, C_6H_5 - CH_3, p-CH_3 - C_6H_4 - CH_3, p-NO_2 - C_6H_4 - NO_2$   
 (d)  $p-CH_3 - C_6H_4 - CH_3, C_6H_5 - CH_3, p-CH_3 - C_6H_4 - NO_2, p-NO_2 - C_6H_4 - NO_2$

32. A metal nitrate reacts with KI to give a black precipitate which on addition of excess of KI converts into orange colour solution. The cation of metal nitrate is

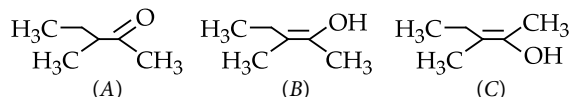
- (a)  $Hg^{2+}$  (b)  $Bi^{3+}$  (c)  $Pb^{2+}$  (d)  $Cu^+$

33. An acid solution has a pH = 6. It is diluted 100 times, the pH of the resultant solution would be

- (a) 5.95 (b) 6.95 (c) 7 (d) 8

34. Which amino acid has imidazole ring?  
 (a) Alanine (b) Leucine  
 (c) Tyrosine (d) Histidine

35. The incorrect statement concerning the structures of A, B and C is



- (a) A, B and C are resonance structures  
 (b) A, B and A, C are tautomers  
 (c) B and C are geometrical isomers  
 (d) B and C are diastereomers.
36. Which complex compound obeys 18-electron rule?  
 (a)  $[\text{V}(\text{CO})_5]$  (b)  $[\text{Fe}(\text{NH}_3)_6]^{2+}$   
 (c)  $[\text{Ni}(\text{CO})_6]$  (d)  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$

37. Which of these does not contain  $-\text{COOH}$  group?  
 (a) Aspirin (b) Benzoic acid  
 (c) Picric acid (d) Salicylic acid

38. The number of radial nodes and angular nodes for  $d$ -orbital can be represented as

- (a)  $(n - 2)$  radial nodes + 1 angular node  
 $= (n - 1)$  total nodes  
 (b)  $(n - 1)$  radial nodes + 1 angular node  
 $= (n - 1)$  total nodes  
 (c)  $(n - 3)$  radial nodes + 2 angular nodes  
 $= (n - 1 - 1)$  total nodes  
 (d)  $(n - 3)$  radial nodes + 2 angular nodes  
 $= (n - 1)$  total nodes

39. Cerium ( $Z = 58$ ) is an important member of the lanthanides. Which of the following statements about cerium is incorrect?

- (a) The common oxidation states of cerium are + 3 and + 4.  
 (b) The + 3 oxidation state of cerium is more stable than the + 4 oxidation state.  
 (c) The + 4 oxidation state of cerium is not known in solutions.  
 (d) Cerium (IV) acts as an oxidising agent.

40. In which of the given reactions do we find  $\alpha, \beta$ -unsaturated carbonyl compounds undergoing a ring closure reaction with conjugated dienes?

- (a) Perkin reaction (b) Diels-Alder reaction  
 (c) Claisen rearrangement  
 (d) Hofmann reaction

41. The non-breakable plastic household crockery is prepared by using

- (a) melamine and tetrafluoroethane

- (b) malonic acid and hexamethyleneamine  
 (c) melamine and vinyl acetate  
 (d) melamine and formaldehyde.

42. Match List I with List II and select the correct answer using the codes given below the lists :

**List I**

**List II**

- P. Heavy water (i) Bicarbonates of Mg and Ca in water  
 Q. Temporary hard water (ii) No foreign ions in water  
 R. Soft water (iii)  $\text{D}_2\text{O}$   
 S. Permanent hard water (iv) Sulphates and chlorides of Mg and Ca in water

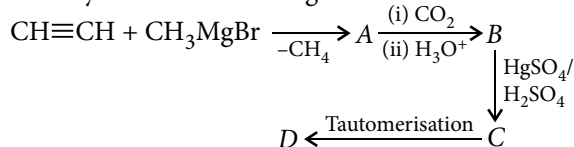
**Code :**

- (a) P-(iii), Q-(iv), R-(ii), S-(i)  
 (b) P-(ii), Q-(i), R-(iii), S-(iv)  
 (c) P-(ii), Q-(iv), R-(iii), S-(i)  
 (d) P-(iii), Q-(i), R-(ii), S-(iv)

43. Which one of the following sequences represents the correct increasing order of bond angles in the given molecules ?

- (a)  $\text{H}_2\text{O} < \text{OF}_2 < \text{OCl}_2 < \text{ClO}_2$   
 (b)  $\text{OCl}_2 < \text{ClO}_2 < \text{H}_2\text{O} < \text{OF}_2$   
 (c)  $\text{OF}_2 < \text{H}_2\text{O} < \text{OCl}_2 < \text{ClO}_2$   
 (d)  $\text{ClO}_2 < \text{OF}_2 < \text{OCl}_2 < \text{H}_2\text{O}$

44. Identify 'D' in the following reaction :



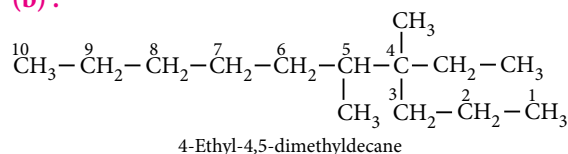
- (a)  $\text{HOOC}-\text{CH}_2-\text{COOH}$   
 (b)  $\text{OHC}-\text{CH}_2-\text{COOH}$   
 (c)  $\text{OHC}-\text{CH}_2-\text{CHO}$   
 (d)  $\text{HO}-\text{CH}=\text{CH}-\text{COOH}$

45. Which of the following is present in animals like cow, buffaloes, etc. to digest compound like paper, cloth, etc.?

- (a) Urease (b) Cellulase  
 (c) Lipase (d) Sucrase

**SOLUTIONS**

1. (b) :



2. (d): Increasing oxidation number of iodine is in the order :



3. (c):  $[\text{Co}(\text{py})_2(\text{H}_2\text{O})_2\text{Cl}_2]\text{Cl}$  and  $[\text{Co}(\text{py})_2(\text{H}_2\text{O})\text{Cl}_3]\text{H}_2\text{O}$  show hydrate isomerism.

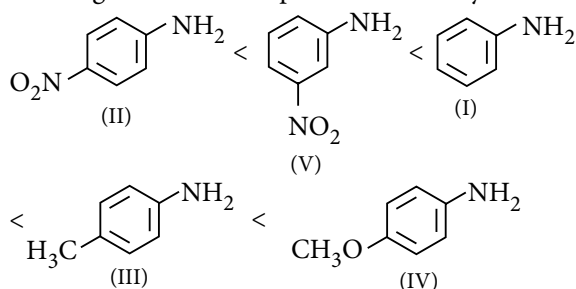
4. (b): In stomach pH is 2 (acidic) therefore, proteins get denatured.

5. (c): Draw a line at constant pressure parallel to volume-axis. Take volume corresponding to each temperature.

From volume axis,  $V_1 > V_2 > V_3$

Hence,  $T_1 > T_2 > T_3$ .

6. (a):  $-\text{OCH}_3$  is strongest electron releasing group (+M effect) which opposes most the dispersion of lone pair of electrons of nitrogen into the ring. Thus,  $-\text{OCH}_3$  being at *para* position imparts highest basicity.  $-\text{NO}_2$  being at *meta* position stabilises the electron pair of nitrogen only by  $-I$  effect. While  $-\text{NO}_2$  being present at *para* position due to  $-M$  effect and  $-I$  effect stabilises the lone pair of electrons of nitrogen most and imparts least basicity.

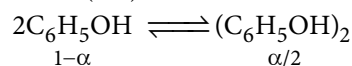


7. (c): It is a hydroboration oxidation reaction. It is the addition of  $\text{H}_2\text{O}$  according to anti-Markownikoff's rule. Hence, terminal carbon gets the  $-\text{OH}$  group.

$$8. (a): M_{2(\text{obs.})} = \frac{K_f \times w \times 1000}{W \times \Delta T_f} = \frac{5.12 \times 2.0 \times 10^{-2} \times 1000}{1.0 \times 0.69} = 148.4$$

Calculated molecular mass of phenol = 94

$$i = \frac{M_{2(\text{cal.})}}{M_{2(\text{obs.})}} = \frac{94}{148.4} = 0.633$$



$$\text{Total species} = (1-\alpha) + \frac{\alpha}{2} = 1 - \frac{\alpha}{2}$$

$$i = \frac{1-\alpha/2}{1} \quad \text{or} \quad \frac{\alpha}{2} = 1-i$$

$$\text{or} \quad \alpha = 2(1-i) = 2(1-0.633) = 0.734 = 73.4\%$$

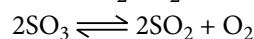
9. (d): The forces of attraction between the molecules of an ideal gas are negligible so

$$\left(\frac{\partial U}{\partial V}\right)_T = 0, \left(\frac{\partial H}{\partial P}\right)_T = 0 \quad \text{and} \quad \left(\frac{\partial T}{\partial P}\right)_H = 0.$$

10. (d):  $\text{Ti}(Z=22) \rightarrow 3d^2 4s^2$ ;  $\text{Ti}^{2+} \rightarrow 3d^2$   
 $\text{V}(Z=23) \rightarrow 3d^3 4s^2$ ;  $\text{V}^{3+} \rightarrow 3d^3$   
 $\text{Cr}(Z=24) \rightarrow 3d^5 4s^1$ ;  $\text{Cr}^{4+} \rightarrow 3d^2$   
 $\text{Mn}(Z=25) \rightarrow 3d^5 4s^2$ ;  $\text{Mn}^{5+} \rightarrow 3d^2$

11. (a):  $\text{SO}_2 + \frac{1}{2} \text{O}_2 \rightleftharpoons \text{SO}_3$

$$K_1 = \frac{[\text{SO}_3]}{[\text{SO}_2][\text{O}_2]^{1/2}} \quad \dots(i)$$



$$\text{Thus, } K_2 = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2} \quad \dots(ii)$$

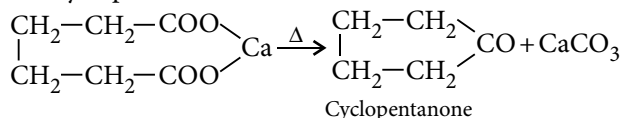
Comparing (i) and (ii) we get,

$$K_2 = \frac{1}{K_1^2} \quad \text{or} \quad K_2 = \left(\frac{1}{K_1}\right)^2$$

12. (c):  $\text{CH}_3-\text{CH}_2-\overset{*}{\underset{\text{Cl}}{\text{C}}}-\text{CH}_3$

2-Chlorobutane contains a chiral carbon atom and hence, is optically active compound.

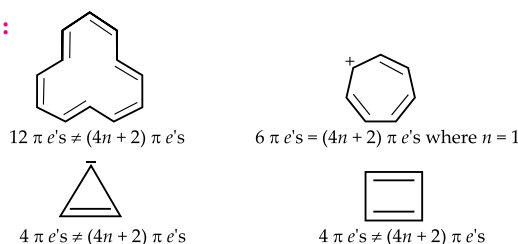
13. (b): Calcium salt of adipic acid on heating gives cyclopentanone.



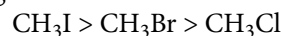
14. (a):  $1850 \text{ ng} = 1850 \times 10^{-9} \text{ g} = 1.85 \times 10^{-6} \text{ g}$   
 $1.85 \times 10^3 \mu\text{g} = 1.85 \times 10^3 \times 10^{-6} \text{ g} = 1.85 \times 10^{-3} \text{ g}$   
 $1.85 \times 10^{-6} \text{ kg} = 1.85 \times 10^{-6} \times 10^3 \text{ g} = 1.85 \times 10^{-3} \text{ g}$

15. (d): Greater is the number of chelate rings, greater is stability of the chelate. Hence, five fused cyclic system is most stable for a chelate.

16. (b):



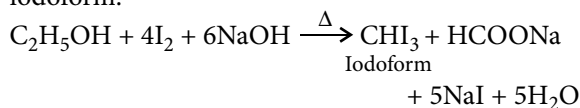
17. (a): Among alkyl halides, iodides are least stable, hence these form Grignard reagent easily. Hence, the correct order of reactivity in formation of Grignard reagent is



18. (d): The electronic configuration of Be =  $1s^2, 2s^2$   
(Fully filled).  
The electronic configuration of N =  $1s^2, 2s^2, 2p^3$   
(Half filled).

Due to stable electronic configuration of Be and N the *IE* of these elements is more than elements of the next group.

19. (a)  
20. (b): Electrolyte X is strong electrolyte as on dilution the number of ions remains same, only interionic attraction decreases and hence, not much increase in  $\Lambda_m$  is seen. While Y is a weak electrolyte since,  $\Lambda_m$  for a weak electrolyte like  $\text{CH}_3\text{COOH}$  increases significantly on dilution.  
21. (b): During adsorption the -ve value of  $\Delta H$  goes on decreasing because as adsorption proceeds number of adsorption sites decreases and hence, exothermicity decreases.  
22. (d):  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{C}_6\text{H}_5\text{OH}$  can be distinguished by neutral  $\text{FeCl}_3$  solution or  $\text{I}_2 + \text{NaOH}$  solution.  $\text{C}_2\text{H}_5\text{OH}$  gives iodoform test with  $\text{I}_2 + \text{NaOH}$  solution while phenol does not give yellow ppt. of iodoform.



$\text{C}_6\text{H}_5\text{OH} + \text{I}_2 + \text{NaOH} \rightarrow$  No reaction  
 $\text{C}_6\text{H}_5\text{OH}$  reacts with neutral  $\text{FeCl}_3$  solution to give purple colour while  $\text{C}_2\text{H}_5\text{OH}$  does not give any colour with neutral  $\text{FeCl}_3$  solution.

23. (d): For  $\text{He}^+$  ion,
- $$\frac{1}{\lambda} = Z^2 R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \Rightarrow (2)^2 R \left[ \frac{1}{2^2} - \frac{1}{4^2} \right] = \frac{3R}{4}$$

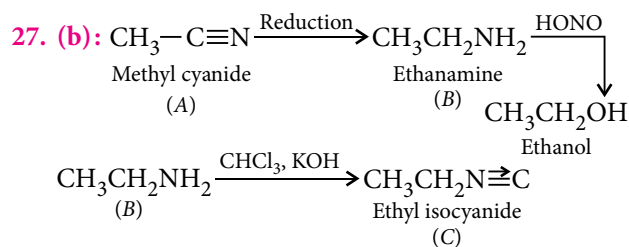
For hydrogen atom,  $\frac{1}{\lambda} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$

$$\frac{3R}{4} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ or } \frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{3}{4}$$

$$n_1 = 1 \text{ and } n_2 = 2.$$

24. (a):  $\Delta G^\circ$  of Y is less than Z and hence, it will reduce oxide of Z.  
25. (b): Since, the salt on treatment with dil. HCl give a pungent smelling gas ( $\text{SO}_2$ ) and a yellow ppt., it must contain  $\text{S}_2\text{O}_3^{2-}$  (thiosulphate ion) and further since it gives green flame test, it must contain  $\text{Ba}^{2+}$  ion. Therefore, salt is  $\text{BaS}_2\text{O}_3$ .

26. (d)



28. (b): (P) For a zero order reaction,  $C = C_0 - kt$   
(Q) For a first order reaction,

$$\log C = \log C_0 - \frac{k}{2.303} \times t$$

(R) For a zero order reaction,  $-\frac{dC}{dt} = k$  (constant)

Hence, slope of  $-\frac{dC}{dt}$  vs  $C = 0$

(S) For a first order reaction,  $-\frac{dC}{dt} = kC$ ,

$$\ln \left( -\frac{dC}{dt} \right) = \ln k + \ln C$$

Hence, plot of  $\ln \left( -\frac{dC}{dt} \right)$  against  $\ln C$  will have slope equal to unity.

29. (c):  $\text{H}_2\text{O}$  and  $\text{NH}_3$  have abnormally high boiling points because of their tendency to form hydrogen bonds.  $\text{NH}_3$  has higher boiling point than phosphine and the boiling point increases down the group because of increase in size. Hence, the order of boiling point will be

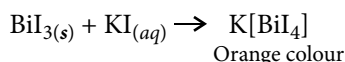
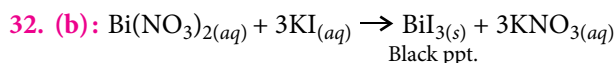


30. (c):  $(\text{C}_6\text{H}_{10}\text{O}_5)_n \xrightarrow{\text{Diastase}} \text{C}_{12}\text{H}_{22}\text{O}_{11} \xrightarrow{\text{Maltase}} \text{C}_6\text{H}_{12}\text{O}_6 \xrightarrow{\text{Zymase}} \text{C}_2\text{H}_5\text{OH} + \text{CO}_2$   
Starch Maltose Glucose Ethanol

Exam Dates 2017	
SRMJEEE	1 <sup>st</sup> April to 30 <sup>th</sup> April (Online)
JEE MAIN	2 <sup>nd</sup> April (Offline)
	8 <sup>th</sup> & 9 <sup>th</sup> April (Online)
VITEEE	5 <sup>th</sup> April to 16 <sup>th</sup> April (Online)
NATA	16 <sup>th</sup> April
WBJEE	23 <sup>rd</sup> April
Kerala PET	24 <sup>th</sup> April (Physics & Chemistry)
	25 <sup>th</sup> April (Mathematics)
Karnataka CET	2 <sup>nd</sup> May (Biology & Mathematics)
	3 <sup>rd</sup> May (Physics & Chemistry)
BITSAT	16 <sup>th</sup> May to 30 <sup>th</sup> May (Online)
JEE Advanced	21 <sup>st</sup> May



31. (d):  $p\text{-CH}_3\text{-C}_6\text{H}_4\text{-CH}_3$  with two electron donating methyl groups is the most reactive, followed by  $\text{CH}_3\text{-C}_6\text{H}_5$  with one methyl group. Out of the remaining,  $p\text{-CH}_3\text{-C}_6\text{H}_4\text{-NO}_2$  with one electron withdrawing  $-\text{NO}_2$  group is more reactive than  $\text{NO}_2\text{-C}_6\text{H}_4\text{-NO}_2$  with two nitro groups.



33. (b):  $\text{pH} = 6$  or  $[\text{H}^+] = 10^{-6}$ ; when it is diluted 100 times.

*i.e.*,  $[\text{H}^+] = 10^{-6} \times 10^{-2} = 10^{-8}$

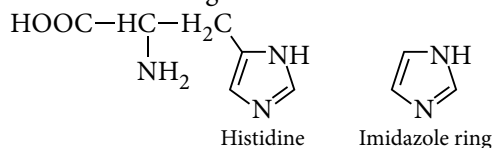
But  $\text{pH}$  of an acid cannot exceed 7. Here we should also consider  $[\text{H}^+]$  that comes from water.

Now  $[\text{H}^+] = [\text{H}^+]$  from  $\text{HCl} + [\text{H}^+]$  from  $\text{H}_2\text{O}$

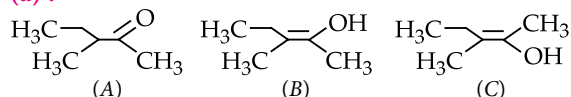
$= 10^{-8} + 10^{-7} = 10^{-8} + 10 \times 10^{-8} = 11 \times 10^{-8}$

$\text{pH} = -\log(11 \times 10^{-8}) = -(1.0413 - 8) = 6.9587$

34. (d): Histidine is the unique amino acid which contains imidazole ring.



35. (a):



$A$ ,  $B$  and  $A$ ,  $C$  are tautomers to each other.  $B$  and  $C$  are geometrical isomers as their methyl groups can be *cis* and *trans* position to each other. Also all geometrical isomers are diastereomers to each other.

36. (b): The complex which contains 18 valence electrons, follows 18-electron rule.

(a)  $[\text{V}(\text{CO})_5]$ : The number of valence electrons  
 $= 5 + (2 \times 5) = 15 e^-$

(b)  $[\text{Fe}(\text{NH}_3)_6]^{2+}$ : The number of valence electrons  
 $= 6 + (6 \times 2) = 6 + 12 = 18 e^-$

(c)  $[\text{Ni}(\text{CO})_6]$ : The number of valence electrons  
 $= 10 + (2 \times 6) = 22 e^-$

(d)  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ : The number of valence electrons  
 $= 5 + (6 \times 2) = 17 e^-$

Thus, only  $[\text{Fe}(\text{NH}_3)_6]^{2+}$  follows 18-electron rule.

37. (c): Picric acid does not contain  $-\text{COOH}$  group. It is 2, 4, 6-trinitrophenol.

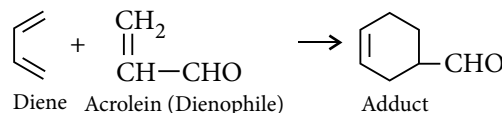
38. (d): Total number of nodes  $= n - 1$

For  $d$ -orbital, radial nodes  $= n - l - 1 = n - 3$  and there are 2 angular nodes.

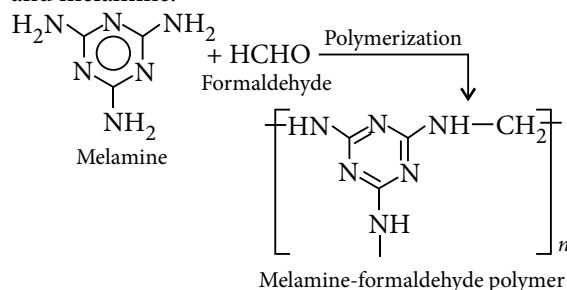
The number of angular nodes is given by  $l$ . *i.e.*, for  $p$ , 1 angular node, for  $d$ , 2 angular nodes and so on.

39. (c): + 3 and + 4 states are shown by  $\text{Ce}$  in aqueous solution.

40. (b): The addition of  $\alpha$ ,  $\beta$ -unsaturated carbonyl compound, with conjugated diene is called Diels-Alder reaction.

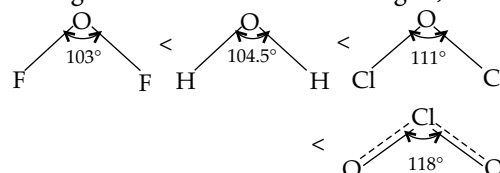


41. (d): The non-breakable plastic household crockery is made from copolymer of formaldehyde (HCHO) and melamine.

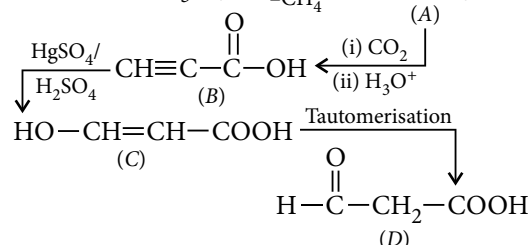


42. (d)

43. (c):  $\text{H}_2\text{O}$  is  $sp^3$  hybridised with bond angle  $104.5^\circ$  due to presence of two lone pairs.  $\text{OF}_2$  has structure similar to  $\text{H}_2\text{O}$  with bond angle  $103^\circ$  due to higher electronegativity of fluorine.  $\text{OCl}_2$  also has similar structure with bond angle  $111^\circ$  because of steric crowding of two chlorine atoms. However,  $\text{ClO}_2$  has  $\pi$ -bond character with an odd electron so that bond angle is  $118^\circ$ . Thus, four compounds can be arranged in order of their bond angles, as

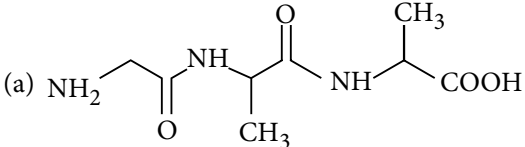
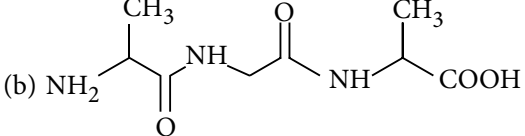
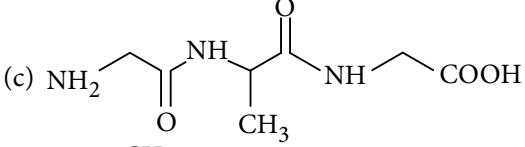
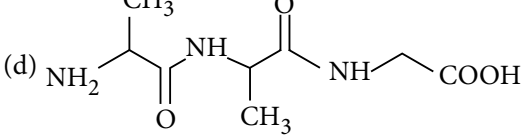
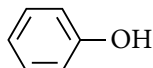
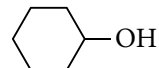
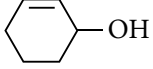
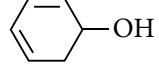


44. (b):  $\text{CH}\equiv\text{CH} + \text{CH}_3\text{MgBr} \xrightarrow{-\text{CH}_4} \text{CH}\equiv\text{CMgBr}$  (A)



45. (b): Cellulase enzyme is present in the stomach of grazing mammals. It digests cellulose. ♦♦

# PRACTICE PAPER 2017 JEE MAIN

- An organic compound,  $C_5H_{10}O$  forms phenylhydrazone, gives positive iodoform test and undergoes Wolff-Kishner reaction to give isopentane. The compound is  
(a) pentanol (b) pentan-2-one  
(c) pentan-3-one (d) 3-methylbutan-2-one.
- The correct order of decreasing ionic nature of lead dihalides is  
(a)  $PbF_2 > PbCl_2 > PbBr_2 > PbI_2$   
(b)  $PbF_2 > PbBr_2 > PbCl_2 > PbI_2$   
(c)  $PbF_2 < PbCl_2 > PbBr_2 < PbI_2$   
(d)  $PbI_2 < PbCl_2 < PbBr_2 > PbF_2$
- Which of the following is a hypnotic drug?  
(a) Luminal (b) Salol  
(c) Piperazine (d) Novalgin
- A ketone reacted with  $C_2H_5MgBr$  reagent followed by hydrolysis gave a product which on dehydration gave an alkene. The alkene on ozonolysis gave diethyl ketone and acetaldehyde. The ketone is  
(a) dimethyl ketone (b) ethyl methyl ketone  
(c) diethyl ketone (d) ethyl propyl ketone.
- A weak base  $BOH$  is titrated with a strong acid  $HA$ . When 10 mL of  $HA$  is added, the pH is found to be 9.00 and when 25 mL is added, pH is 8.00. The volume of the acid required to reach the equivalence point is  
(a) 35 mL (b) 40 mL (c) 30 mL (d) 50 mL
- Which of the following is not a water softener?  
(a) Calgon (b) Permutit  
(c)  $Na_2CO_3$  (d)  $Na_2SO_4$
- The total hardness of water containing 68 ppm of  $CaSO_4$  and 19 ppm of  $MgCl_2$  will be  
(a) 50 ppm (b) 70 ppm  
(c) 90 ppm (d) 110 ppm
- Among the following species, identify the isostructural pairs.  
 $NF_3, NO_3^-, BF_3, H_3O^+, HN_3$
- (a)  $[NF_3, NO_3^-]$  and  $[BF_3, H_3O^+]$   
(b)  $[NF_3, HN_3]$  and  $[NO_3^-, BF_3]$   
(c)  $[NF_3, H_3O^+]$  and  $[NO_3^-, BF_3]$   
(d)  $[NF_3, H_3O^+]$  and  $[HN_3, BF_3]$
- A tripeptide is written as glycine-alanine-glycine. The correct structure of the tripeptide is  
(a)   
(b)   
(c)   
(d) 
- Glycol reacts with  $PCl_3$  and gives ethylene dichloride. What will be the product, if it reacts with  $P + I_2$ ?  
(a) Ethylene iodide (b) Ethylene iodohydrin  
(c) Ethylene (d) None of these
- Dehydration of the following in increasing order is  
(I)  (II)   
(III)  (IV)   
(a)  $I < II < III < IV$  (b)  $II < III < IV < I$   
(c)  $I < III < IV < II$  (d) none of these.

12. Vapour pressure of dilute aqueous solution of glucose is 750 mm of mercury at 373 K. The mole fraction of solute is

- (a) 1/76 (b) 1/7.6 (c) 1/38 (d) 1/10

13. Fluorobenzene can be prepared from aniline via diazotisation, the reaction is known as

- (a) Sandmeyer reaction  
(b) Gattermann reaction  
(c) Schiemann reaction  
(d) Koch synthesis.

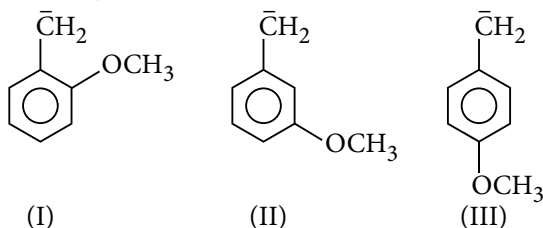
14. The complex ion which has three 'd' electrons in the central metal atom is

- (a)  $[\text{MnO}_4]^-$  (b)  $[\text{Co}(\text{NH}_3)_6]^{3+}$   
(c)  $[\text{Fe}(\text{CN})_6]^{3-}$  (d)  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$

15. The principal products obtained on heating iodine with concentrated caustic soda solution are

- (a)  $\text{NaOI} + \text{NaI}$  (b)  $\text{NaIO}_3 + \text{NaI}$   
(c)  $\text{NaOI} + \text{NaIO}_3 + \text{NaI}$   
(d)  $\text{NaIO}_4 + \text{NaI}$

16. Arrange the following in decreasing order of stability :



- (I) (II) (III)  
(a) I > II > III (b) I > III > II  
(c) II > I > III (d) II > III > I

17. A current of strength of 2.5 A was passed through  $\text{CuSO}_4$  solution for 6 minutes 26 seconds. The amount of copper deposited is

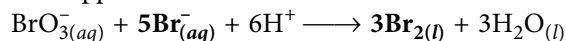
[At. wt. of Cu = 63.5, Faraday = 96500 coulombs]

- (a) 0.3175 g (b) 3.175 g  
(c) 0.635 g (d) 6.35 g

18. IUPAC name of  $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$  is

- (a) sodium cobaltinitrite  
(b) sodium hexanitritocobaltate (III)  
(c) sodium hexanitrocobalt (III)  
(d) sodium hexanitritocobaltate (II).

19. In the following reactions, how is the rate of appearance of the bold product related to the rate of disappearance of the bold reactant ?



(a)  $\frac{d[\text{Br}_2]}{dt} = -\frac{5}{3} \frac{d[\text{Br}^-]}{dt}$

(b)  $\frac{d[\text{Br}_2]}{dt} = -\frac{d[\text{Br}^-]}{dt}$

(c)  $\frac{d[\text{Br}_2]}{dt} = \frac{3}{5} \frac{d[\text{Br}^-]}{dt}$

(d)  $\frac{d[\text{Br}_2]}{dt} = -\frac{3}{5} \frac{d[\text{Br}^-]}{dt}$

20. Which of the following statements is correct for  $\text{CsBr}_3$ ?

- (a) It is a covalent compound.  
(b) It contains  $\text{Cs}^{3+}$  and  $\text{Br}^-$  ions.  
(c) It contains  $\text{Cs}^+$  and  $\text{Br}_3^-$  ions.  
(d) It contains  $\text{Cs}^+$ ,  $\text{Br}^-$  and lattice  $\text{Br}_2$  molecule.

21. For which one of the following reactions,  $\Delta H$  is not equal to  $\Delta E$ ?

- (a)  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$   
(b)  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g})$   
(c)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$   
(d)  $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightleftharpoons \text{NaCl}(\text{aq}) + \text{H}_2\text{O}$

22. The oxidation numbers of sulphur in  $\text{S}_8$ ,  $\text{S}_2\text{F}_2$ ,  $\text{H}_2\text{S}$  respectively, are

- (a) 0, +1 and -2 (b) +2, +1 and -2  
(c) 0, +1 and +2 (d) -2, +1, and -2

23. Which one of the following is not an ionic surfactant?

- (a)  $\text{CH}_3 - (\text{CH}_2)_{15} - \overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{N}^+}} - \text{CH}_3\text{Br}^-$   
(b)  $\text{CH}_3 - (\text{CH}_2)_{14} - \text{CH}_2 - \text{NH}_2$   
(c)  $\text{CH}_3 - (\text{CH}_2)_{16} - \text{CH}_2\text{OSO}_2^- \text{Na}^+$   
(d)  $\text{OHC} - (\text{CH}_2)_{14} - \text{CH}_2 - \text{COO}^- \text{Na}^+$

24. Increasing order of electronegativity is

- (a)  $\text{Bi} < \text{P} < \text{S} < \text{Cl}$  (b)  $\text{P} < \text{Bi} < \text{S} < \text{Cl}$   
(c)  $\text{S} < \text{Bi} < \text{P} < \text{Cl}$  (d)  $\text{Cl} < \text{S} < \text{Bi} < \text{P}$

25. Tin dissolves in boiling caustic soda solution because of the formation of soluble

- (a)  $\text{Sn}(\text{OH})_2$  (b)  $\text{Sn}(\text{OH})_4$   
(c)  $\text{Na}_2\text{SnO}_3$  (d) none of these.

Contd. on Page No. 88



# CONCEPT BOOSTER

## SOLUTIONS OF CONCEPT BOOSTER

(Published on Page no. 83, Chemistry Today, January '17)

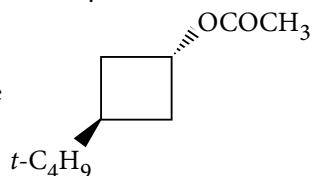
\*Arunava Sarkar

### TYPE-1 : SINGLE OPTION CORRECT

1. (c): This is a clear cut substitution reaction.  $F^-$  even though a very poor leaving group will leave because of the formation of stable triphenylmethyl carbocation intermediate. Therefore, the product is (c).

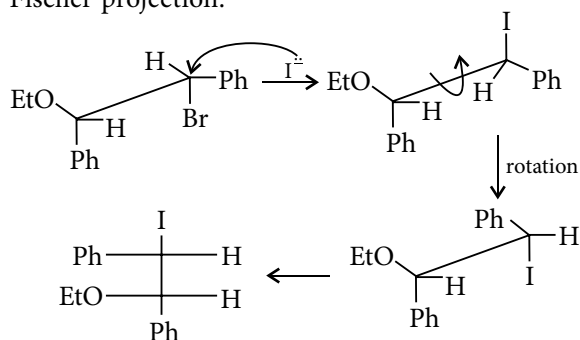
2. (d): First of all identify the nucleophile. It is  $\text{O}=\text{C}-\text{CH}_3$ . Now, of course here the nature of reaction is  $S_N2$ . So, after the brosylate ion leaves ( $\text{O}^-$ )

product appears to be



$\therefore$  Option (d) is correct.

3. (a): First draw the sawhorse projection of the given Fischer projection.



$\therefore$  Option (a) is correct. Even if you go with NGP concept major product will be (a) only.

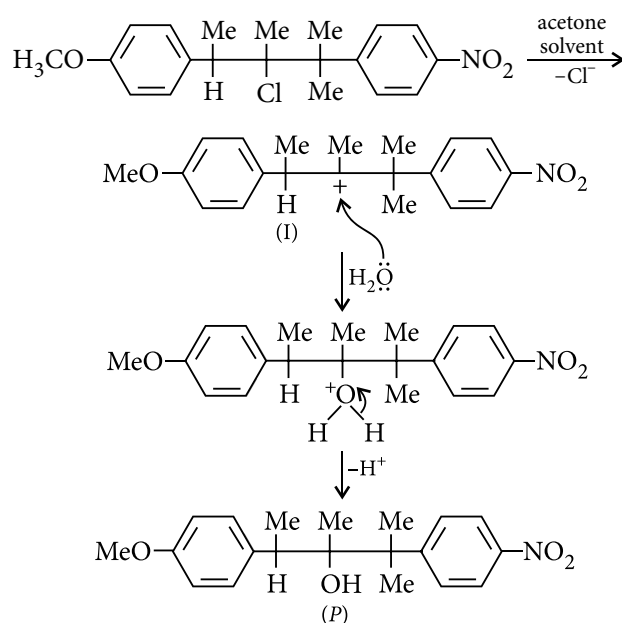
4. (d): Leaving group ability is  $I > Br > Cl$ . More branching will decrease the chance of  $S_N2$  reaction. Presence of a carbonyl group at the

adjacent position will increase the possibility of  $S_N2$  reactivity.

Considering all the points, the correct order should be :  $IV < I < II < III < V$ .

$\therefore$  Option (d) is correct.

5. (a): The halide is a crowded one. It will definitely undergo  $S_N1$  reaction. Acetone helps to dissolve the halide. Now, see how the reaction proceeds :



Now, for sure, (I) can undergo a hydride shift to give a more stable carbocation (II).

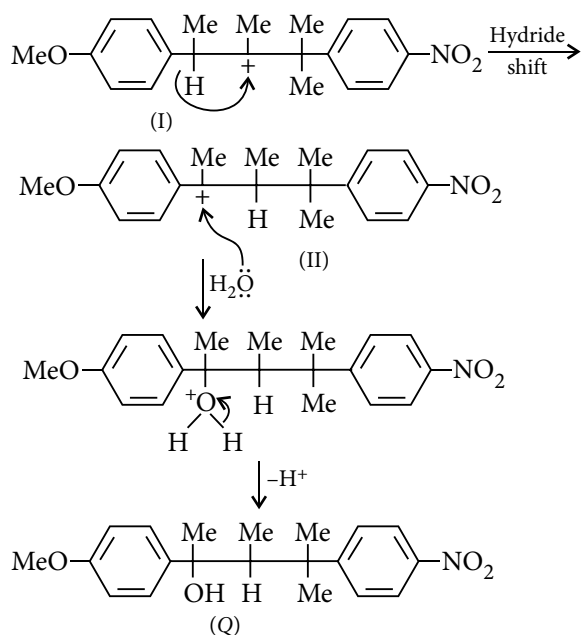


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Remember, in (I), methyl shift cannot take place as it'll lead to the formation of less stable carbocation.

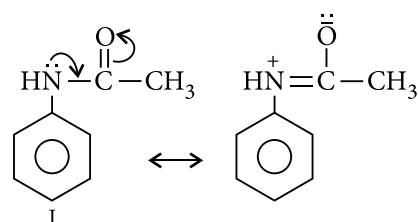
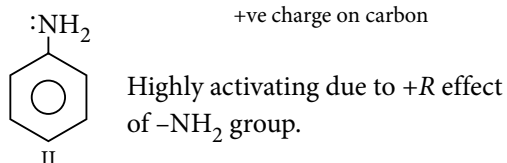
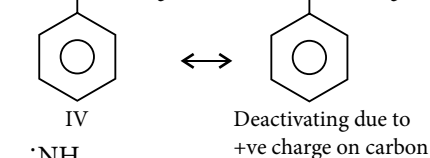
∴ A mixture of P and Q will be formed. So, correct option is (a).

6. (c): Remember that intramolecular substitution will give a ring structure. The ring that will be more strained (mainly 3 or 4 membered) will not be formed. Five and six membered rings are welcome. So, according to this, correct option is (c), III, IV.

7. (b): A very good conceptual question it is!!  $\ddot{\text{Br}}$  is a better leaving group than  $\ddot{\text{Cl}}$ . DMSO is a polar aprotic solvent which will favour  $\text{S}_{\text{N}}2$  reaction. Obviously, inversion will take place. ∴ Correct option is (b).

8. (c): Here  $(\text{C}_6\text{H}_5)_3\text{C}^+$  is most stable carbocation, so it will undergo  $\text{S}_{\text{N}}1$  reaction most rapidly. ∴ Correct option is (c).

9. (a):  $\ddot{\text{O}}=\text{C}-\text{CH}_3 \leftrightarrow \ddot{\text{O}}-\overset{+}{\text{C}}-\text{CH}_3$



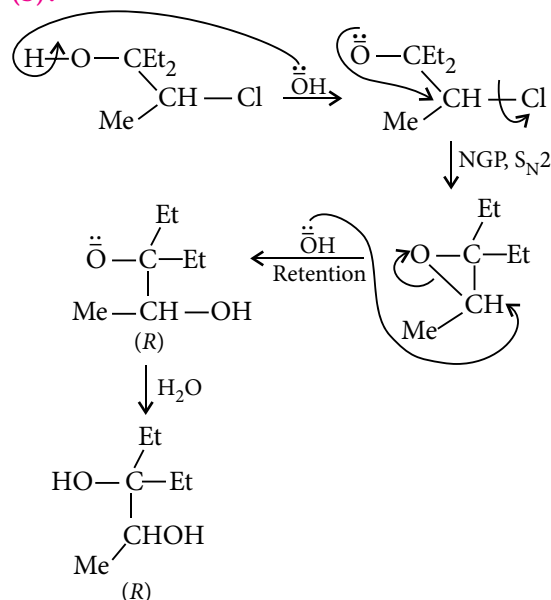
Some fraction of the electron density does not come to the benzene ring.

∴ Correct order is  $\text{IV} < \text{III} < \text{II} < \text{I}$ .  
∴ Option (a) is correct.

10. (a): With more branching, reactivity in  $\text{S}_{\text{N}}2$  reaction decreases.

∴ Option (a) is correct.

11. (b):



∴ Option (b) is correct.

12. (c): DMSO

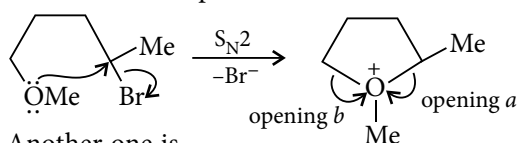
13. (c): Except (c) in all other cases different products are obtained either with rearrangement or any other means. Option (c) has got a plane of symmetry too. ∴ Correct option is (c).

### TYPE-2 : ONE OR MORE THAN ONE OPTIONS CORRECT

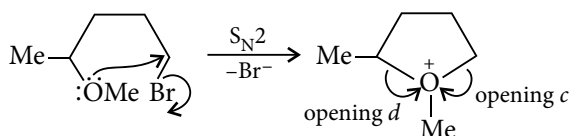
1. (a, b, c, d): Substrates which can produce stable carbocations prefer to undergo  $\text{S}_{\text{N}}1$  reaction. Those who can't, prefer to undergo  $\text{S}_{\text{N}}2$  reactions. DMSO is polar aprotic solvent, so due to lesser size (anion will not be trapped here)  $\text{Cl}^-$  will be a better nucleophile here. ∴ Correct options are (a), (b), (c), (d).

2. (a, c): Correct options are (a), (c).

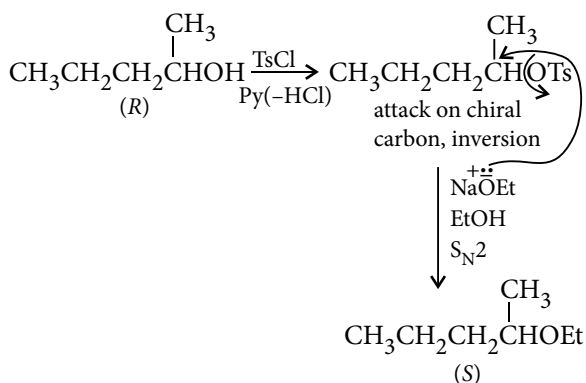
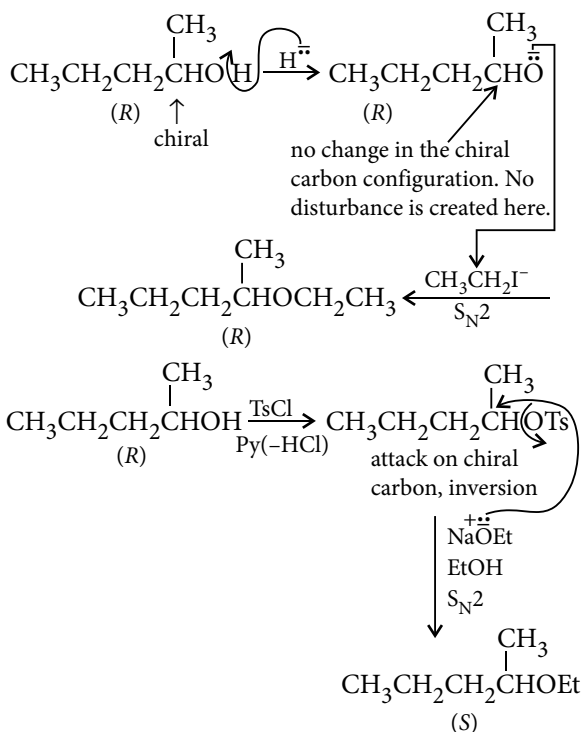
Let us see the explanation:



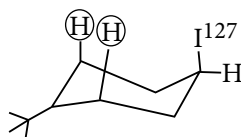
Another one is



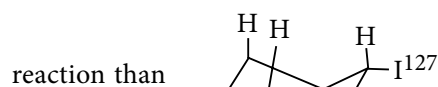
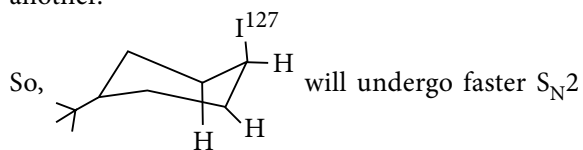
You can understand opening a and opening d will give the same product and opening b and opening c will give same product.



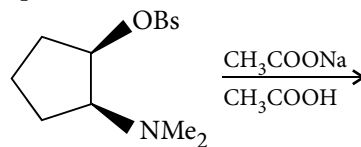
3. (c):



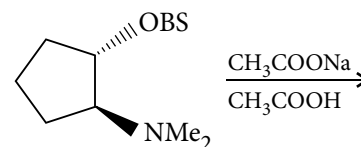
Due to the diaxial interactions, leaving group (i.e., I<sup>127</sup>) will leave more easily here than the another.



So, option (a) is incorrect.



It will follow normal S<sub>N</sub>1 mechanism. So, two products will be obtained.

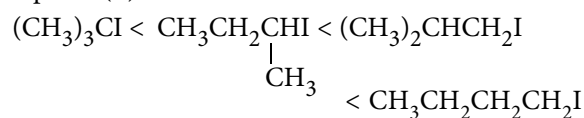


Here, NGP will take place. So, only one product will be obtained without inversion.

So, option (b) is also incorrect.

Option (c) is correct. It is as per the parallelism with the basicity.

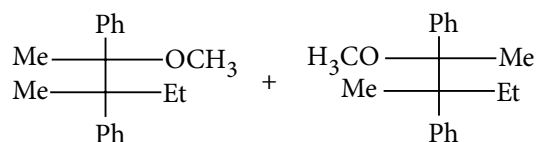
Option (d) is incorrect. Correct order is :



∴ Overall, only option (c) is correct.

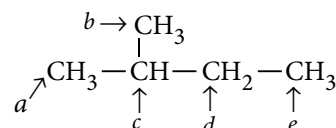
### TYPE-3 : INTEGER TYPE QUESTIONS

1. (2): S<sub>N</sub>1 reaction will take place here. So, both inversion and retention will take place here. Products are :



∴ No. of fractions (products) = 2

2. (5): Check, halogenation at which carbon atom(s) will lead to the different products formation from each other.



But a = b. So, apparently 4.

But, due to chlorination at carbon number d, you will get two enantiomers.

∴ X = 5





# ADVANCED CHEMISTRY BLOC

(THERMOCHEMISTRY)

Mk C.R ay,O ð sh

Chemical reactions are generally performed at a constant pressure of 1 atm. The heat flow,  $q_p$  between the system and the surroundings is therefore, equal to change in enthalpy,  $\Delta H$ . However, for reactions at constant volume, we have  $q_v = \Delta U$ , where  $\Delta U$  may be converted into  $\Delta H$  by using the relation,

$$\Delta H = \Delta U + \Delta n_g RT$$

In a chemical reaction taking place at a constant pressure, there is generally a difference in temperature before and after the reaction. To restore the system to its initial temperature, heat must flow either to or from the surroundings. Accordingly, exothermic reactions evolve heat whereas endothermic reactions absorb heat. The study of enthalpy for different types of chemical reactions is known as thermochemistry. As enthalpy ' $H$ ' is an extensive property, the change in enthalpy of the reaction,  $\Delta H$ , is usually reported for 1 mole of the reactant or product. In thermochemistry, we often deal with  $\Delta H$  and not with  $\Delta U$  as chemical reactions are generally carried out at constant pressure.

## Standard Enthalpy Changes in Different Processes

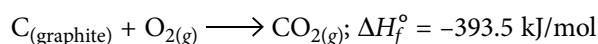
There is no way to measure the absolute value of the enthalpy of a substance. Only values relative to an arbitrary reference can be determined to assign enthalpy values to various substances.

The reference point for all enthalpy expressions is called standard enthalpy of formation,  $\Delta H_f^\circ$ . The reference form is usually the most stable form of the elements. By convention, the enthalpy of formation of the most stable form of an element in its standard state is zero at every temperature. The elements are said to be in standard state at 1 atm, hence the term standard enthalpy is being used. Although the standard state does not specify a temperature, we always use  $\Delta H_f^\circ$  values measured at 25°C.

For oxygen,  $O_2$  is more stable than  $O_3$  at 1 atm and 25°C, therefore  $\Delta H_f^\circ(O_2) = 0$  but  $\Delta H_f^\circ(O_3) \neq 0$ .

Similarly, for the element carbon, graphite is more stable than diamond, hence  $\Delta H_f^\circ(C, \text{graphite}) = 0$  but  $\Delta H_f^\circ(C, \text{diamond}) \neq 0$ . The reference form of S, P and  $Br_2$  are rhombic S, black P and liquid  $Br_2$  respectively.

Thus defining  $\Delta H_f^\circ$  as zero for all elements at standard state, 1 atm establishes a reference point from which  $\Delta H_f^\circ$  values for different substances can be measured. For example, the enthalpy of formation of a mole of  $CO_{2(g)}$  from its elements C and  $O_2$  in their standard states can be written as

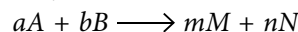


$$\text{or } \Delta H_f^\circ(CO_2) = H^\circ(CO_2) - \{H^\circ(C) + H^\circ(O_2)\}$$

As standard enthalpies of C and  $O_2$  are zero,

$$\Delta H_f^\circ(CO_2) = H^\circ(CO_2)$$

For a hypothetical reaction,



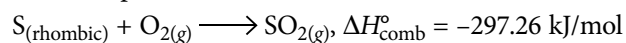
the standard enthalpy of reaction,  $\Delta H_r^\circ$  can be calculated as

$$\Delta H_r^\circ = \{m\Delta H_f^\circ(M) + n\Delta H_f^\circ(N)\} - \{a\Delta H_f^\circ(A) + b\Delta H_f^\circ(B)\}$$

## Enthalpy (Heat) of Combustion

The heat of combustion of a substance is defined as the heat evolved when 1 mole of that substance is burnt completely in oxygen.

For example,



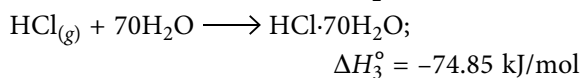
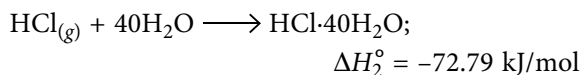
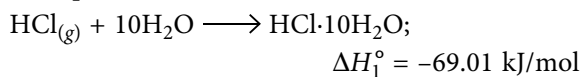
Combustion processes are generally exothermic, and hence  $\Delta H_{\text{comb}}^\circ$  is used to determine the fuel values. The heat of combustion is measured at constant volume. So,  $\Delta U$  is obtained which is then converted to  $\Delta H$ .

## Enthalpy (Heat) of Solution and Dilution

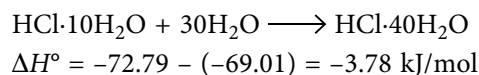
The formation of a solution is either accompanied with absorption or liberation of heat. The heat of solution is the enthalpy change when 1 mole of a solute is dissolved in a specified amount of a solvent

at a constant temperature and pressure. This enthalpy of solution is called the integral heat of solution, which depends on the amount of the solvent per mole of the solute.

For example,

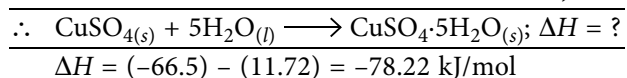
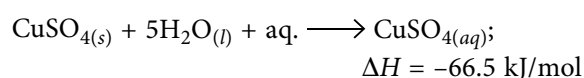
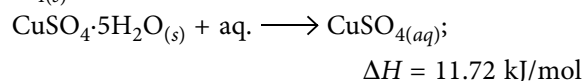


On adding more and more solvent,  $\Delta H^\circ$  value increases and approaches a limiting value at infinite dilution.  $\Delta H_3^\circ$  gives the integral heat of solution at infinite dilution and represents the upper limit of the heat released. The integral heat of dilution is defined as the change in enthalpy when a solution of known concentration is diluted by adding more solvent. For example, when 30 moles of  $\text{H}_2\text{O}$  are added to  $\text{HCl}\cdot 10\text{H}_2\text{O}$  solution, the enthalpy change is calculated by subtracting the above two equations.



### Enthalpy (Heat) of Hydration

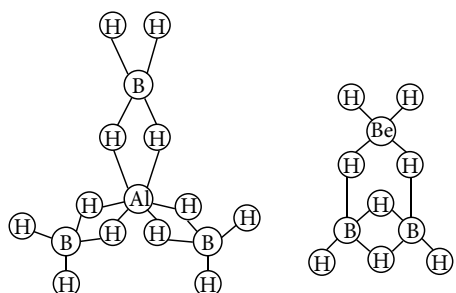
The heat of hydration is defined as the heat change accompanying the formation of 1 mole of a specified hydrate from 1 mole of its anhydrous substance. This is calculated from the enthalpies of solutions of hydrous and anhydrous substances. For example, from the values of enthalpies of solutions of  $\text{CuSO}_4\cdot 5\text{H}_2\text{O}_{(s)}$  and  $\text{CuSO}_{4(s)}$  we can calculate the enthalpy of hydration of  $\text{CuSO}_{4(s)}$ .



Enthalpy of neutralisation and enthalpy of formation are very common concepts. So we have consciously dropped them from this discussion.

### CHEMISTRY MUSING

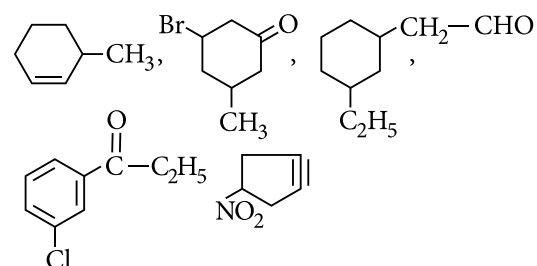
Contd. from Page No. 8



7. Select the incorrect statement from the following.
- Hybridisation of Al in  $\text{Li}[\text{AlH}_4]$  is same as B in  $\text{Na}[\text{BH}_4]$ .
  - Geometry around Al in  $\text{Li}[\text{AlH}_4]$  is same as  $\text{AlCl}_4^-$ .
  - $\text{AlH}_4^-$ ,  $\text{BH}_4^-$ ,  $\text{AlCl}_4^-$  are iso-structural.
  - $\text{AlH}_4^-$ ,  $\text{AlCl}_4^-$ ,  $\text{BH}_4^-$  are iso-electronic.
8. Select the correct statement about  $\text{Al}(\text{BH}_4)_3$ .
- Each tetrahydridoborate ion forms two hydrogen bridges.
  - Two  $\text{BH}_4$  form 2 hydrogen bridges and one  $\text{BH}_4$  forms one hydrogen bridge.
  - One  $\text{BH}_4$  forms 2 hydrogen bridges and two  $\text{BH}_4$  form one hydrogen bridge.
  - B forms only  $2c - 2e$  bond.

### INTEGER VALUE

9. How many organic compounds given below will exhibit both Wolff–Kishner reduction as well as nucleophilic addition reaction?



10. In a certain reaction,  $B^{n+}$  is getting converted to  $B^{(n+4)+}$  in solution. The rate constant of this reaction is measured by titrating a volume of the solution with a reducing agent which reacts only with  $B^{n+}$  and  $B^{(n+4)+}$ . In the process, it converts  $B^{n+}$  to  $B^{(n+2)+}$  and  $B^{(n+4)+}$  to  $B^{(n-1)+}$ . At  $t = 0$ , the volume of the reagent consumed is 25 mL and at  $t = 10$  minutes, the volume used is 32 mL. The rate constant for the conversion of  $B^{n+}$  to  $B^{(n+4)+}$  is found out in the form of  $x \times 10^{-3}$ . Find the value of  $x$ , assuming it to be a first order reaction.



# MPP-8 MONTHLY Practice Problems

## Class XII



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

### Biomolecules, Polymers and Chemistry in Everyday Life

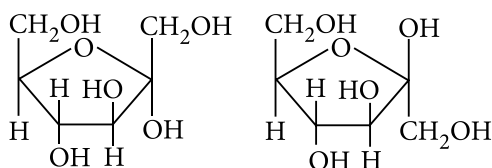
Total Marks : 120

Time Taken : 60 Min.

NEET / AIIMS

Only One Option Correct Type

1. Five-membered ring structures of fructose are given below. Mark the incorrect statement.

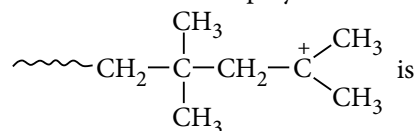


- (a) The five-membered ring structures are named as furanose structures.  
 (b) The cyclic structures represent two anomers of fructose.  
 (c) Five-membered ring structures are named as pyranose structures.  
 (d) These are also called Haworth structures.
2. Serotonin is usually used as  
 (a) analgesic (b) tranquilizer  
 (c) antiseptic (d) antioxidant.
3. The turbidity of a polymer solution measures  
 (a) light absorbed by the solution  
 (b) light transmitted by the solution  
 (c) light scattered by the solution  
 (d) none of the above.
4. Chargaff's rule states that in an organism  
 (a) amount of all bases are equal  
 (b) amount of adenine (A) is equal to that of thymine (T) and the amount of guanine (G) is equal to that of cytosine (C)  
 (c) amount of adenine (A) is equal to that of guanine (G) and the amount of thymine (T) is equal to that of cytosine (C)



- (d) amount of adenine (A) is equal to that of cytosine (C) and the amount of thymine (T) is equal to that of guanine (G).

5. In the following sets of compounds, the one which contains only antibiotics is  
 (a) sulphadiazine, salvarsan, cephalosporin  
 (b) tetracycline, streptomycin, ofloxacin  
 (c) chloramphenicol, erythromycin, ranitidine  
 (d) norethindrone, terfenadine, lansoprazole.

6. The monomer of the polymer



- (a)  $\text{H}_2\text{C}=\text{C}(\text{CH}_3)_2$  (b)  $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)_2$   
 (c)  $\text{CH}_3\text{CH}=\text{CHCH}_3$  (d)  $\text{CH}_3\text{CH}=\text{CH}_2$
7. Most of the antifertility drugs contain a mixture of  
 (a) oxytocin and alitame  
 (b) norethindrone and ethynylestradiol  
 (c) norethindrone and alitame  
 (d) ethynylestradiol and oxytocin.
8. Which of the following if taken in excess can accumulate in body and cause toxicity?  
 (a) Vitamin C (b) Vitamin D  
 (c) Vitamin B<sub>2</sub> (d) None of these
9. Ibuprofen contains  
 (a) only S-enantiomer  
 (b) only R-enantiomer  
 (c) racemic mixture of both R and S enantiomers  
 (d) both R and S enantiomers which are active pain killers.

10. A zwitter ion is
- a positively charged ion without a metal atom in it
  - a negatively charged ion without a metal atom in it
  - an ion with positive and negative charges at different points on it
  - a heavy ion with a small charge on it.
11. Which of the following sets forms the biodegradable polymer?
- $\text{CH}_2=\text{CH}-\text{CN}$  and  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$
  - $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$  and  $\text{H}_2\text{N}-(\text{CH}_2)_5\text{COOH}$
  - $\text{HO}-\text{CH}_2\text{CH}_2-\text{OH}$  and
- 
-   $\text{CH}=\text{CH}_2$  and  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$
12. The preservative which is ultimately excreted in urine as hippuric acid is
- sodium benzoate
  - sodium metabisulphite
  - sodium propionate
  - sodium sorbate

#### Assertion & Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- If both assertion and reason are true and reason is the correct explanation of assertion.
- If both assertion and reason are true but reason is not the correct explanation of assertion.
- If assertion is true but reason is false.
- If both assertion and reason are false.

13. **Assertion :** Artificial sweeteners are added to the food to control the intake of calories.

**Reason :** Most of the artificial sweeteners are inert and do not metabolise in the body.

14. **Assertion :** A solution of sucrose in water is dextrorotatory but on hydrolysis in presence of little hydrochloric acid, it becomes laevorotatory.

**Reason :** Sucrose on hydrolysis gives unequal amounts of glucose and fructose as a result of which change in sign of rotation is observed.

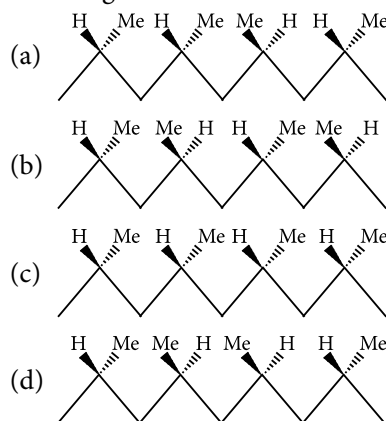
15. **Assertion :** Neoprene can be further hardened by heating in presence of sulphur.

**Reason :** Neoprene contains allylic double bonds which help in introducing sulphur bridges between different polymer chains.

#### JEE MAIN / JEE ADVANCED / PETS

##### Only One Option Correct Type

16. Which of the following polymer is stored in the liver of animals?
- Amylose
  - Cellulose
  - Amylopectin
  - Glycogen
17. Identify the isotactic polypropylene from the following :



18. Sodium rosinate is generally added in the soap because it

- prevents rapid drying of soap
- produces rich lather
- gives antiseptic property
- acts as a perfume.

19. Which of the following statements is not true?

- Pheromones are secreted outside the body by the insects.
- Aspirin is an analgesic and antipyretic.
- Sucrose is a dipeptide commonly known as aspartame.
- The DNA assists in the synthesis of RNA molecules.

##### More than One Options Correct Type

20. Which of the following are addition polymers?

- Buna-S
- Neoprene
- Teflon
- PVC

21. Which of the following carbohydrates on treatment with excess of phenylhydrazine give the same osazone?

- Glucose
- Fructose
- Mannose
- Galactose

22. Which of the following surfactants do not cause any water pollution?  
 (a) Sodium stearate  
 (b) Sodium laurylsulphate  
 (c) Cetyltrimethylammonium bromide  
 (d) Alkyl benzenesulphonates having highly branched chain alkyl groups.
23. Which of the following polymers are thermoplastic?  
 (a) Teflon (b) Polyacrylonitrile  
 (c) Polyvinyl chloride (d) Polystyrene
27. Which of the following  $\alpha$ -amino acids does not form optical isomers?  
 (a)  $\overset{+}{N}H_3CH(CH_3)COO^-$   
 (b)  $\overset{+}{N}H_3CH_2COO^-$   
 (c)  $\overset{+}{N}H_3CH(CH_2Ph)COO^-$   
 (d)  $\overset{+}{N}H_3CH(CH(CH_3)_2)COO^-$
28. Which of the following amino acids contains sulphur and is an essential amino acid?  
 (a) Isoleucine (b) Methionine  
 (c) Proline (d) Glutamine

## Integer Answer Type

24. In chemistry, some substances can act as an antiseptic as well as disinfectant by varying the concentration. 0.2% solution of phenol is an antiseptic while its  $y\%$  solution is disinfectant. The value of  $y$  is
25. A decapeptide (Mol. wt. 796) on complete hydrolysis gives glycine (Mol. wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is
26. In a polymer sample, 20% of molecules have molecular mass of 20,000, 50% have 30,000 and the rest 60,000. The polydispersity Index (PDI) for the polymer approximately is

## Comprehension Type

Proteins are the polymers of about twenty different  $\alpha$ -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids because they cannot be synthesised by our body, hence must be provided through diet. Proteins perform various structural and dynamic functions in the organisms. Proteins which contain only  $\alpha$ -amino acids are called simple proteins. The secondary or tertiary structure of proteins gets disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.

## Matrix Match Type

29. Match the entries listed in Column I with appropriate entries listed in Column II.

Column I		Column II	
(A) Adrenaline		(P) Releases HCl from stomach walls	
(B) Noradrenaline		(Q) Causes allergy	
(C) Histamine		(R) Hormone	
(D) Dopamine		(S) Neurotransmitter	
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
(a) R	R, S	P, Q	S
(b) P, S	R, S	P, Q, R	S
(c) S	Q, R	Q	R, S
(d) P, Q, R	R, S	P, Q	S

30. Match the entries listed in Column I with appropriate entries listed in Column II.

Column I		Column II	
(A) Cellulose		(P) Natural polymer	
(B) Nylon-6,6		(Q) Synthetic polymer	
(C) Protein		(R) Amide linkage	
(D) Sucrose		(S) Glycosidic linkage	
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
(a) P, Q, R	Q, R	P, R	S
(b) P, S	Q, R	P, R	S
(c) P, S	Q, R	P	Q, R
(d) P, Q, R	P	R	R, S

Keys are published in this issue. Search now! ☺

## SELF CHECK

No. of questions attempted .....  
 No. of questions correct .....  
 Marks scored in percentage .....

## Check your score! If your score is

> 90%	<b>EXCELLENT WORK !</b>	You are well prepared to take the challenge of final exam.
90-75%	<b>GOOD WORK !</b>	You can score good in the final exam.
74-60%	<b>SATISFACTORY !</b>	You need to score more next time.
< 60%	<b>NOT SATISFACTORY!</b>	Revise thoroughly and strengthen your concepts.

# NEET | JEE

## ESSENTIALS

Class XII

Maximize your chance of success, and high rank in NEET, JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

### Unit 8

## POLYMERS

### CHEMISTRY IN EVERYDAY LIFE

#### POLYMERS

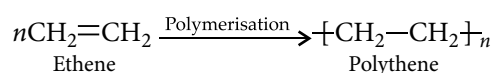
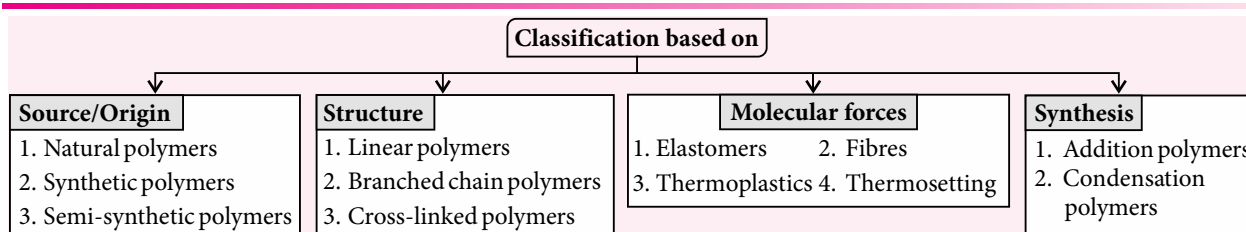
##### INTRODUCTION

- ↪ The word 'polymer' is coined from two Greek words. *Poly* means many and *mer* means unit or part.
- ↪ Polymers are very large molecules having high molecular mass ( $10^3$ – $10^7$  u).
- ↪ These are also referred to as *macromolecules*, which are formed by joining of repeating structural units *monomers* on a large scale.
- ↪ The process of formation of polymers from respective monomers is called *polymerisation*.
- ↪ All polymers are macromolecules but all macromolecules are not polymers.

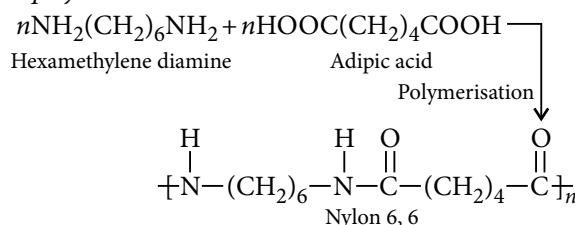
##### TYPES OF POLYMERS

- ↪ **Homopolymer** : Polymer made up of only one type of monomer. *e.g.*, Polythene, Polypropylene, PVC, etc.

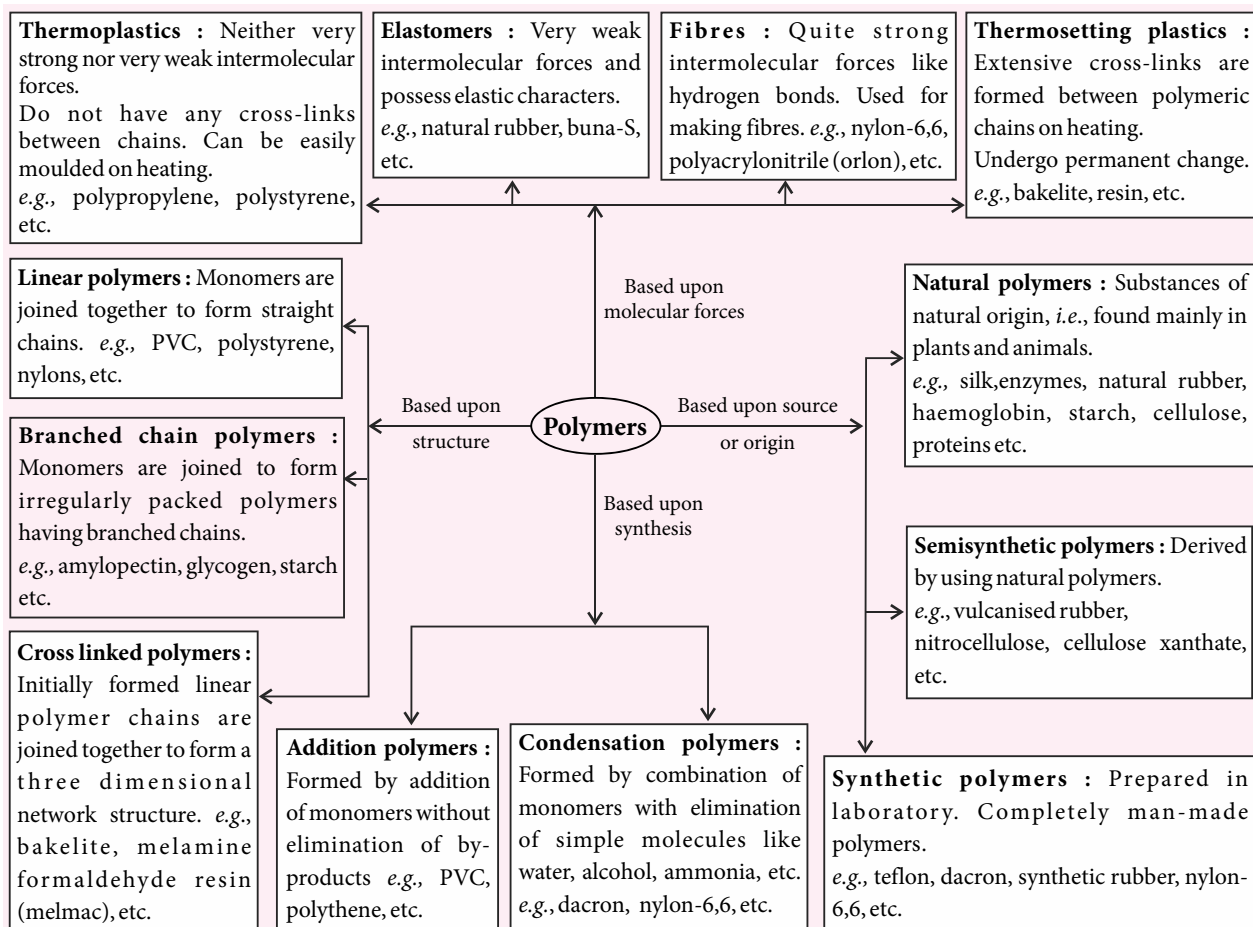
##### CLASSIFICATION OF POLYMERS



- ↪ **Copolymer** : Polymer made up of two or more types of monomers. *e.g.*, Nylon 6,6, Buna-S, Bakelite, etc. The process of formation of copolymer is called *copolymerisation*.



- Copolymers have better physical and mechanical properties. The properties of copolymers could be changed by varying the amount of each monomer.



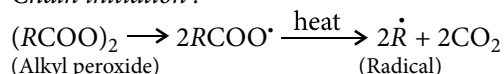
## METHODS OF POLYMERISATION

### ➤ Addition (chain-growth) polymerisation :

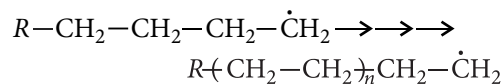
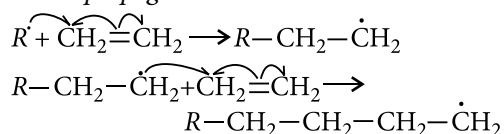
This involves a number of steps, in each step a reactive particle is consumed and the similar one is produced. The monomers used are unsaturated compounds such as alkenes and their derivatives. Depending upon the reactive particles formed these are of three types, free radical, cationic and anionic polymerisation.

➤ **Mechanism of free radical polymerisation :** This is initiated by organic peroxides or by light. Steps involved are :

- **Chain initiation :**

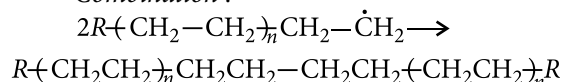


- **Chain propagation :**

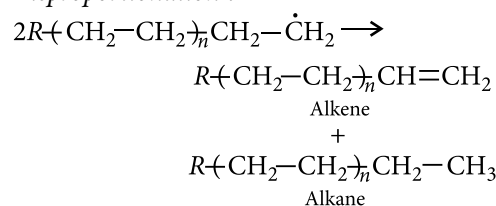


- **Chain termination :**

**Combination :**

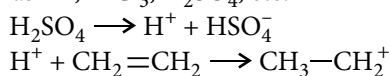


**Disproportionation :**



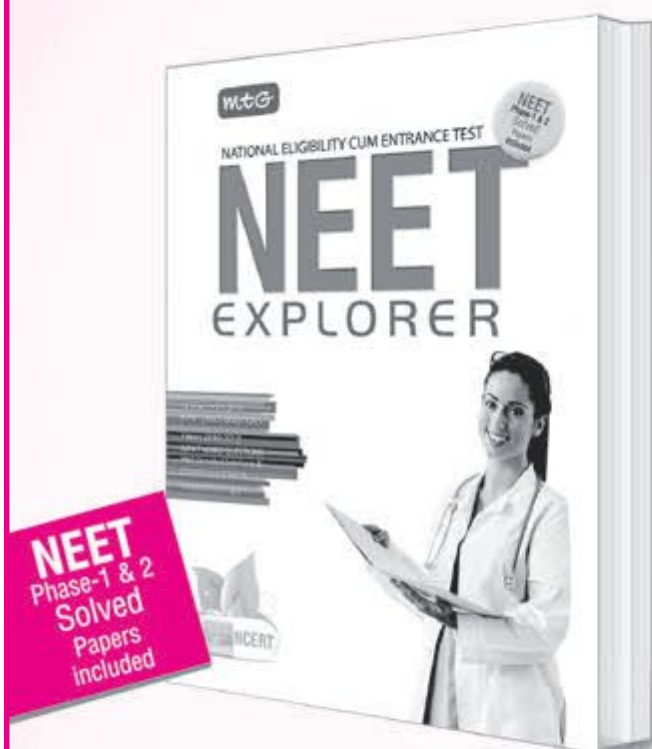
*e.g.*, polythene, polystyrene

➤ **Mechanism of cationic addition polymerisation :** Initiated by the use of strong Lewis acids such as HF, AlCl<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, etc.



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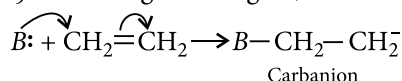
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- The carbocation thus formed undergoes addition with several monomers and finally the chain is terminated by combination with a negative ion or loss of a proton. e.g., polyvinyl ether, polyisobutylene, polystyrene, etc.

➤ **Mechanism of anionic addition polymerisation:** Initiated by strong bases such as  $\text{Na}^-\text{NH}_2^+$ ,  $\text{C}_4\text{H}_9\text{Li}$  and Grignard reagent, etc.



The carbanion thus so formed undergoes addition with number of monomers and finally terminates. e.g., polymerisation of acrylonitrile, vinyl chloride and methyl methacrylate, etc.

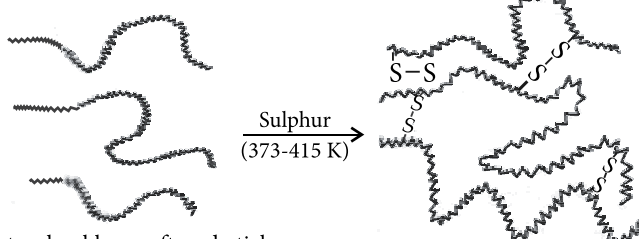
#### ➤ **Condensation (step-growth) polymerisation :**

These are formed by the condensation of two or more bifunctional monomer units with the elimination of simple molecules like  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{CO}_2$ , etc, e.g., formation of nylon, terylene and bakelite, etc.

## RUBBER

### Vulcanisation of rubber

It is the process of heating natural rubber with sulphur at a temperature of 373-415 K. Sulphur cross-links makes the rubber hard, tough with greater tensile strength. Some additives like carbon black, zinc oxide etc are used to improve wearing properties.



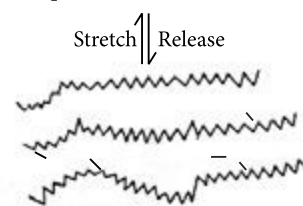
Natural rubber, soft and sticky  
No cross-links between the polymeric chains.

Vulcanised rubber: The hydrocarbon chains are held together by cross-linking chains of sulphur atoms.

### Natural rubber

It is a linear 1, 4-addition polymer of isoprene and have *cis*-configuration of all double bonds thus, known as *cis*-1, 4-polyisoprene.

- It is insoluble in water, dilute acids and alkalis but soluble in organic solvents like benzene, petrol etc.
- It has low elasticity and tensile strength.
- It has weak intermolecular van der Waals' forces.
- Its natural *trans*-isomer is *gutta-percha* which is non-elastic.



When stretched, the chains are straighten out, but they cannot slip past each other because of polysulphide bridges. Thus, rubber can be stretched only to a limited extent. When the tension is removed, the chains tend to coil up again and the rubber resumes its original shape.

## Rubber

### Synthetic rubber

It is obtained by polymerising certain organic compounds which may have properties similar to rubber and some additional desirable properties. Most of these polymers are derived from butadiene derivatives. These are also vulcanised. For example, neoprene, styrene butadiene rubber (SBR), thiokol, silicones, polyurethane rubber.

### Styrene Butadiene Rubber (SBR) or Buna-S

It is a polymer of buta-1,3-diene and styrene. It has less tensile strength than natural rubber.

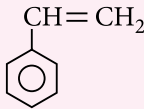
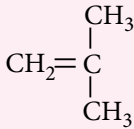
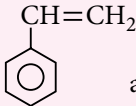
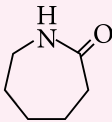
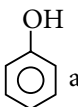
### Nitrile rubber or Buna-N

It is a polymer of buta-1,3-diene and acrylonitrile. It is resistant to the action of petrol, lubricating organic solvents, etc.

### Neoprene rubber

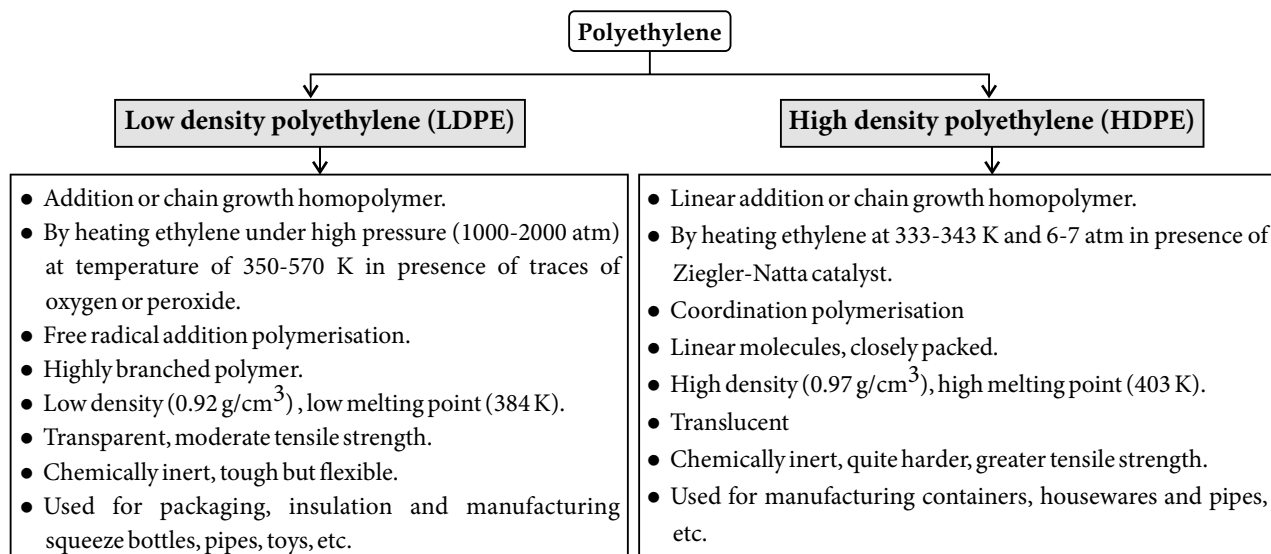
It is prepared by polymerisation of chloroprene. Neoprene is superior to natural rubber in its stability to aerial oxidation and its resistance to solvents.

### SOME IMPORTANT POLYMERS

Polymer	Structure of monomer	Structure of polymer	Uses
Polythene	$\text{CH}_2=\text{CH}_2$	$\text{-(CH}_2\text{-CH}_2\text{)}_n\text{-}$	As insulator, packing material, household and laboratory ware.
Polystyrene		$\text{-(CH(CH}_2\text{C}_6\text{H}_5\text{)-CH}_2\text{)}_n\text{-}$	As insulator, wrapping material, household articles and toys maker.
Polyvinyl chloride (PVC)	$\text{CH}_2=\text{CHCl}$	$\text{-(CH}_2\text{-CH(Cl))}_n\text{-}$	In manufacture of raincoats, hand bags, leather clothes and vinyl flooring.
Polytetrafluoro-ethylene (PTFE) or Teflon	$\text{CF}_2=\text{CF}_2$	$\text{-(CF}_2\text{-CF}_2\text{)}_n\text{-}$	As lubricant, insulator and making cooking wares.
Polyacrylonitrile (PAN) or Orlon	$\text{CH}_2=\text{CH-CN}$	$\text{-(CH}_2\text{-CH(CN))}_n\text{-}$	In making synthetic fibres and wool.
Butyl rubber		$\text{-(CH}_2\text{-C(CH}_3\text{)}_2\text{)}_n\text{-}$	Used in place of natural rubber in industry.
Neoprene	$\text{CH}_2=\text{C(Cl)-CH=CH}_2$	$\text{-(CH}_2\text{-C(Cl)=CH-CH}_2\text{)}_n\text{-}$	As insulator, making conveyor belts and printing rollers.
Styrene Butadiene Rubber (SBR) or (Buna-S)	 and $\text{CH}_2=\text{CH-CH=CH}_2$	$\text{-(CH}_2\text{-CH(C}_6\text{H}_5\text{)-CH}_2\text{-CH=CH-CH}_2\text{)}_n\text{-}$	In making automobile tyres, floor tiles, cable insulation and footwear.
Nitrile rubber (Buna-N)	$\text{CH}_2=\text{CHCN}$ and $\text{CH}_2=\text{CH-CH=CH}_2$	$\text{-(CH(CN)-CH}_2\text{-CH}_2\text{-CH=CH-CH}_2\text{)}_n\text{-}$	In making oil seals, hose-pipes and tank linings.
Nylon-6 (Perlon-L)		$\text{-(C(=O)-(CH}_2\text{)}_5\text{-NH)}_n\text{-}$	In making carpets, ropes and tyre cords.
Nylon-6, 6	$\text{HOOC-(CH}_2\text{)}_4\text{-COOH}$ and $\text{H}_2\text{N-(CH}_2\text{)}_6\text{-NH}_2$	$\text{-(CO-(CH}_2\text{)}_4\text{-CONH-(CH}_2\text{)}_6\text{-NH)}_n\text{-}$	Synthetic fibres, fishing nets, ropes and tyre industries.
Terylene (Dacron)	$\text{HOOC-C}_6\text{H}_4\text{-COOH}$ and $\text{HOCH}_2\text{CH}_2\text{OH}$	$\text{-(O-CH}_2\text{-CH}_2\text{-O-C(=O)-C}_6\text{H}_4\text{-C(=O))}_n\text{-}$	Synthetic fibres, safety belts, tyre cords and tents.
Bakelite (Phenol-formaldehyde resin)	 and $\text{HCHO}$	$\text{-(C}_6\text{H}_4\text{(OH)-CH}_2\text{-C}_6\text{H}_4\text{(OH)-CH}_2\text{)}_n\text{-}$	In making gears, protective coatings and electric fittings.



## POLYETHYLENES



### MOLECULAR MASS OF POLYMER

↪ Number average molecular mass,  $\bar{M}_n = \frac{\sum N_i M_i}{\sum N_i}$

↪ Weight average molecular mass,  $\bar{M}_w = \frac{\sum N_i M_i^2}{\sum N_i M_i}$

↪ The ratio of weight average molecular mass to number average molecular mass is called *polydispersity index* (PDI).

↪ Natural fibres usually have PDI equal to 1 while synthetic fibres usually have PDI > 1

## INFOSHOTS

### Macromolecules: Light to design precision polymers

Chemists of Karlsruhe Institute of Technology (KIT) have succeeded in specifically controlling the setup of precision polymers by light-induced chemical reactions. The new method allows for the precise, planned arrangement of the chain links, *i.e.* monomers, along polymer chains of standard length. The precisely structured macromolecules develop defined properties and may possibly be suited for use as storage systems of information or synthetic biomolecules. Chemical reactions may be triggered by light at room temperature. This effect was used by KIT scientists to specifically linked molecules to defined polymer chains under light. In many conventional processes, polymer chains of variable length are produced. The building blocks are arranged randomly along the chain, they wanted to develop a light-induced method for polymer structuring, which reaches the precision of nature. The models in nature, *e.g.* proteins, have an exactly defined structure. The new, light-induced synthesis method allows for customised molecule design, with the building blocks being arranged at the positions desired similar to a string of coloured pearls. By controlling the structure of the molecule, the so-called sequence, properties of macromolecules can be controlled. Sequence-defined polymers might also be used as molecular data and information storage systems. Information might be encoded by the sequence of monomers, similar to the genetic information of the DNA. The developers expect the fundamental method to become a tool for chemists, biologists, and material scientists and to be the key to future macromolecular chemistry.

## CHEMISTRY IN EVERYDAY LIFE

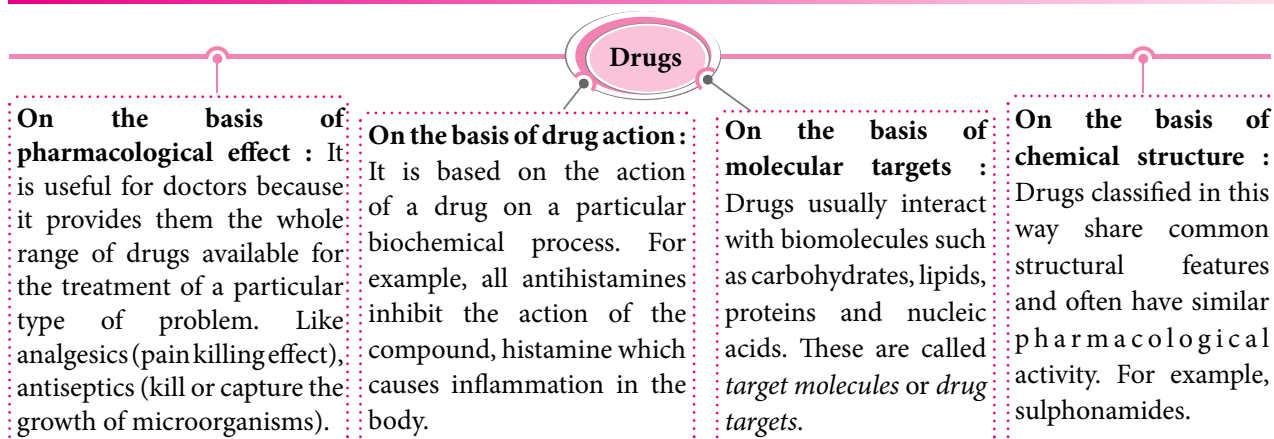
### CHEMICALS IN MEDICINES

↪ Contribution of chemistry over the last two centuries towards the eradication of diseases forms perhaps the most interesting and useful era in the history of mankind. The substances used in the

prevention, treatment or alleviation of diseases are called *drugs* or *medicines*.

↪ The use of these chemicals (drugs) to injure or destroy infectious micro-organisms without causing any injury to the host is known as *chemotherapy*.

### CLASSIFICATION OF DRUGS



## INFOSHOTS

### Artificial sweeteners can increase appetite

Researchers have revealed, for the first time, how artificial sweeteners can stimulate appetite in the brain. Billions of people worldwide consume artificial sweeteners and they are prescribed as a tool to treat obesity, despite little being known until now about their full impact on the brain and in regulating hunger. Researchers from the University of Sydney's Charles Perkins Centre and the Garvan Institute of Medical Research have identified a new system in the brain that senses and integrates the sweetness and energy content of food. After chronic exposure to a diet that contained the artificial sweetener sucralose, researcher's saw that animals began eating a lot more. Through systematic investigation of this effect, they found that inside the brain's reward centres, sweet sensation is integrated with energy content. When sweetness versus energy is out of balance for a period of time, the brain recalibrates and increases total calories consumed. When they investigated why animals were eating more even though they had enough calories, it is found that chronic consumption of this artificial sweetener actually increases the sweet intensity of real nutritive sugar, and this then increases the animal's overall motivation to eat more food. These findings further reinforce the idea that 'sugar-free' varieties of processed food and drink may not be as inert as we anticipated. Artificial sweeteners can actually change how animals perceive the sweetness of their food, with a discrepancy between sweetness and energy levels prompting an increase in caloric consumption.

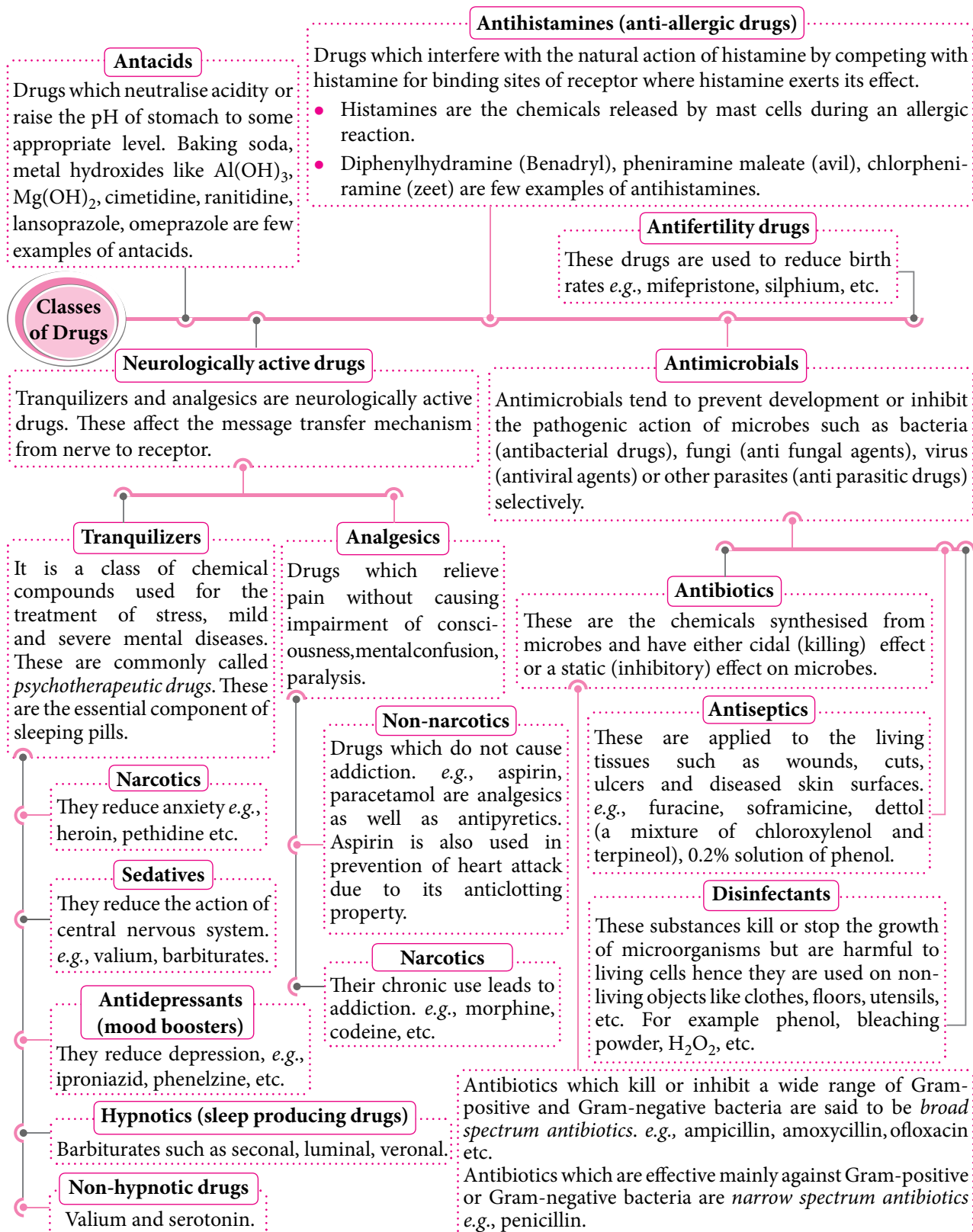
### DRUG-TARGET INTERACTION

↪ **Receptors as drug targets :** Proteins which transmit communication to the different parts of the body are called *receptors*. Receptor proteins are embedded in the cell membrane and receptor changes its shape to accommodate a chemical messenger which brings about transfer of message into the cell.

↪ **Drugs interact with receptors in two ways :**

- Drugs bind to their receptor sites and inhibit its natural function (**antagonists**). These are useful when blocking of message is required.
- Some drugs mimic the natural messenger by switching on the receptor (**agonists**). These are useful when there is lack of natural chemical messenger.

## THERAPEUTIC ACTION OF DIFFERENT CLASSES OF DRUGS



## CHEMICALS IN FOOD

- ↪ Chemicals which are added to food for their preservation or enhancing their appeal, flavour, etc. are known as *food additives*.
- ↪ **Food preservatives** : These are the chemical substances which are added to the food materials to prevent their spoilage and to retain their nutritive value for long periods.
  - These preservatives prevent the rancidity of food and inhibit the growth or kill the microorganisms.
  - The most common preservative used is sodium benzoate ( $C_6H_5COONa$ ).
- ↪ Certain food preservatives such as BHA and BHT used for edible oils also act as antioxidants.
- ↪ **Artificial sweetening agents** : These are chemical compounds which give sweetening effect to the food and enhance its odour and flavour.

Artificial sweetener	Sweetness value in comparison to cane sugar
Aspartame	100
Saccharin	550
Sucralose	600
Alitame	2000

- ↪ **Antioxidants** : These are the chemical substances which prevent oxidation and subsequent spoilage of the food by retarding the action of oxygen on food. They act as sacrificial materials as they are more reactive towards oxygen than the materials they are protecting. They also reduce the rate of involvement of free radicals in the ageing process.

## CLEANSING AGENTS

- ↪ **Soaps** : These are sodium or potassium salts of higher fatty acids (with 12-18 carbon atoms). e.g., salts of  $C_{15}H_{31}COOH$  (palmitic acid),  $C_{17}H_{35}COOH$  (stearic acid),  $C_{17}H_{33}COOH$  (oleic acid),  $C_{17}H_{31}COOH$  (linoleic acid), etc.
- ↪ **Soapless soaps or synthetic detergents** : These are sodium salts of long chain alkyl hydrogen sulphates or the sodium salts of long chain benzene sulphonic acids.

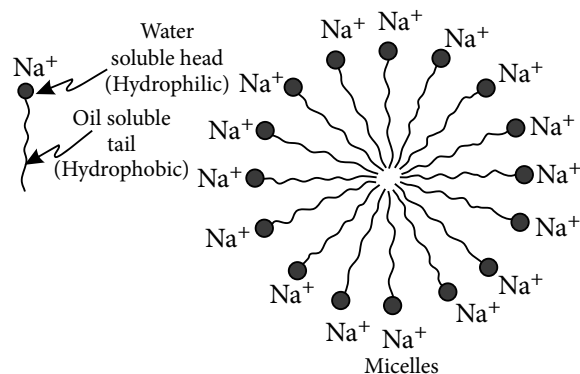
- **Cationic detergents** : These are quaternary ammonium salts of amines with acetates or halides as anions. e.g., trimethylstearyl ammonium chloride,  $CH_3(CH_2)_{17}\overset{+}{N}(CH_3)_3Cl^-$
- **Anionic detergents** : These contain anionic hydrophilic groups e.g., sodium lauryl sulphate,  $C_{12}H_{25}OSO_3Na^+$
- **Non-ionic detergents** : These are esters of high molecular mass and do not contain ions. e.g., polyethyleneglycol stearate,  $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$

### Advantages of synthetic detergents over soaps :

- They can be used in hard water, in acidic medium while soaps get precipitated.
- They are more soluble in water and thus, form lather more easily.
- They are stronger cleansing agents than soaps as they decrease the surface tension to greater extent.

### Cleansing action of soaps and detergents :

- The hydrophilic carboxylate group interact with water molecules while the hydrophobic long non-polar hydrocarbon chain does not interact.
- The hydrocarbon chains cluster together forming a structure called *micelles*.
- In the micelles, the carboxylate groups form a negatively-charged spherical surface, with the hydrocarbon chains inside the sphere.
- Being negatively charged, soap micelles repel each other and remain dispersed in water.



# SPEED PRACTICE

1. Given polymers : A = Nylon; B = Buna-S; C = Polythene. Arrange these in increasing order of their intermolecular forces (lower to higher).

- (a)  $A > B > C$       (b)  $B > C > A$   
 (c)  $B < C < A$       (d)  $C < A < B$

2. Which of the following can possibly be used as analgesic without causing addiction and modification?

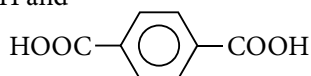
- (a) Morphine  
 (b) *N*-Acetyl-*para*-aminophenol  
 (c) Diazepam      (d) Tetrahydrocatechol

3. On complete hydrogenation, natural rubber produces

- (a) ethylene-propylene copolymer  
 (b) vulcanised rubber (c) polypropylene  
 (d) polybutylene.      (JEE Advanced 2016)

4. Which one of the following sets forms the biodegradable polymer?

- (a)  $\text{CH}_2=\text{CH}-\text{CN}$  and  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$   
 (b)  $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$  and  $\text{H}_2\text{N}-(\text{CH}_2)_5-\text{COOH}$   
 (c)  $\text{HO}-\text{CH}_2\text{CH}_2-\text{OH}$  and

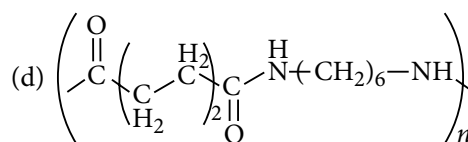
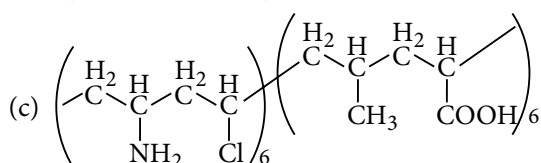
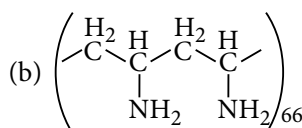
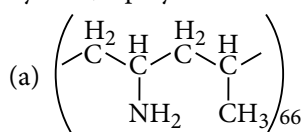


- (d) and  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$

5. Drugs which bind the receptor site and inhibit its natural function are called

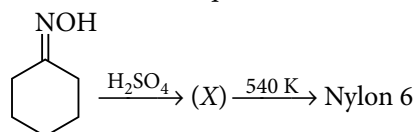
- (a) chemical messengers    (b) agonists  
 (c) antagonists      (d) neurotransmitters.

6. Which one of the following structures represents nylon 6, 6 polymer?



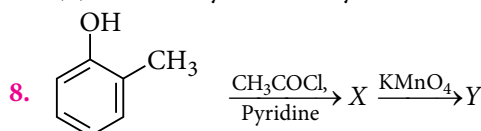
(NEET Phase-II 2016)

7. In the reaction sequence



(X) is

- (a) cyclohexanone    (b) caprolactum  
 (c) hexamethylene diamine  
 (d) hexamethylene diisocyanate.



The final product 'Y' is a medicine. Which of the following is incorrect regarding 'Y'?

- (a) It has analgesic as well as antipyretic properties.  
 (b) It helps to prevent heart attack.  
 (c) It has anti-blood clotting action.  
 (d) It suppresses the gastric anomalies.

9. Which of the following is an anionic detergent?

- (a) Sodium stearate  
 (b) Sodium lauryl sulphate  
 (c) Cetyltrimethyl ammonium bromide  
 (d) Glycerol oleate      (JEE Main 2016 Offline)

10. Which of the following is an analgesic?

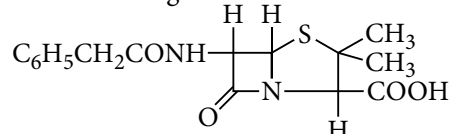
- (a) Streptomycin    (b) Chloromycetin  
 (c) Novalgin      (d) Penicillin

(NEET Phase-I 2016)

11. Super glue or Krazy glue is

- (a) poly methyl methacrylate  
 (b) poly ethyl acrylate  
 (c) poly methyl  $\alpha$ -cyanoacrylate  
 (d) poly ethyl methacrylate.

12. The structure given below is known as



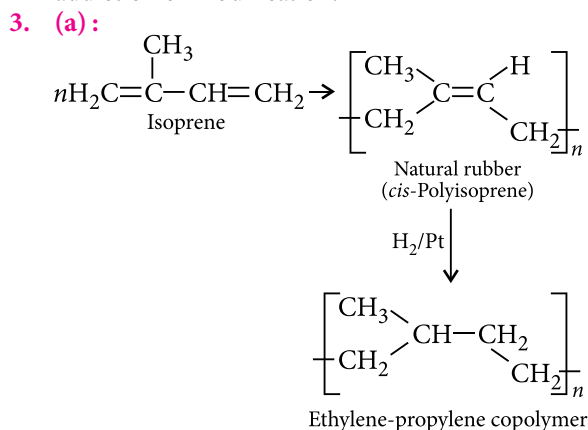
- (a) Penicillin F      (b) Penicillin G  
(c) Penicillin K      (d) Ampicillin.
13. Formation of polyethylene from calcium carbide takes place as follows :  
 $\text{CaC}_2 + 2\text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \text{C}_2\text{H}_2$   
 $\text{C}_2\text{H}_2 + \text{H}_2 \longrightarrow \text{C}_2\text{H}_4$   
 $n\text{C}_2\text{H}_4 \longrightarrow (-\text{CH}_2-\text{CH}_2-)_n$   
 Thus the amount of polyethylene obtained from 64 kg of  $\text{CaC}_2$  is  
 (a) 7 kg    (b) 14 kg    (c) 21 kg    (d) 28 kg
14. Alizarin dye obtained from the root of madder plant is anthraquinone derivative. Its structure corresponds to  
 (a) 1, 2-dihydroxy anthraquinone  
 (b) 2, 3-dihydroxy anthraquinone  
 (c) 1, 4-dihydroxy anthraquinone  
 (d) 1-hydroxy anthraquinone.
15. The mass average molecular mass and number average molecular mass of a polymer are 40,000 and 30,000 respectively. The polydispersity index of polymer will be  
 (a)  $< 1$     (b)  $> 1$     (c) 1    (d) 0
16. Which one of the following statements is not true?  
 (a) Buna-S is a copolymer of butadiene and styrene.  
 (b) Natural rubber is a 1, 4-polymer of isoprene.  
 (c) In vulcanisation, the formation of sulphur bridges between different chains make rubber harder and stronger.  
 (d) Natural rubber has the *trans* configuration at every double bond.
17. Which polymer is used in the manufacture of paints and lacquers?  
 (a) Polypropene      (b) Polyvinyl chloride  
 (c) Bakelite          (d) Glyptal  
 (JEE Main 2015 Offline)
18. Which artificial sweetener contains chlorine?  
 (a) Aspartame      (b) Saccharin  
 (c) Sucralose        (d) Alitame  
 (JEE Main 2015 Online)
19. The species which can best serve as an initiator for the cationic polymerisation is  
 (a)  $\text{HNO}_3$             (b)  $\text{AlCl}_3$   
 (c)  $\text{BuLi}$              (d)  $\text{LiAlH}_4$ .
20. Which of the following could act as a propellant for rockets?  
 (a) Liquid hydrogen + liquid nitrogen  
 (b) Liquid oxygen + liquid argon  
 (c) Liquid hydrogen + liquid oxygen  
 (d) Liquid nitrogen + liquid oxygen
21. Select the one that can be remelted without producing any change.  
 (a) Thermoplastic polymers  
 (b) Thermosetting polymers  
 (c) Bakelite  
 (d) Melamine formaldehyde polymer
22. Which among the following detergents is non-ionic in character?  
 (a) Sodium lauryl sulphate  
 (b) Pentaerythrityl stearate  
 (c) Cetyltrimethylammonium chloride  
 (d) Sodium *n*-dodecylbenzenesulphonate
23. Which one of the following is an example of thermosetting polymer?  
 (a)  $-(\text{CH}_2-\underset{\text{Cl}}{\text{C}}=\text{CH}-\text{CH}_2)_n-$   
 (b)  $-(\text{CH}_2-\underset{\text{Cl}}{\text{CH}})_n-$   
 (c)  $-(\text{N}-\underset{\text{H}}{\text{C}}(\text{H})-(\text{CH}_2)_6-\underset{\text{H}}{\text{N}}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_4-\overset{\text{O}}{\parallel}{\text{C}})_n-$   
 (d)  $(\text{C}_6\text{H}_3(\text{OH})_2-\text{CH}_2)_n$
24. Benzalkonium chloride is a  
 (a) cationic surfactant and antiseptic  
 (b) anionic surfactant and soluble in most of the organic solvents  
 (c) cationic surfactant and insoluble in most of the organic solvents  
 (d) cationic surfactant and antimalarial.
25. Which of the following pair of monomers are used in preparation of PHBV?  
 (a)  $\beta$ -Hydroxy butyric acid,  $\beta$ -hydroxy valeric acid  
 (b)  $\beta$ -Hydroxy valeric acid, Amino caproic acid  
 (c)  $\beta$ -Hydroxy butyric acid, Adipic acid  
 (d) Lactic acid, Adipic acid
26. The polymer melmac is obtained by  
 (a) addition polymerisation of melamine and formaldehyde  
 (b) condensation polymerisation of melamine and formaldehyde  
 (c) coordination polymerisation of melamine  
 (d) free-radical polymerisation of tetra-fluoroethylene.
27. If  $N_1, N_2, N_3, \dots, N_i$  are the number of molecules with molecular masses  $M_1, M_2, M_3, \dots, M_i$  respectively, then the weight average molecular mass ( $\bar{M}_w$ ) is expressed as

- (a)  $\frac{\sum N_i M_i^2}{\sum N_i M_i}$       (b)  $\frac{\sum N_i M_i}{\sum N_i}$   
 (c)  $\frac{\sum M_i^2}{\sum N_i}$       (d)  $\frac{\sum N_i M_i}{\sum M_i}$

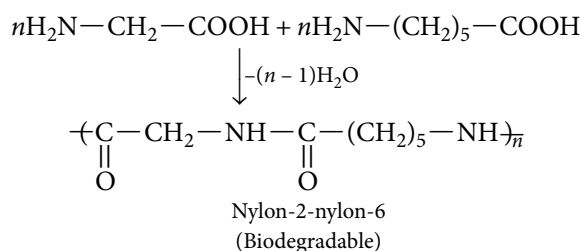
28. Which of the following statements is correct?  
 (a) Some tranquilisers function by inhibiting the enzymes which catalyse the degradation of noradrenaline.  
 (b) Tranquilisers are narcotic drugs.  
 (c) Tranquilisers are chemical compounds that do not affect the message transfer from nerve to receptor.  
 (d) Tranquilisers are chemical compounds that can relieve pain and fever.
29. The outer capsule of drugs is made up of a polymer of  
 (a) glycolic acid and lactic acid  
 (b) glycine and caproic acid  
 (c) salicylic acid and *p*-aminobenzoic acid  
 (d) 3-hydroxybutanoic acid and 3-hydroxypentanoic acid.
30. The role of phosphate in detergent powder is to  
 (a) control pH level of the detergent-water mixture  
 (b) remove  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions from the water that cause the hardness of water  
 (c) provide whiteness to the fabrics  
 (d) form solid detergents as phosphateless detergents are liquid in nature.

### SOLUTIONS

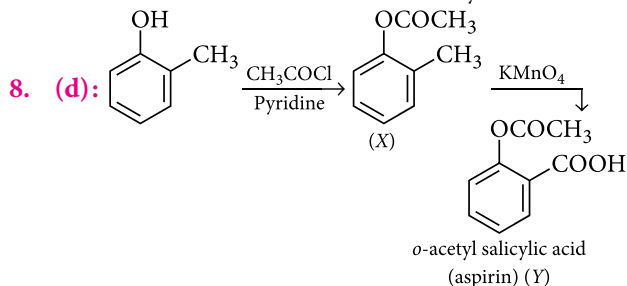
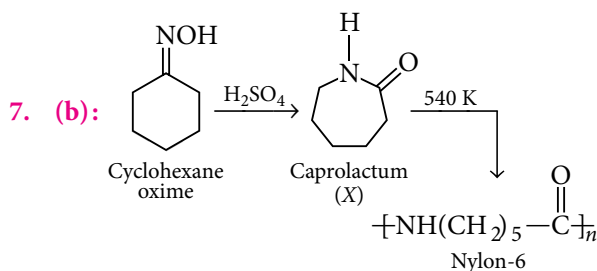
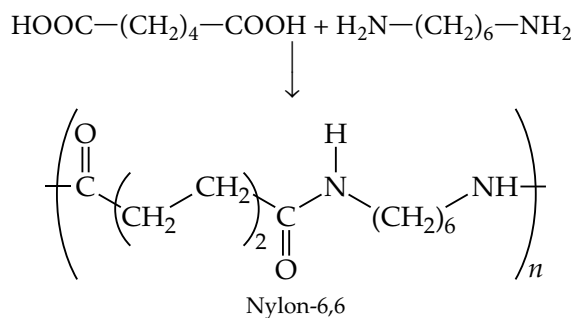
1. (c): Fibres have the strongest and elastomers have the weakest forces of attraction. Thus, option (c) is correct, i.e., B (Buna-S) < C (polythene) < A (nylon).
2. (b): *N*-Acetyl-*para*-aminophenol also called as paracetamol can be used as analgesic without causing addiction or modification.



4. (b): Monomers listed under option (b) form the biodegradable nylon-2-nylon-6 polymer.

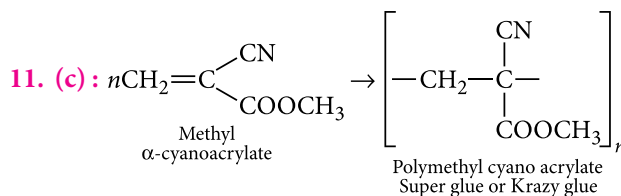


5. (c)  
 6. (d): Nylon 6,6 is obtained by condensing adipic acid ( $\text{HOOC}-(\text{CH}_2)_4-\text{COOH}$ ) with hexamethylenediamine ( $\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$ ).



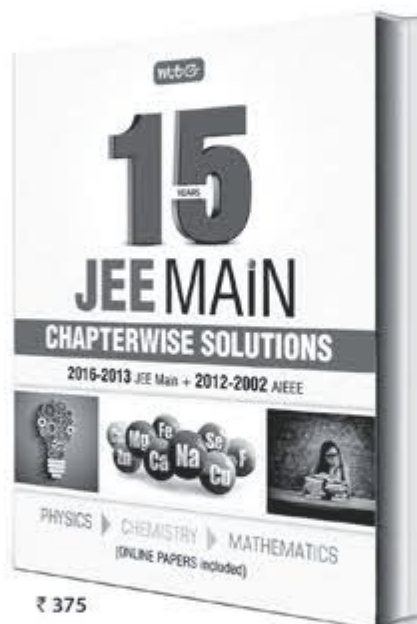
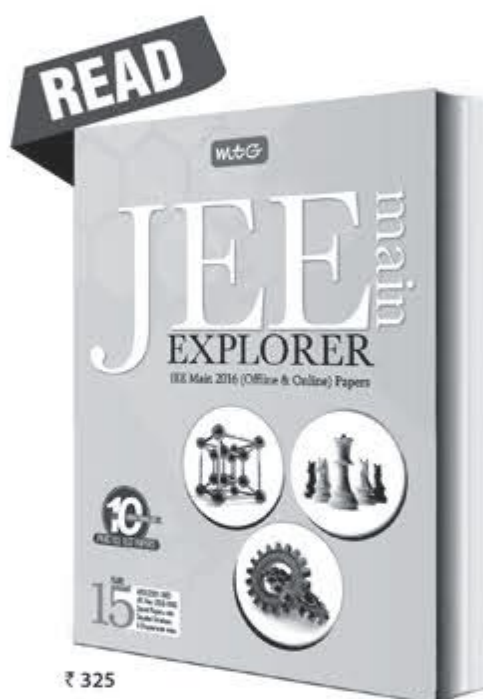
Aspirin does not suppress gastric anomalies.

9. (b): Sodium lauryl sulphate:  $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3^- \text{Na}^+$   
 10. (c): Streptomycin, chloromycetin and penicillin are antibiotics while novalgin is an analgesic.



12. (b): Benzylpenicillin is called Penicillin-G.

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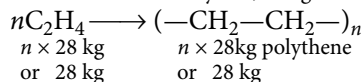
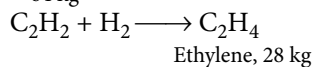
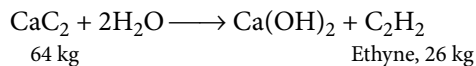


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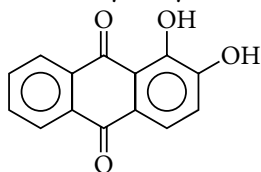


13. (d): The concerned chemical reactions are



Thus 64 kg of  $\text{CaC}_2$  gives 26 kg of acetylene which in turn gives 28 kg of ethylene whose 28 kg gives 28 kg of the polymer, polythene.

14. (a): Alizarin is 1, 2-dihydroxy anthraquinone *i.e.*,



15. (b): Number average molecular weight  $\bar{M}_n = 30,000$

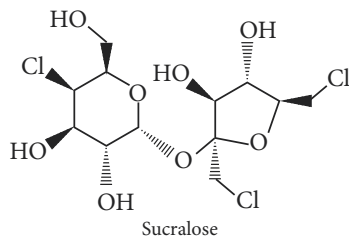
Mass average molecular weight  $\bar{M}_w = 40,000$

$$\text{Polydispersity index (PDI)} = \frac{\bar{M}_w}{\bar{M}_n} = \frac{40,000}{30,000} = 1.33$$

16. (d): Natural rubber has *cis*-configuration at each double bond while Gutta-Percha has *trans*-configuration at each double bond.

17. (d)

18. (c): Sucralose contains chlorine as it is trichloroderivative of sucrose.



19. (b): Cationic polymerisation is initiated by use of strong Lewis acids such as  $\text{H}_2\text{SO}_4$ , HF,  $\text{AlCl}_3$ ,  $\text{SnCl}_4$  or  $\text{BF}_3$  in  $\text{H}_2\text{O}$ .

20. (c): Liquid hydrogen (because of its low mass and high enthalpy of combustion) and liquid oxygen (as it is a strong supporter of combustion) are used as an excellent fuel for rockets.

21. (a): Thermoplastic polymers can be remelted without producing any change.

22. (b): Non-ionic detergents are esters of high molecular mass obtained by the reaction of alcohols with stearic acid.

Sodium laurylsulphate – Anionic detergent

Pentaerythryl stearate – Non-ionic detergent

Cetyltrimethylammonium chloride – Cationic detergent

Sodium *n*-dodecylbenzenesulphonate – Anionic detergent

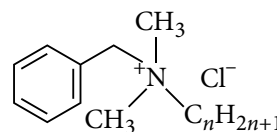
23. (d) : (a) - Neoprene rubber (elastomer)

(b) - PVC (thermoplastic polymer)

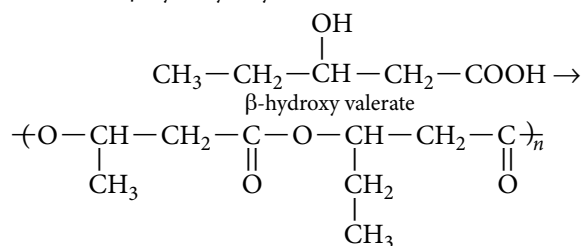
(c) - Nylon-6, 6 (fibre)

(d) - Novolac which further undergoes cross linking to produce bakelite (thermosetting polymer).

24. (a): Benzalkonium chloride, also known as alkyl-dimethylbenzylammonium chloride is nitrogenous cationic surface active agent belonging to the quaternary ammonium group. It is used as antiseptic.

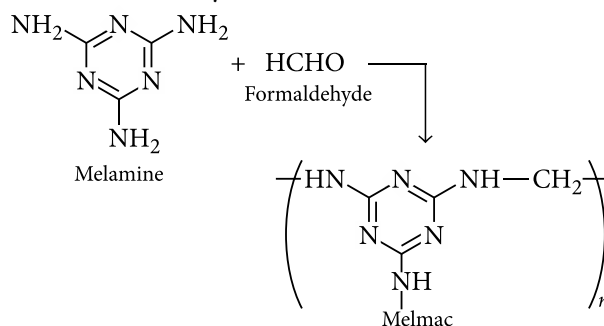


25. (a):  $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_2-\text{COOH} +$   
 $\beta$ -hydroxy butyric acid



PHBV

26. (b): Condensation polymerisation of melamine and formaldehyde.



27. (a):  $\bar{M}_w = \frac{\sum N_i M_i^2}{\sum N_i M_i}$

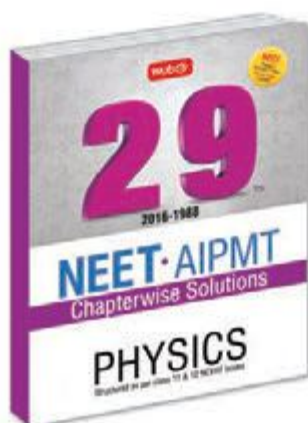
28. (a)

29. (d): 3-hydroxybutanoic acid and 3-hydroxypentanoic acid

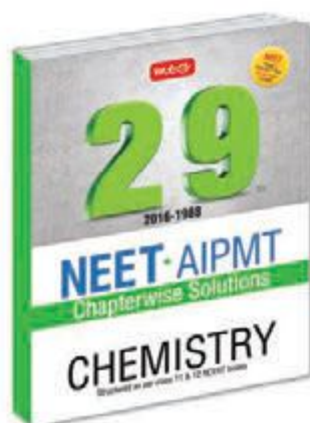
30. (b): The main use of sodium tripolyphosphate is to act as water softener by forming soluble complexes with  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions which cause hardness of water.



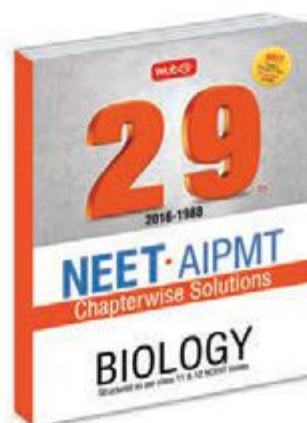
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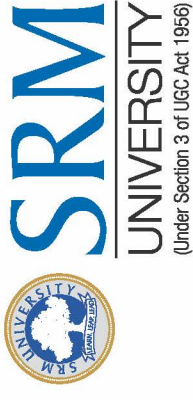


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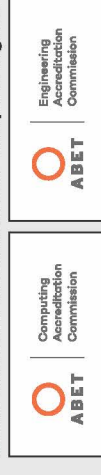
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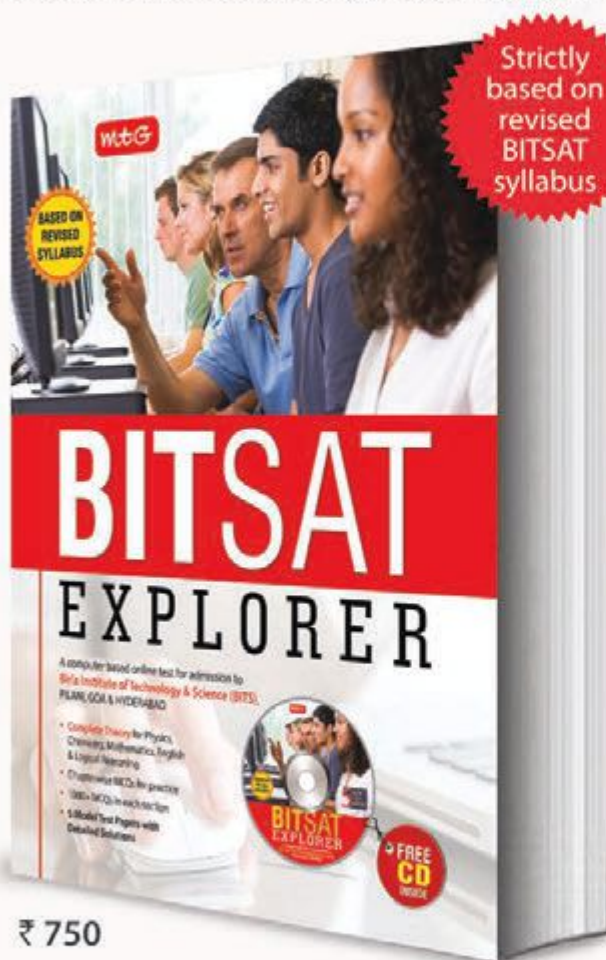
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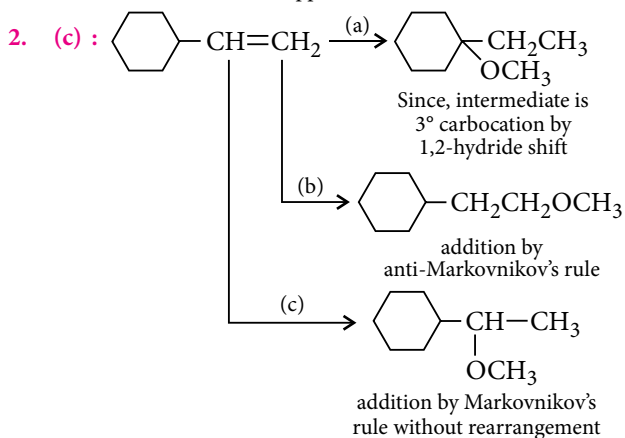
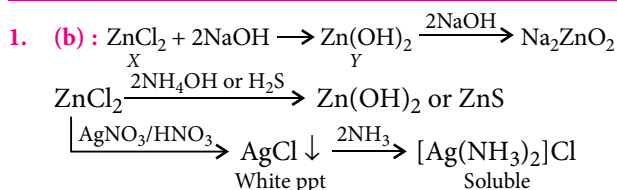
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# CHEMISTRY MUSING

## SOLUTION SET 42



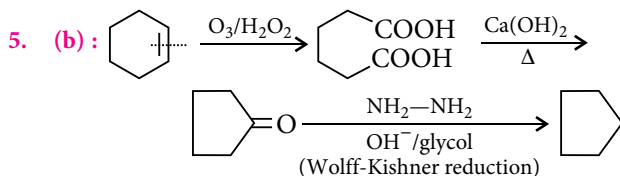
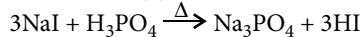
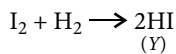
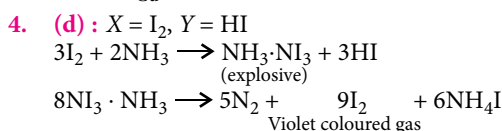
3. (c) : Number of equivalents of silver formed = number of equivalents of copper formed  
 In  $\text{AgNO}_3$ , Ag is in +1 oxidation state.  
 In  $\text{CuSO}_4$ , Cu is in +2 oxidation state.

$$\text{Equivalent weight of Ag} = \frac{108}{1} = 108 \text{ g eq}^{-1}$$

$$\text{Equivalent weight of Cu} = \frac{63.6}{2} = 31.8 \text{ g eq}^{-1}$$

$$\frac{\text{Mass of Ag deposited}}{\text{Mass of Cu deposited}} = \frac{\text{Eq. wt. of Ag}}{\text{Eq. wt. of Cu}}$$

$$\therefore \frac{10.79}{w_{\text{Cu}}} = \frac{108}{31.8} \text{ or } w_{\text{Cu}} = \frac{10.79 \times 31.8}{108} \approx 3.2 \text{ g}$$



6. (a) : We know for a first order reaction,

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$1.5 \times 10^{-6} = \frac{2.303}{10 \times 60 \times 60} \log \frac{a}{a-x}$$

$$\therefore \log \frac{a}{a-x} = \frac{1.5 \times 10^{-6} \times 10 \times 60 \times 60}{2.303} = 0.02344$$

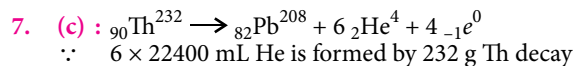
$$\text{or } \log \frac{a-x}{a} = -0.02344 \Rightarrow \frac{a-x}{a} = 0.9474$$

$$\text{Percentage of reactant remained} = \frac{a-x}{a} \times 100$$

$$= 0.9474 \times 100 = 94.74\%$$

$\therefore$  percentage of the initial concentration changed to product

$$= 100 - 94.74 = 5.26\%$$



$$\therefore 8 \times 10^{-5} \text{ mL He is formed by}$$

$$\frac{232 \times 8 \times 10^{-5}}{6 \times 22400} \text{ g Th decay} = 1.38 \times 10^{-7} \text{ g Th decay}$$

$$\text{At } t = t, \text{ sample has } 5 \times 10^{-7} \text{ g of Th} \propto N$$

$$\text{At } t = 0, \text{ sample had } 5 \times 10^{-7} + 1.38 \times 10^{-7} \text{ g of Th}$$

$$= 6.38 \times 10^{-7} \text{ g} \propto N_0$$

$$\text{For Th decay, } \therefore t = \frac{2.303}{\lambda} \log_{10} \frac{N_0}{N}$$

$$= \frac{2.303 \times 1.39 \times 10^{10}}{0.693} \log_{10} \frac{6.38 \times 10^{-7}}{5 \times 10^{-7}}$$

$$= 4.89 \times 10^9 \text{ year}$$



The energy produced during emission of two photons

$$= 2 \times m_e \times c^2 = 2 \times 9.108 \times 10^{-31} \times (3.0 \times 10^8)^2$$

$$= 163.9 \times 10^{-15} \text{ J}$$

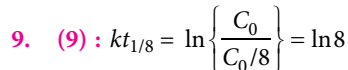
$$\therefore \text{Energy of one photon} = \frac{16.39 \times 10^{-14}}{2}$$

$$= 8.195 \times 10^{-14} \text{ J}$$

$$\text{Now, } E = \frac{hc}{\lambda}$$

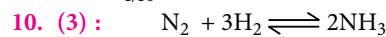
$$\text{or } 8.195 \times 10^{-14} = \frac{6.625 \times 10^{-34} \times 3.0 \times 10^8}{\lambda}$$

$$\text{or } \lambda = 2.425 \times 10^{-12} \text{ m} = 2.425 \text{ pm}$$



$$kt_{1/10} = \ln \left\{ \frac{C_0}{C_0/10} \right\} = \ln 10$$

$$\text{then } \frac{t_{1/8}}{t_{1/10}} \times 10 = \frac{\ln 8}{\ln 10} \times 10 = \frac{3 \log 2}{\log 10} \times 10 = 9$$



Initial mole	1	3	0
At eq.	$1-x$	$3-3x$	$2x$

$\therefore$  Out of 4 moles of mixture, 2 moles have reacted and hence 2 moles are left.

$$\therefore 1-x+3-3x=2 \text{ or } 4x=2 \text{ or } x=0.5$$

$$\therefore \text{Total moles at equilibrium} = 1-x+3-3x+2x = 4-2x = 4-2 \times 0.5 = 3$$

No. of mole(s) of  $\text{NH}_3$  at equilibrium  $2x = 2 \times 0.5 = 1$

$$\therefore P_{\text{NH}_3} = \frac{1}{3} \times P = \frac{P}{3} \therefore y = 3$$



In thermodynamics, interaction between large ensembles of objects are studied and categorized. Central to this are the concepts of system and surroundings. A system is composed of particles whose average motions define its properties. Properties can be combined to express internal energy and thermodynamic potentials.

## Thermodynamic terms

**Properties of system:** Physical quantities which are used to define the system.

## Thermodynamic processes

- If  $dq=0$ , process is adiabatic.
- If  $dT=0$  and  $dE=0$ , the process is isothermal.
- If  $dV=0$ , process is isochoric.
- If  $dP=0$ , process is isobaric.

Heat ( $q$ ) and heat capacity ( $C$ )

- Heat capacity,  $C = dq/dT$
  - $C_v = \left(\frac{\partial U}{\partial T}\right)_V$ ;  $C_p = \left(\frac{\partial H}{\partial T}\right)_P$
  - When  $n_1$  moles of gas A and  $n_2$  moles of gas B are mixed.
- $$(C_v)_{\text{mix}} = \frac{n_1 C_{v1} + n_2 C_{v2}}{n_1 + n_2}$$
- $C_p - C_v = nR$

Work ( $W$ )

- $W = -P_{\text{ext}}\Delta V$   
[irreversible isothermal expansion]
- $W = -2.303nRT \log(P_1/P_2)$
- $W = -2.303nRT \log(V_2/V_1)$   
[reversible isothermal expansion]
- $W = nC_v dT = \frac{nR}{\gamma-1}(T_2 - T_1)$   
[reversible adiabatic expansion]  
where,  $\gamma = C_p/C_v$
- $W = -P_{\text{ext}}R \left(\frac{T_2 P_1 - T_1 P_2}{P_1 P_2}\right)$   
[irreversible adiabatic expansion]

## Bond enthalpy

It is the enthalpy change accompanying the breaking of one mole of covalent bonds.

$$\text{Bond enthalpy} = \sum \text{Bond enthalpies of reactants} - \sum \text{Bond enthalpies of products}$$

**Intensive:** These do not depend upon quantity of matter. e.g.,  $T, P$ .

**Extensive:** These depend upon quantity of matter. e.g., mass, volume, energy.

Enthalpy ( $H$ )

Total heat of the system

- $H = U + PV$
- $\Delta H = \Delta U + P\Delta V = C_p \Delta T$   
 $= \Delta U + \Delta n_g RT$  (at constant pressure)
- $\Delta H = \sum H_{\text{product}} - \sum H_{\text{reactant}}$   
 $= -ve$  (exothermic)  
 $= +ve$  (endothermic)

Gibbs Free Energy ( $G$ )

Useful work done by the system

- $G = H - TS$
- $\Delta G = \Delta H - T\Delta S$   
(Gibbs - Helmholtz equation)
- $\Delta G^\circ = \sum G_f^\circ(\text{product}) - \sum G_f^\circ(\text{reactant})$
- $\Delta G^\circ = -2.303 RT \log K_{eq}$
- If  $\Delta G = +ve$  (Non-spontaneous)
- If  $\Delta G = -ve$  (Spontaneous)

Enthalpy of combustion,  $\Delta_c H$ 

It is the enthalpy change when 1 mole of a substance burnt completely in air.

## Hess's law of constant heat summation

$$\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$$

## Enthalpy change of a reaction

It is the enthalpy change when a given reactant reacts completely.

## Enthalpy of formation

It is the enthalpy change occurring during the formation of 1 mole of a substance from its elements.

## Enthalpy of solution

$$\Delta_{\text{sol}} H = \Delta_{\text{lattice}} H + \Delta H_{\text{hyd}}$$

where,  $\Delta_{\text{lattice}} H = S + I + \frac{1}{2}D - \Delta_f H + E.A.$

## Thermodynamic laws

**Zerth law:** System in thermal equilibrium with each other have same temperature.

**First law:** The total energy of the universe remains constant although it may undergo transformation from one form to the other.

$$\Delta U = q + w \quad (\Delta U = \text{internal energy})$$

**Second law:** In a spontaneous process total energy of the universe increases.

$$\Delta S_{\text{universe}} = \Delta S_{\text{system}} + \Delta S_{\text{surrounding}} > 0$$

Entropy ( $S$ )

Measure of randomness or disorder

- $\Delta S = \frac{q_{\text{rev}}}{T}$  (reversible process)
- $\Delta S = 2.303n C_v \log\left(\frac{T_2}{T_1}\right) + 2.303nR \log\left(\frac{V_2}{V_1}\right)$
- $\Delta S = 2.303n C_p \log\left(\frac{T_2}{T_1}\right) + 2.303nR \log\left(\frac{P_1}{P_2}\right)$
- $\Delta S = 2.303nR \log\left(\frac{V_2}{V_1}\right)$  } Isothermal
- $\Delta S = 2.303nR \log\left(\frac{P_1}{P_2}\right)$  }
- $\Delta S = 2.303n C_p \log\left(\frac{T_2}{T_1}\right)$  [isobaric]

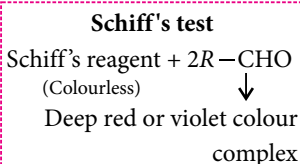
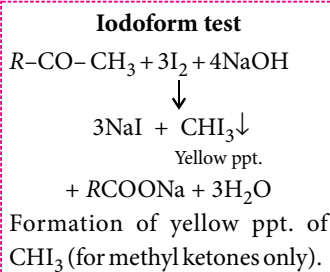
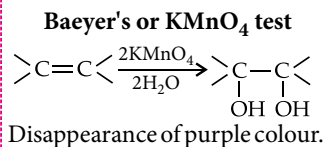
## Third law

- Entropy of all pure crystals is zero at the absolute zero temperature.
- $\lim_{T \rightarrow 0} S = 0$
- Residual Entropy  
 $S_R = k \ln W$   
( $W$  = thermodynamic probability)

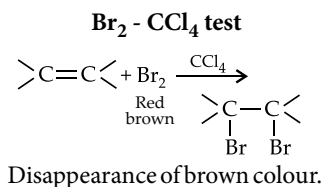
Functional groups are the specific groups of atoms within molecules that have characteristic properties regardless of the other atoms present in a molecule. The identification of functional groups and the ability to predict reactivity based on functional group properties is one of the cornerstones of organic chemistry.

## Detection of functional group

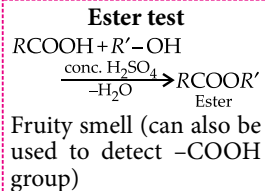
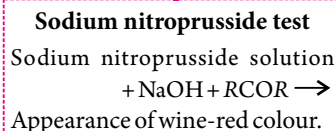
## Detection of unsaturation



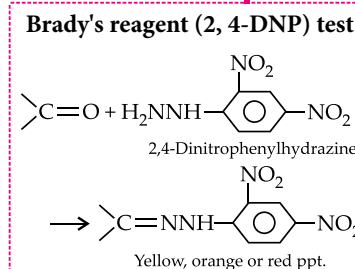
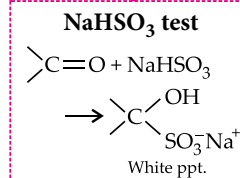
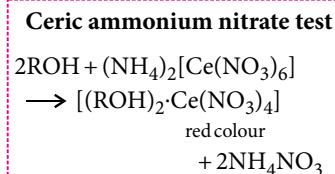
## Detection of carbonyl group



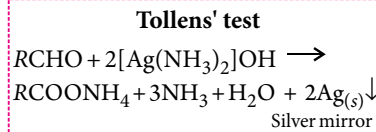
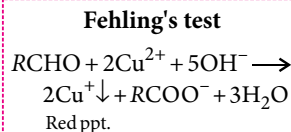
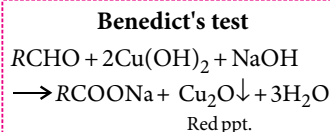
## Ketonic group



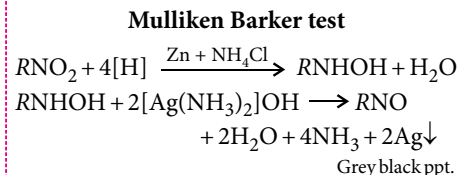
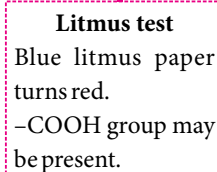
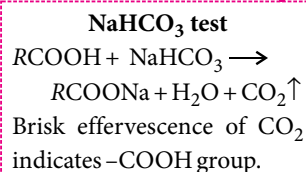
## Detection of alcoholic group



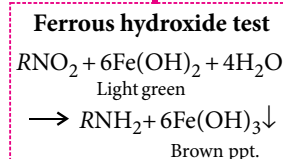
## Aldehydic group



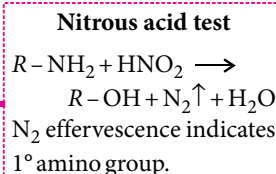
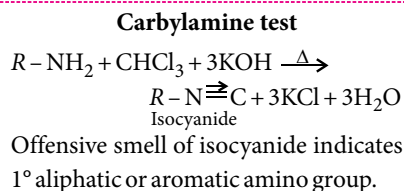
## Detection of carboxylic group



## Detection of nitro group



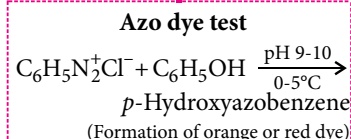
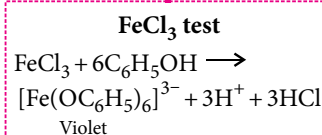
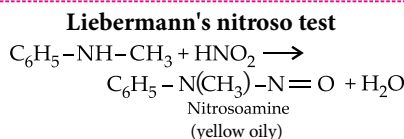
## Primary amine



## Detection of amino group

## Detection of phenolic group

## Secondary amine



CLASS XI

ACE

YOUR WAY

CBSE

Practice Paper 2017

Time Allowed : 3 hours  
Maximum Marks : 70

## GENERAL INSTRUCTIONS

- All questions are compulsory.
- Questions on every short answer question carry marks.
- Questions on the short answer questions carry marks.
- Questions on the short answer questions carry marks.
- Questions on the short answer questions carry marks.
- Questions on the long answer questions carry marks.
- Use of the calculator is not allowed.

- Arrange the following elements in the increasing order of non-metallic character.  
B, C, Si, N, F
  - CO<sub>2</sub> is heavier than N<sub>2</sub> and O<sub>2</sub> gases present in the atmosphere, yet it does not form the lower layer of the atmosphere. Why?
  - What happens when lead(II) chloride reacts with Cl<sub>2</sub>?
  - What would be the SI unit for the quantity  $pV^2T^2/n$ ?
  - The enthalpy of atomisation for the reaction  $\text{CH}_{4(g)} \rightarrow \text{C}_{(g)} + 4\text{H}_{(g)}$  is 1665 kJ mol<sup>-1</sup>. What is the bond energy of C—H bond?
  - How many atoms and molecules of sulphur are present in 64.0 g of sulphur (S<sub>8</sub>)?
  - A balloon filled with an ideal gas is taken from the surface of the sea deep to a depth of 100 m. What will be its volume in terms of its original volume?
- OR**
- 1 mole of sulphur dioxide occupies a volume of 350 mL at 27°C and  $5 \times 10^6$  Pa pressure. Calculate the compressibility factor of the gas. Is it more compressible than an ideal gas?
- A swimmer coming out from a pool is covered with a film of water weighing about 18 g. How much heat must be supplied to evaporate this water at 298 K? Calculate the internal energy of vaporisation at 100°C. ( $\Delta_{\text{vap}}H^\circ$  for water at 373 K = 40.66 kJ mol<sup>-1</sup>).
  - Why does presence of a nitro group make the benzene ring less reactive in comparison to the unsubstituted benzene ring? Explain.
  - Which out of NH<sub>3</sub> and NF<sub>3</sub> has higher dipole moment and why?
  - If 4 g of NaOH dissolves in 36 g of H<sub>2</sub>O, calculate the mole fraction of each component in the solution. Also, determine the molarity of solution (specific gravity of solution is 1 g mL<sup>-1</sup>).
  - (i) The energy associated with the first orbit in the hydrogen atom is  $-2.18 \times 10^{-18}$  J atom<sup>-1</sup>. What is the energy associated with the fifth orbit?  
(ii) Calculate the radius of Bohr's fifth orbit for hydrogen atom.
  - Arrange the following as stated.  
(i) Increasing order of bond dissociation energy of N<sub>2</sub>, O<sub>2</sub>, F<sub>2</sub>, Cl<sub>2</sub>.



- (ii) Decreasing order of electropositive character of Cu, Fe, Mg.
- (iii) Increasing order of valency of nitrogen in  $\text{HNO}_3$ ,  $\text{HNO}_2$ ,  $\text{NO}_2$ .
14. (i) If the diameter of a carbon atom is 0.15 nm, calculate the number of carbon atoms which can be placed side by side in a straight line across length of scale of length 20 cm long.
- (ii) Which of the following orbitals are possible?  
1p, 2s, 2p and 3f
15. (i) Using molecular orbital theory, compare the bond energy and magnetic character of  $\text{O}_2^+$  and  $\text{O}_2^-$  species.
- (ii) Explain the shape of  $\text{BrF}_5$ .
16. Calculate the enthalpy change for the process  

$$\text{CCl}_{4(g)} \rightarrow \text{C}_{(g)} + 4\text{Cl}_{(g)}$$
 and calculate bond enthalpy of C—Cl in  $\text{CCl}_{4(g)}$ .  
 $\Delta_{vap}H^\circ(\text{CCl}_4) = 30.5 \text{ kJ mol}^{-1}$ ,  
 $\Delta_f H^\circ(\text{CCl}_4) = -135.5 \text{ kJ mol}^{-1}$ ,  
 $\Delta_a H^\circ(\text{C}) = 715.0 \text{ kJ mol}^{-1}$ ,  
 $\Delta_a H^\circ(\text{Cl}_2) = 242 \text{ kJ mol}^{-1}$ .  
 where  $\Delta_a H^\circ$  is enthalpy of atomisation.
17. The average concentration of  $\text{SO}_2$  in atmosphere over a city on a certain day is 10 ppm, when the average temperature is 298 K. Given that the solubility of  $\text{SO}_2$  in water at 298 K is 1.3653 mol/L and the  $\text{p}K_a$  of  $\text{H}_2\text{SO}_3$  is 1.92, estimate the pH of acid rain on that day.
18. Depict the galvanic cell in which the reaction,  

$$\text{Zn}_{(s)} + 2\text{Ag}^+_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + 2\text{Ag}_{(s)}$$
 takes place. Further show :  
 (i) which of the electrode is negatively charged,  
 (ii) the carriers of the current in the cell and  
 (iii) individual reaction at each electrode.
- OR**
- (i) Balance the following equations by the oxidation number method.  
 (a)  $\text{Fe}^{2+} + \text{H}^+ + \text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+} + \text{Fe}^{3+} + \text{H}_2\text{O}$   
 (b)  $\text{I}_2 + \text{NO}_3^- \rightarrow \text{NO}_2 + \text{IO}_3^-$
- (ii) Nitric acid is an oxidising agent and reacts with  $\text{PbO}$  but it does not react with  $\text{PbO}_2$ . Explain why?
19. The ionisation constant of phenol is  $1.0 \times 10^{-10}$ . What is the concentration of phenolate ion in 0.05 M solution of phenol? What will be its degree of ionisation if the solution is also 0.01M in sodium phenolate?
20. (i) Write one chemical reaction for the preparation of  $\text{D}_2\text{O}_2$ .
- (ii) Calculate the strength of 5 volume  $\text{H}_2\text{O}_2$  solution.
21. What happens when  
 (i) magnesium is burnt in air  
 (ii) quick lime is heated with silica  
 (iii) chlorine reacts with slaked lime  
 (iv) calcium nitrate is heated?
22. (i)  $\text{H}_2\text{C}=\overset{+}{\text{C}}\text{H}$  is more basic than  $\text{HC}\equiv\text{C}^-$ . Explain why?
- (ii) Which of the following ions is more stable? Use resonance to explain your answer.
- (A)  $\longleftrightarrow$  (B)
- (iii) Why does  $\text{SO}_3$  act as an electrophile?
23. Water is essential for life and we cannot imagine our life without it. Municipal and industrial discharge lead to water pollution. Organic wastes also create water pollution. Heavy metals from industries create lot of water pollution. Immersion of statues of Durga, Ganesha etc. create lot of water pollution. The RWA of Chitrangan Park decided not to put Durga statue into Yamuna river like every year. This step was highly appreciated by Delhi Govt. and NGO 'Save Yamuna Project'.
- (i) What should be done to reduce water pollution? Give three ways.
- (ii) What is the effect of water pollution?
- (iii) What is the threat for aquatic animals due to water pollution?
- (iv) What values are possessed by the RWA members of Chitrangan Park?
24. (i) An alkane  $\text{C}_8\text{H}_{18}$  is obtained as the only product on subjecting a primary alkyl halide to Wurtz reaction. On monobromination this alkane yields a single isomer of a tertiary bromide. Write the structure of alkane and the tertiary bromide.
- (ii) The relative reactivity of 1°, 2°, 3° hydrogens towards chlorination is 1 : 3.8 : 5. Calculate the percentage of all monochlorinated products obtained from 2-methylbutane.

**OR**

- (i) Predict the major product(s) of the following reactions and explain their formation.
- (a)  $\text{H}_3\text{C}-\text{CH}=\text{CH}_2 \xrightarrow[\text{HBr}]{(\text{Ph}\cdot\text{CO}\cdot\text{O})_2}$
- (b)  $\text{H}_3\text{C}-\text{CH}=\text{CH}_2 \xrightarrow{\text{HBr}}$
- (ii) How will you convert benzene into
- (a) *p*-nitrobromobenzene
- (b) *m*-nitrobromobenzene?
25. (i) Explain the following reactions :
- (a) Silicon is heated with methyl chloride at high temperature in the presence of copper;
- (b) Silicon dioxide is treated with hydrogen fluoride;
- (c) CO is heated with ZnO.
- (ii) Suggest a reason as to why CO is poisonous.
- OR**
- (i) Explain the following :
- (a) Gallium has higher ionisation enthalpy than aluminium.
- (b) Boron does not exist as  $\text{B}^{3+}$  ion.
- (c) Aluminium forms  $[\text{AlF}_6]^{3-}$  ion but boron does not form  $[\text{BF}_6]^{3-}$  ion.
- (ii) Which of the following is not hydrolysed by water and why?  
 $\text{BF}_3$ ,  $\text{BCl}_3$  and  $\text{BBr}_3$
26. (i) Why is nitric acid added to sodium extract before adding silver nitrate for testing halogens?
- (ii) An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

**OR**

- (i) An alkane has a molecular mass 72. Draw all its possible chain isomers and write their IUPAC names.
- (ii) Give three points of differences between inductive effect and resonance effect.

**SOLUTIONS**

1.  $\text{Si} < \text{B} < \text{C} < \text{N} < \text{F}$   
Increasing non-metallic character  $\rightarrow$
2. Gases possess the property of diffusion which is independent of the force of gravitation. As a result of diffusion, gases mix with each other and remain almost uniformly distributed in the atmosphere.

3. Reaction will not take place, because  $\text{Pb}^{2+}$  is more stable than  $\text{Pb}^{4+}$ .

$$4. \frac{pV^2T^2}{n} = \frac{(\text{Nm}^{-2})(\text{m}^3)^2(\text{K})^2}{\text{mol}} = \text{Nm}^4\text{K}^2 \text{mol}^{-1}$$

$$5. \text{CH}_{4(g)} \rightarrow \text{C}_{(g)} + 4\text{H}_{(g)}, \Delta H = + 1665 \text{ kJ mol}^{-1}$$

$$\text{Bond energy of (C-H) bond} = \frac{6}{4} \text{ kJ mol}^{-1} = 416.2 \text{ kJ mol}^{-1}$$

6. Molecular formula of sulphur =  $\text{S}_8$   
Molecular mass of sulphur ( $\text{S}_8$ ) =  $32 \times 8 = 256.0 \text{ u}$   
256 g of sulphur contain  $6.022 \times 10^{23}$  molecules  
 $\therefore$  64 g of sulphur will contain =  $\frac{6.022 \times 10^{23} \times 64}{256} = 1.506 \times 10^{23}$

1 molecule of sulphur ( $\text{S}_8$ ) contains 8 atoms of sulphur  
 $\therefore 1.506 \times 10^{23}$  molecules of sulphur will contain sulphur atoms =  $8 \times 1.506 \times 10^{23} = 1.2048 \times 10^{24}$  atoms.

7. Pressure at the surface = 76 cm of Hg  
 $= 76 \times 13.6 \text{ cm of H}_2\text{O}$   
 $= 1033.6 \text{ cm of H}_2\text{O} = 10.3 \text{ m of H}_2\text{O}$   
 $\therefore$  Pressure at 100 m depth =  $100 + 10.3 \text{ m} = 110.3 \text{ m}$   
Applying  $P_1V_1$  (at surface) =  $P_2V_2$  (At 100 m depth)  
 $10.3 \times V = 110.3 \times V_2$   
or  $V_2 = 0.093 V = 9.3\% \text{ of } V$

**OR**

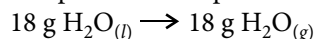
$$\text{Compressibility factor, } Z = \frac{pV}{nRT}$$

$$V = 350 \text{ mL}$$

$$\therefore Z = \frac{5 \times 10^6 \times 0.350 \times 10^{-3}}{1.0 \times 8.314 \times 300} = 0.702$$

Thus,  $\text{SO}_2$  is more compressible than an ideal gas as  $Z < 1$

8. The process of evaporation is :



$$\text{No. of moles in } 18 \text{ g H}_2\text{O} = \frac{18 \text{ g}}{18 \text{ g mol}^{-1}} = 1 \text{ mol}$$

$$\Delta n_g = 1 - 0 = 1$$

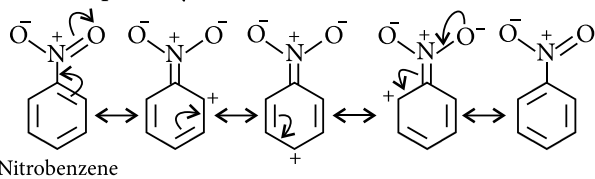
$$\therefore \Delta_{vap}U^\circ = \Delta_{vap}H^\circ - \Delta n_g RT$$

$$= 40.66 \text{ kJ mol}^{-1} - 1 \times (8.314 \times 10^{-3} \text{ kJ K}^{-1} \text{ mol}^{-1}) (373 \text{ K})$$

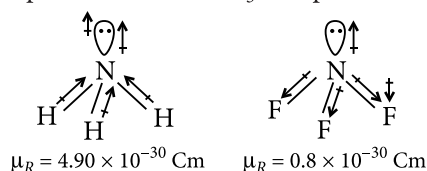
$$= 40.66 \text{ kJ mol}^{-1} - 3.10 \text{ kJ mol}^{-1}$$

$$= 37.56 \text{ kJ mol}^{-1}$$

9. Nitro group being an electron withdrawing group ( $-R$  and  $-I$  effects) deactivates the ring by decreasing nucleophilicity for further substitution.



10. In case of  $\text{NH}_3$  the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the  $\text{N}-\text{H}$  bonds whereas in  $\text{NF}_3$  the orbital dipole is in the direction opposite to the resultant dipole moment of the three  $\text{N}-\text{F}$  bonds. The orbital dipole because of lone pair decreases the effect of the resultant  $\text{N}-\text{F}$  bond moment which results in low dipole moment of  $\text{NF}_3$  as represented below :



11. Mole fraction of  $\text{H}_2\text{O}$

$$= \frac{\text{No. of moles of } \text{H}_2\text{O}}{\text{Total no. of moles (} \text{H}_2\text{O} + \text{NaOH)}} \\ n_{\text{H}_2\text{O}} = \frac{36}{18} = 2 \text{ moles}, n_{\text{NaOH}} = \frac{4}{40} = 0.1 \text{ mol} \\ \text{Total number of moles} = 2 + 0.1 = 2.1 \\ x_{\text{H}_2\text{O}} = \frac{2}{2.1} = 0.95, x_{\text{NaOH}} = \frac{0.1}{2.1} = 0.047 \\ \text{Mass of solution} = M_{\text{H}_2\text{O}} + M_{\text{NaOH}} = 36 + 4 = 40 \text{ g} \\ \text{Volume of solution} = \frac{40}{1} = 40 \text{ mL} \\ \therefore \text{Molarity} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in L}} \\ = \frac{0.1}{0.04 \text{ L}} = 2.5 \text{ M}$$

12. (i) Energy associated with  $n^{\text{th}}$  orbit in hydrogen atom is

$$E_n = \frac{-2.18 \times 10^{-18}}{n^2} \text{ J atom}^{-1}$$

$\therefore$  Energy associated with  $5^{\text{th}}$  orbit is

$$E_5 = \frac{-2.18 \times 10^{-18}}{5^2} = -8.72 \times 10^{-20} \text{ J atom}^{-1}$$

- (ii) Radius of Bohr's orbit for hydrogen atom,

$$r_n = 0.529 n^2 \text{ \AA}$$

$\therefore$  Radius of Bohr's fifth orbit for H-atom

$$r_5 = 0.529 \times 5^2 \text{ \AA} = 13.255 \text{ \AA} = 1.3225 \text{ nm}$$

13. (i) As the size of atom decreases and multiplicity of bond increases, bond dissociation energy increases. On the other hand, due to small size and high electronegativity of F-atom, bond dissociation energy of  $\text{F}_2$  is smaller than  $\text{Cl}_2$ . Thus, the correct order is

$$\text{F}_2 < \text{Cl}_2 < \text{O}_2 < \text{N}_2 \\ 155 \quad 242 \quad 494 \quad 941 \text{ kJ/mol}$$

- (ii) As the electronegativity increases, electropositive character decreases. Since the electronegativities of  $\text{Mg}(1.2) < \text{Fe}(1.8) < \text{Cu}(1.9)$ , therefore electropositive character decrease in the order :  $\text{Mg} > \text{Fe} > \text{Cu}$

- (iii) Valency of N in  $\text{HNO}_3 = +5$

Valency of N in  $\text{HNO}_2 = +3$

Valency of N in  $\text{NO}_2 = +4$

Hence, the order of valency of N is

$\text{HNO}_2 < \text{NO}_2 < \text{HNO}_3$ .

14. (i) A carbon atom covers length = diameter of atom =  $0.15 \text{ nm} = 0.15 \times 10^{-7} \text{ cm}$

$\therefore$  Number of carbon atoms which can be placed on  $20 \text{ cm}$  length

$$= \frac{20}{0.15 \times 10^{-7}} = 1.33 \times 10^9$$

- (ii) For a particular value of  $n$ , the allowed values of  $l$  are  $0$  to  $n - 1$  only. Hence,  $2s$  and  $2p$  are the only possible orbitals.

15. (i)  $\text{O}_2^+(15) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2$   
 $= \pi 2p_y^2, \pi^* 2p_x^1$

$$\text{B.O.} = \frac{1}{2} (10 - 5) = 2.5$$

$$\text{O}_2^-(17) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2$$

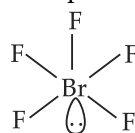
$$= \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$$

$$\text{B.O.} = \frac{1}{2} (10 - 7) = 1.5$$

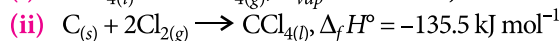
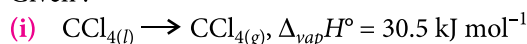
Bond energy of  $\text{O}_2^+ > \text{O}_2^-$ .

Both are paramagnetic due to presence of unpaired electrons.

- (ii) Structure of  $\text{BrF}_5$  is square pyramidal with one unshared pair of electrons.

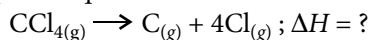


16. Given :



- (iii)  $C_{(s)} \rightarrow C_{(g)}, \Delta_a H^\circ = 715.0 \text{ kJ mol}^{-1}$   
 (iv)  $Cl_{2(g)} \rightarrow 2Cl_{(g)}, \Delta_a H^\circ = 242 \text{ kJ mol}^{-1}$

Required equation is :



From Hess's law,

eqn.(iii) + 2 × eqn.(iv) – eqn.(i) – eqn.(ii) gives required equation :

$$\therefore \Delta H = 715.0 + 2(242) - 30.5 - (-135.5) = 1304 \text{ kJ mol}^{-1}$$

Bond enthalpy of C–Cl in  $CCl_4$  (average

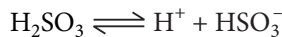
$$\text{value}) = \frac{1304}{4} = 326 \text{ kJ mol}^{-1}$$

17. Amount of  $SO_2$  in atmospheres = 10 ppm =  $\frac{10}{10^6} = 10^{-5}$

Molar conc. of  $SO_2$  in presence of water

= amount of  $SO_2$  × solubility of  $SO_2$  in water

$H_2SO_3$  dissociates at  $1.3653 \times 10^{-5} \text{ mol/L}$



Initial conc.	$1.3653 \times 10^{-5}$	0	0
Molar conc. at equilibrium	$(1.3653 \times 10^{-5} - x)$	x	x

$$K_a = \frac{x^2}{(1.3653 \times 10^{-5} - x)} \quad \dots(i)$$

$$pK_a = 1.92$$

$$\therefore -\log K_a = 1.92 \text{ or } K_a = 1.2 \times 10^{-2}$$

$$\text{From eqn. (i) } 1.2 \times 10^{-2} = \frac{x^2}{(1.3653 \times 10^{-5} - x)}$$

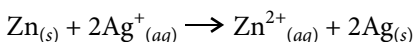
$$x^2 = 1.2 \times 10^{-2} (1.3653 \times 10^{-5} - x)$$

On solving, we get

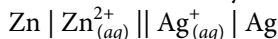
$$x = 1.3664 \times 10^{-5}$$

$$\therefore \text{pH} = -\log (1.364 \times 10^{-5}) = 4.865$$

18. The given redox reaction is



Since Zn gets oxidised to  $Zn^{2+}$  ions, and  $Ag^+$  gets reduced to Ag metal, therefore, oxidation occurs at zinc electrode and reduction occurs at the silver electrode. Thus, galvanic cell corresponding to the above redox reaction may be depicted as :

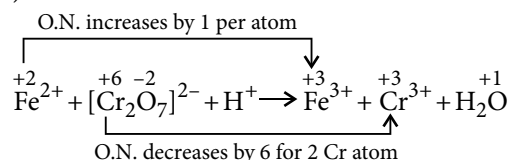


- (i) Since oxidation occurs at the zinc electrode, therefore, electrons accumulate on the zinc electrode and hence, zinc electrode is negatively charged.  
 (ii) The ions carry current. The electrons flow from Zn to Ag electrode while the current flows from Ag to Zn electrode.

- (iii) The reactions occurring at the two electrodes are :  
 At anode :  $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$   
 At cathode :  $Ag^+_{(aq)} + e^- \rightarrow Ag_{(s)}$

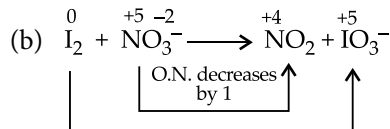
OR

(i) (a)



To balance increase and decrease of oxidation numbers, multiply  $Fe^{2+}$  by 6 and  $Cr_2O_7^{2-}$  by 1. Then we get  
 $6Fe^{2+} + Cr_2O_7^{2-} + H^+ \rightarrow Fe^{3+} + Cr^{3+} + H_2O$

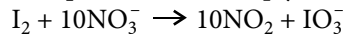
On counting and equating the atoms on both sides, we get the balanced equation as :



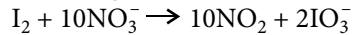
Total increase in O.N. =  $5 \times 2 = 10$

Total decrease in O.N. = 1

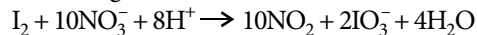
To equalise O.N. multiply  $NO_3^-$  by 10



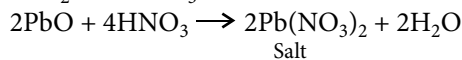
Balancing atoms other than O and H



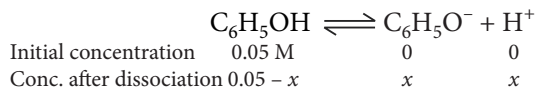
Balancing O and H



- (ii) Nitric acid is an oxidising agent and reacts with PbO to give a simple acid base reaction without any change in oxidation state. In  $PbO_2$ , Pb is in +4 oxidation state and cannot be oxidised further, hence no reaction takes place between  $PbO_2$  and  $HNO_3$ .



19.



$$\therefore K_a = \frac{x \times x}{0.05 - x} = 1.0 \times 10^{-10}$$

$$\text{or } \frac{x^2}{0.05} = 1.0 \times 10^{-10} \quad [\because 0.05 - x \approx 0.05]$$

$$\text{or } x^2 = 5 \times 10^{-12} \text{ or } x = 2.23 \times 10^{-6} \text{ M}$$

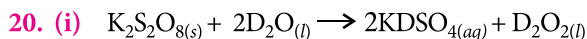
In presence of 0.01 M  $C_6H_5ONa$ , suppose  $y$  is the amount of phenol dissociated, then at equilibrium

$$[C_6H_5OH] = 0.05 - y \approx 0.05 \text{ M}$$

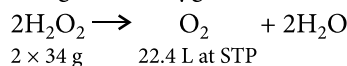
$$[C_6H_5O^-] = 0.01 + y \approx 0.01 \text{ M}, [H^+] = y \text{ M}$$

$$\therefore K_a = \frac{(0.01)(y)}{0.05} = 1.0 \times 10^{-10} \text{ or, } y = 5 \times 10^{-10}$$

$$\therefore \alpha = \frac{y}{C} = \frac{5 \times 10^{-10}}{0.05} = 1 \times 10^{-8}$$



(ii) 5 volume  $H_2O_2$  solution means 1 L of this  $H_2O_2$  will give 5 L oxygen at STP.

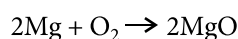


22.4 L of  $O_2$  is produced from 68 g of  $H_2O_2$

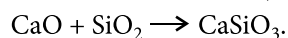
$$5 \text{ L of } O_2 \text{ is produced from } \frac{68 \times 5}{22.4} = 15.18 \text{ g of } H_2O_2$$

Hence, strength of 5 volume  $H_2O_2 = 15.18 \text{ g/L}$

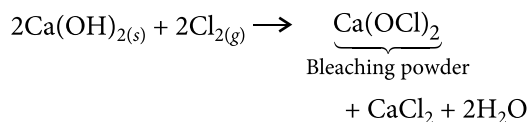
21. (i) Mg burns with dazzling brilliance evolving a lot of heat.



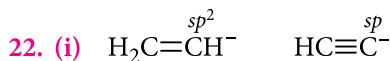
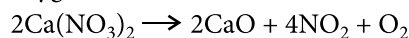
(ii) When quicklime ( $CaO$ ) is heated with silica, it forms calcium silicate ( $CaSiO_3$ ).



(iii) Chlorine reacts with slaked lime to give bleaching powder.



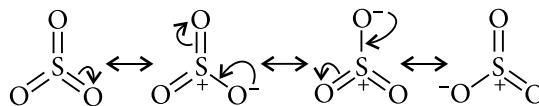
(iv) When calcium nitrate is heated, it decomposes to form calcium oxide, nitrogen dioxide and oxygen.



Since,  $sp$ -carbon is more electronegative than  $sp^2$ -carbon, therefore,  $HC\equiv C^-$  is less willing to donate a pair of electrons than  $H_2C=CH^-$ . That's why,  $H_2C=CH^-$  is more basic than  $HC\equiv C^-$ .

(ii) Structure (A) is more stable due to resonance. An endocyclic double bond is more stable than an exocyclic double bond.

(iii)  $SO_3$  acts as an electrophile because the highly electronegative oxygen atoms are attached to sulphur atom, hence S becomes electron deficient and acquires a positive charge due to resonance, hence  $SO_3$  acts as an electrophile.



23. (i) Ways written below can reduce water pollution.

(a) Do not allow MCD to dispose off waste in water.

(b) Immersion of statues of Durga, Ganesha should be banned.

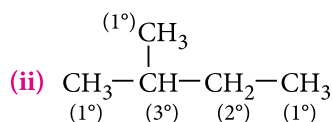
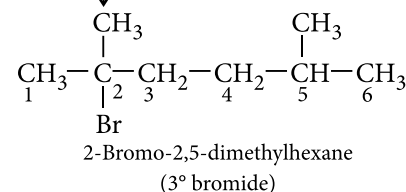
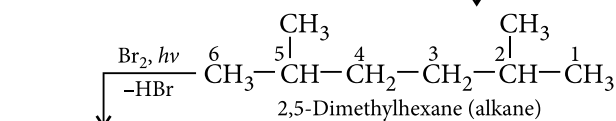
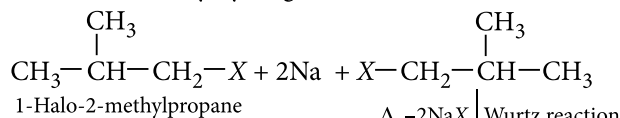
(c) People should not bath with soap in Yamuna and should not wash clothes.

(ii) It leads to waterborne diseases in animals as well as human beings.

(iii) Dissolved oxygen reduces in water due to pollution and aquatic animals cannot survive in polluted water.

(iv) They saved Yamuna from pollution and have concern for others.

24. (i) Since, alkane  $C_8H_{18}$  on monobromination yields a single isomer of a tertiary bromide, therefore alkane must contain tertiary hydrogen. This is possible if primary alkyl halide (which undergoes Wurtz reaction) has a tertiary hydrogen.



Relative amount of monochlorinated product  
 = Number of hydrogen  $\times$  relative reactivity  
 For (1°) monochlorinated product =  $9 \times 1 = 9$   
 (2°) monochlorinated product =  $2 \times 3.8 = 7.6$   
 (3°) monochlorinated product =  $1 \times 5 = 5$   
 Total amount of monochlorinated products  
 =  $9 + 7.6 + 5 = 21.6$

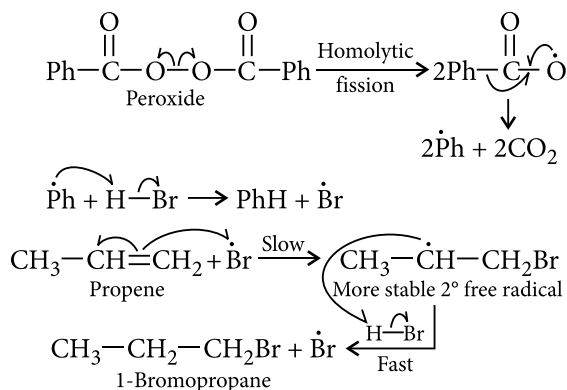
$$\% \text{ of } 1^\circ \text{ product} = \frac{9 \times 100}{21.6} = 41.67$$

$$\% \text{ of } 2^\circ \text{ product} = \frac{7.6 \times 100}{21.6} = 35.18$$

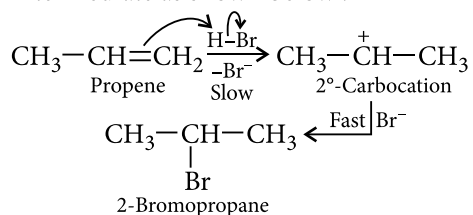
$$\% \text{ of } 3^\circ \text{ product} = \frac{5 \times 100}{21.6} = 23.15$$

OR

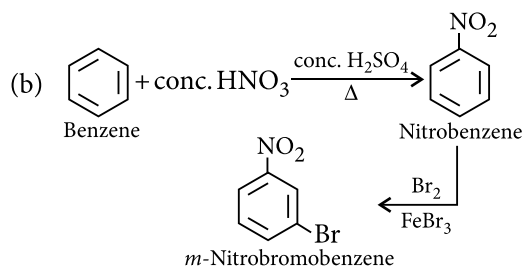
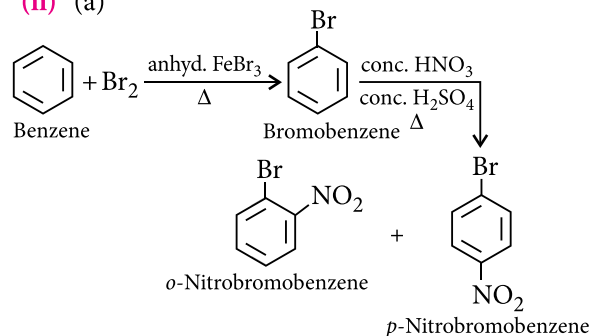
- (i) (a) In presence of peroxides, addition of HBr to propene follows anti-Markownikoff's rule and hence gives 1-bromopropane as the major product. The reaction occurs through a free radical mechanism *via* a more stable free radical intermediate as shown below:



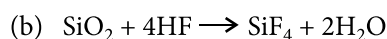
- (b) However, in absence of peroxides, addition of HBr to propene follows Markownikoff's rule and hence gives 2-bromopropane as the major product. The reaction occurs through ionic mechanism *via* the formation of more stable carbocation intermediate as shown below:



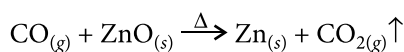
(ii) (a)



25. (i) (a)  $2\text{CH}_3\text{Cl} + \text{Si} \xrightarrow[573 \text{ K}]{\text{Cu powder}} (\text{CH}_3)_3\text{SiCl}_3 + (\text{CH}_3)_2\text{SiCl}_2 + (\text{CH}_3)_3\text{SiCl} + (\text{CH}_3)_4\text{Si}$



(c) CO is a powerful reducing agent, it reduces ZnO to Zn.



(ii) Carbon monoxide has a tendency to bind to haemoglobin (the oxygen carrying

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molecule in blood), forming a complex called carboxyhaemoglobin, which can seriously hamper the oxygen supply to different organs and ultimately can cause death. This is why CO is said to be so poisonous and dangerous.

OR

- (i) (a) In gallium, due to poor shielding of valence electrons by the intervening of  $3d$ -electrons, the nuclear charge becomes more effective, thus, atomic radius decreases and hence, the ionisation enthalpy of gallium is higher than that of aluminium.
- (b) Due to small size of boron, the sum of its first three ionisation enthalpies is very high. This prevents it to form  $+3$  ion and forces it to form only covalent compound. Thus boron does not exist as  $B^{3+}$  ion.
- (c) Aluminium forms  $[AlF_6]^{3-}$  ion because of the presence of vacant  $d$ -orbitals to which it can expand its coordination number from 4 to 6. On the other hand, boron does not form  $[BF_6]^{3-}$  ion, because of the unavailability of  $d$ -orbitals as it cannot expand its covalency beyond four.
- (ii)  $BF_3$  is not easily hydrolysed by water. It forms an adduct  $BF_3 \cdot OH_2$ . This is because the B—F bond in  $BF_3$  is very strong due to extensive  $p\pi-p\pi$  back bonding. However, in  $BCl_3$  and  $BBr_3$ , the corresponding B—Cl and B—Br bond energy is relatively less than B—F because of inefficient  $p\pi-p\pi$  back bonding. Therefore, these get hydrolysed to form boric acid and HCl or HBr.

26. (i) Halogens are detected by  $AgNO_3$  due to the formation of  $AgX$  ppt. But, if the Lassaigne's extract contains  $S^{2-}$  or  $CN^-$  ions due to the compound, then they may interfere in the test for halogens.  $CN^-$  and  $S^{2-}$  form  $AgCN$  and  $Ag_2S$  with  $AgNO_3$  and may produce erroneous results. Therefore, the Lassaigne's extract is treated with  $HNO_3$  to

decompose HCN and  $H_2S$  (vapours) so as to prevent interference.

- (ii) Given : % of C = 69 % of H = 4.8%  
% of O =  $100 - (69 + 4.8) = 26.2\%$   
Mass of compound = 0.2 g  
100 g of compound contains 69 g of C  
0.2 g of compound contains  $\frac{69 \times 0.2}{100} = 0.138$  g of C  
Also, 12 g of C produces 44 g of  $CO_2$   
 $\therefore$  0.138 g of C will give  
$$= \frac{44 \times 0.138}{12} = 0.506$$
 g of  $CO_2$   
100 g of compound contains 4.8 g of H  
 $\therefore$  0.2 g of compound contains  
$$\frac{4.8 \times 0.2}{100} = 0.0096$$
 g of H  
Also, 2 g of H produces 18 g of  $H_2O$   
 $\therefore$  0.0096 g of H produces  
$$\frac{18 \times 0.0096}{2} = 0.0864$$
 g of  $H_2O$

OR

- (i) Molecular formula of alkane is  $C_nH_{2n+2}$ .  
Molecular mass = 72  
 $\therefore 12n + 2n + 2 = 72$ . Thus,  $n = 5$   
The alkane is  $C_5H_{12}$ . The possible chain isomers are
- (a)  $CH_3-CH_2-CH_2-CH_2-CH_3$   
Pentane
- (b)  $CH_3-\underset{\substack{| \\ CH_3}}{CH}-CH_2-CH_3$   
2-Methylbutane
- (c)  $CH_3-\underset{\substack{| \\ CH_3}}{\overset{\substack{| \\ CH_3}}{C}}-CH_3$   
2,2-Dimethyl propane
- (ii) The main points of difference between inductive and resonance effects are given below.

	Inductive effect	Resonance effect
(i)	Uses $\sigma$ -electrons and occurs only in saturated compounds.	Uses $\pi$ -electrons or lone pair of electrons and occurs only in unsaturated and conjugated system.
(ii)	Moves upto 3 carbon atoms.	All along the length of conjugated system.
(iii)	Slight displacement of electrons.	Complete transfer of electrons.



# MPP-8 MONTHLY Practice Problems

## Class XI

This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

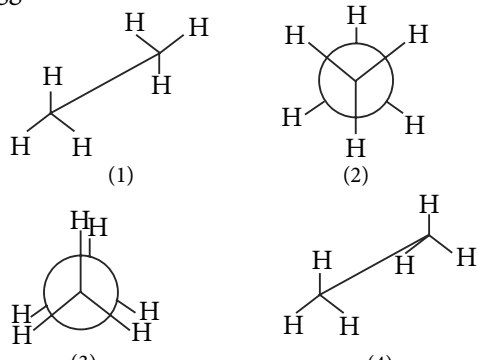
### Hydrocarbons and Environmental Chemistry

Total Marks : 120

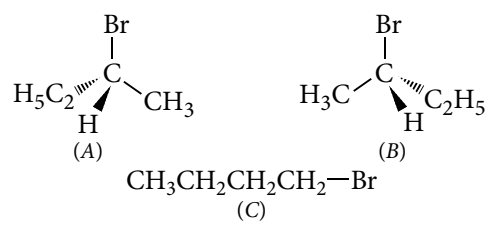
Time Taken : 60 Min.

NEET / AIIMS

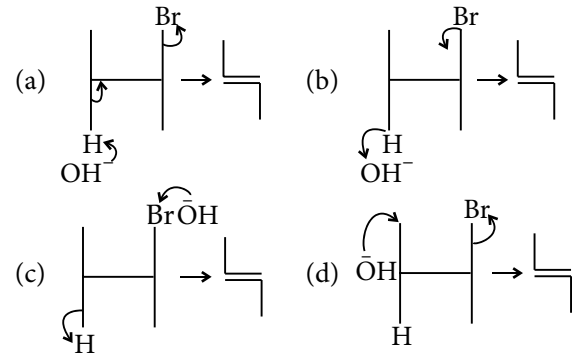
Only One Option Correct Type

- Which of the following causes damage to the building containing calcium carbonate and responsible for cough and choking in humans?
  - Sulphur
  - Carbon
  - Nitrogen
  - Sulphur dioxide
- In the following structures which two forms are the staggered conformation of ethane?
 

- 1 and 4
- 2 and 3
- 1 and 2
- 1 and 3

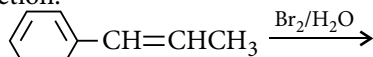
- Which of the following alkene will give same product when treated with HBr in presence and absence of benzoyl peroxide?
  - 1, 1-Dichloroethene
  - trans*-1,2-Dichloro-2-pentene
  - cis*-1,2-Dichloro-2-pentene
  - 2-Butene
- Addition of HBr to 1-butene gives a mixture of products A, B and C.
 

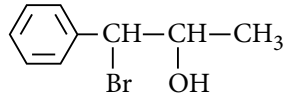
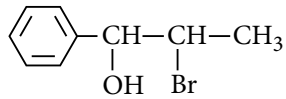
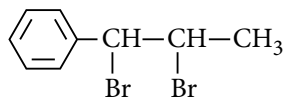
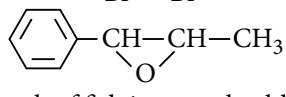
The mixture consists of

- A and B as major and C as minor product
  - B as major, A and C as minor products
  - B as minor, A and C as major products
  - A and B as minor and C as major product.
- How carbon monoxide emitted by automobiles prevents transport of oxygen in the body tissues?
    - By changing oxygen into carbon dioxide.
    - By destroying the haemoglobin.
    - By forming a stable compound with haemoglobin.
    - By obstructing the reaction of oxygen with haemoglobin.
  - Dehydrohalogenation in presence of  $\text{OH}^-$  is correctly represented by
 

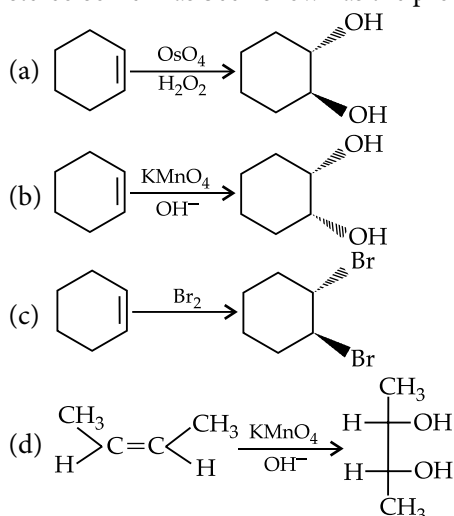


7. Which of the following statement is false?  
 (a) London smog is oxidising in nature.  
 (b) London smog contains  $\text{H}_2\text{SO}_4$  droplets.  
 (c) London smog is formed in winter.  
 (d) London smog causes bronchitis.
8. Identify the major product of the following reaction.



- (a) 
- (b) 
- (c) 
- (d) 
9. Growth of fish is not as healthy in warm water as in cold water because  
 (a) the amount of D.O. in warm water is higher than in cold water  
 (b) warm water is not liked by fish  
 (c) cold water contains more marine plants  
 (d) the amount of D.O. in warm water is less than in cold water.
10. Brewery and sugar factory waste alters the quality of a water body by increasing  
 (a) temperature (b) turbidity  
 (c) pH (d) COD and BOD.

11. In the given reactions, identify the one where wrong stereoisomer has been shown as the product.



12. Which of the following statements about polar stratospheric clouds (PSCs) is not correct?  
 (a) Type I clouds are formed at about  $-77^\circ\text{C}$  and contain solid  $\text{HNO}_3 \cdot 3\text{H}_2\text{O}$ .  
 (b) Type II clouds are formed at about  $-85^\circ\text{C}$  and contain some ice.  
 (c) A tight whirlpool of wind called Polar Vortex is formed which surrounds Antarctica.  
 (d) PSCs do not react with chlorine nitrate and HCl.

### Assertion & Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.  
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.  
 (c) If assertion is true but reason is false.  
 (d) If both assertion and reason are false.

13. **Assertion :** Melting of glaciers and polar ice caps would result into the rise in level of sea water thus flooding the coastal lands.

**Reason :** Greenhouse effect is responsible for global warming.

14. **Assertion :** Friedel-Crafts reaction between benzene and acetic anhydride in the presence of anhydrous  $\text{AlCl}_3$  yields acetophenone and not poly substituted products.

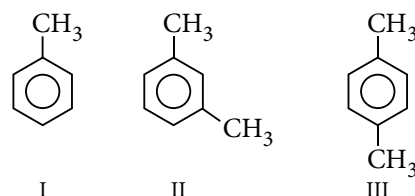
**Reason :** Acetophenone formed poisons the catalyst preventing further reaction.

15. **Assertion :** Water pollutants are measured by BOD.  
**Reason :** If BOD is more, the water is polluted.

### JEE MAIN / JEE ADVANCED / PETS

#### Only One Option Correct Type

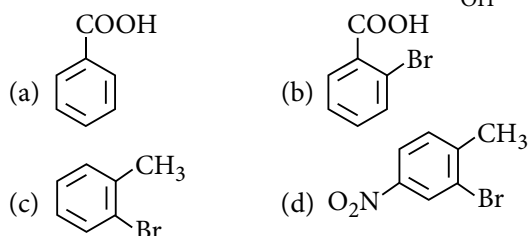
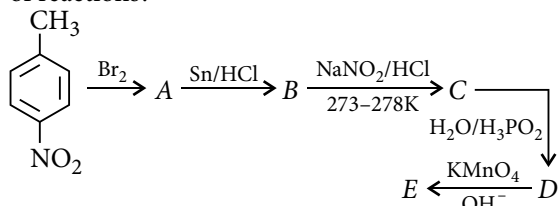
16. The ease of nitration of the following three hydrocarbons follows the order



- (a)  $\text{II} = \text{III} > \text{I}$  (b)  $\text{II} > \text{III} > \text{I}$   
 (c)  $\text{III} > \text{II} > \text{I}$  (d)  $\text{I} = \text{III} > \text{I}$

17. Which of the following pollutants effect more to organisms of the higher trophic level of a food chain due to biological amplification?
- Sewage and plant fertilisers
  - Detergents
  - Heavy metals mercury salts and non-biodegradable phenolic chemicals
  - Poisonous cyanides

18. Identify the product (E) in the following sequence of reactions?

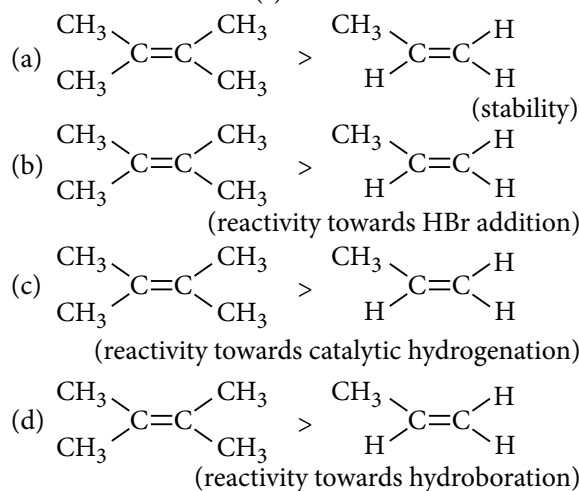


19. Which of the following is not an example of green chemistry?
- Catalytic dehydrogenation of diethanolamine without using cyanide and formaldehyde.
  - Replacement of CFCs by  $\text{CO}_2$  as blowing agent in the manufacture of polystyrene foam sheets.
  - Reacting methylamine and phosgene to produce methyl isocyanate.
  - Replacement of organotins by 'sea-nine' as anti fouling compound in sea marines.

**More than One Options Correct Type**

20. Which of the following are aromatic?
- Cyclopentadienyl cation
  - Cyclopropenyl cation
  - Tropylium cation
  - Cyclopentadienyl anion
21. Which of the following statements pertaining to pollutants are incorrect?
- DDT is a non-biodegradable pollutant.
  - Excess fluoride in drinking water causes osteoporosis.
  - Excess cadmium in drinking water causes black foot disease.
  - Methyl mercury in water may cause "Itai-Itai disease".

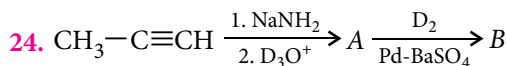
22. Pick the correct order(s).



23. Pick up the incorrect statements?

- CO which is a major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog.
- Classical smog has an oxidising character while the photochemical smog is reducing in character.
- Photochemical smog occurs in day time whereas the classical smog occurs in winters in early morning hours.
- During formation of smog the level of ozone in the atmosphere goes down.

**Integer Answer Type**



Total number of deuterium atoms in the final product is

25. Number of oxygen atoms in peroxyacetylnitrates (PAN) is

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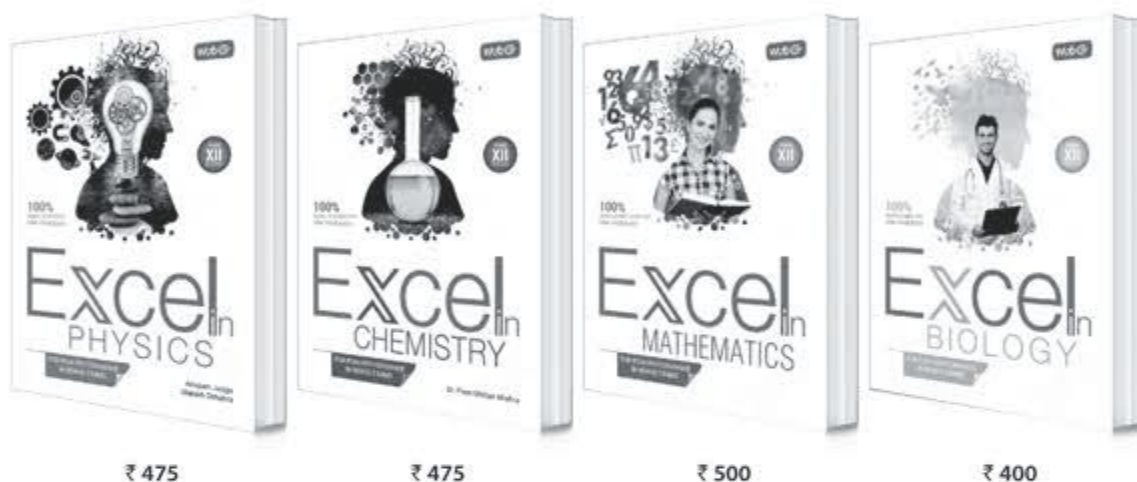
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CLASS XII

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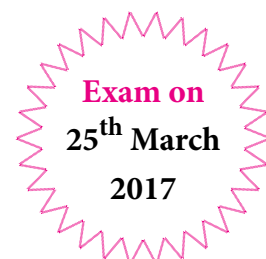
## Practice Paper 2017

Time Allowed : 3 hours  
Maximum Marks : 70



### GENERAL INSTRUCTIONS

- All questions are compulsory.
- Q.no.1 to 5 are very short answer questions and carry 1 mark each.
- Q.no.6 to 10 are short answer questions and carry 2 marks each.
- Q.no.11 to 15 are so short answer questions and carry 3 marks each.
- Q.no.16 to 18 are short answer questions and carry 4 marks each.
- Q.no.19 to 21 are long answer questions and carry 5 marks each.
- Use of calculator is not allowed.



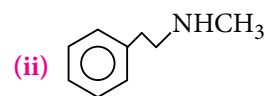
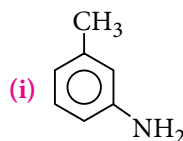
- Out of  $\text{NH}_3$  and  $\text{CO}_2$ , which gas will be adsorbed more readily on the surface of activated charcoal and why?
- Why  $\text{Cd}^{2+}$  salts are white?
- Draw the molecular structure of the compound 4-methylpent-3-en-2-one.
- How is toluene obtained from phenol?
- What type of defect is produced when NaCl is doped with  $\text{SrCl}_2$ ?
- Aqueous copper sulphate solution (blue in colour) gives :
  - a green precipitate with aqueous potassium fluoride and
  - a bright green solution with aqueous potassium chloride.
 Explain these experimental results.

OR

$[\text{Cr}(\text{NH}_3)_6]^{3+}$  is paramagnetic while  $[\text{Ni}(\text{CN})_4]^{2-}$  is diamagnetic. Explain why?

- Complete the following reaction :  
 $\text{XeF}_6 + \text{KF} \longrightarrow$

- Draw the structure of  $\text{XeF}_4$  and predict its shape.
- A solution is obtained by mixing 300 g of 25% and 400 g of 40% solution by mass. Calculate the percentage composition of the resulting solution.
  - Rate constant,  $k$  for a first order reaction has been found to be  $2.54 \times 10^{-3} \text{ sec}^{-1}$ . Calculate its  $3/4^{\text{th}}$  life. ( $\log 4 = 0.6020$ )
  - Give the IUPAC names of the following compounds :



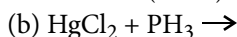
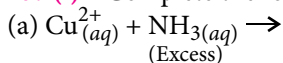
- By X-ray diffraction methods, the unit length of NaCl is observed to be 0.5627 nm. The density of NaCl is found to be  $2.164 \text{ g cm}^{-3}$ . What type of defect exists in the crystal? Calculate the percentage of  $\text{Na}^+$  and  $\text{Cl}^-$  ions missing.
- Describe the underlying principle of recovery of silver from the solution obtained by leaching silver ore with a solution of NaCN.

(ii) Give reasons for the following :

(a) Zinc oxide can be reduced to the metal by heating with carbon but not  $\text{Cr}_2\text{O}_3$ .

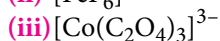
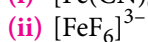
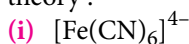
(b) Extraction of copper directly from sulphide ores is less favourable than that from its oxide ores through reduction.

13. (i) Complete the following chemical equations :



(ii) Which one of  $\text{PCl}_4^+$  and  $\text{PCl}_4^-$  is not likely to exist and why?

14. Discuss the nature of bonding in the following coordination entities on the basis of valence bond theory :



15. (i) Answer the following :

(a) What is a racemic mixture? Give an example.

(b) Of the two bromoderivatives,  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{Br}$  and  $(\text{C}_6\text{H}_5)_2\text{CHBr}$ , which one is more reactive towards  $\text{S}_{\text{N}}1$  substitution reaction and why?

(ii) Give a chemical test to distinguish between  $\text{C}_2\text{H}_5\text{Br}$  and  $\text{C}_6\text{H}_5\text{Br}$ .

16. (i) For the coagulation of 100 mL of arsenious sulphide sol, 5 mL of 1 M NaCl is required. What is the flocculation value of NaCl?

(ii) Gelatin is generally added to ice creams. Why?

(iii) Why does bleeding stop by rubbing moist alum?

17. To 500  $\text{cm}^3$  of water,  $3.0 \times 10^{-3}$  kg of acetic acid is added. If 23% of acetic acid is dissociated, what will be the depression in freezing point?  $K_f$  and density of water are  $1.86 \text{ K kg mol}^{-1}$  and  $0.997 \text{ g cm}^{-3}$  respectively.

OR

An aqueous solution containing 12.48 g of barium chloride in 1.0 kg of water boils at 373.0832 K. Calculate the degree of dissociation of barium chloride :

[Given :  $K_b$  for  $\text{H}_2\text{O} = 0.52 \text{ K m}^{-1}$ ;

Molar mass of  $\text{BaCl}_2 = 208.23 \text{ g mol}^{-1}$ ]

18. How are the following conversions carried out?

(i) Benzyl chloride to Benzyl alcohol

(ii) Ethyl magnesium chloride to Propan-1-ol

(iii) Propene to Propan-2-ol

19. (i) Write short notes on the following :

(a) Carbylamine reaction

(b) Gabriel phthalimide synthesis

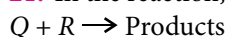
(ii) How will you convert ethanoic acid into methanamine?

20. (i) How do you explain the presence of six carbon atoms in glucose in a straight chain?

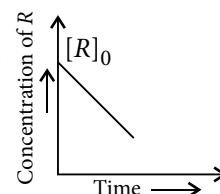
(ii) Amino acids behave like salts rather than simple amines or carboxylic acids. Explain.

(iii) Coagulation of egg white on boiling is an example of denaturation of protein. Explain it in terms of structural changes.

21. In the reaction,

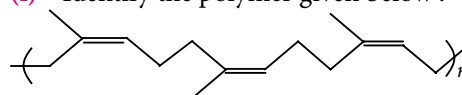


The time taken for 99% reaction of Q is twice the time taken for 90% reaction of Q. The concentration of R varies with time as shown in the figure.

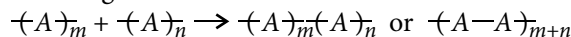


What is the overall order of the reaction? Give the units of the rate constant for the same. Write the rate expression for the above reaction.

22. (i) Identify the polymer given below :



(ii) Out of chain growth polymerisation and step growth polymerisation, in which type will you place the following?



(iii) Why does *cis*-polyisoprene possess elastic property?

23. Rajesh was looking very upset and worried. When his close friend Ajit asked him the reason, he told him that since morning he has been feeling an uncomfortable burning sensation in his chest, vomiting and his stomach is bloated. He also told Ajit that he took Eno in the morning but to no effect. Ajit suggested him that Eno gives only temporary relief and he should consult a doctor. The doctor diagnosed that Rajesh was suffering from hyperacidity. The doctor prescribed him some medicines and Rajesh was feeling happy and cheerful after two hours.

After reading the above passage, answer the following questions :

(i) What values are expressed by Ajit?

(ii) What is the cause of hyperacidity?

(iii) What is Eno and how does it work?

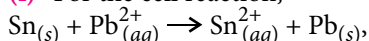
(iv) What type of medicine is used to cure hyperacidity. Name one medicine of this type and explain how does it work?

**24. (i)** Find the solubility product of  $\text{Ag}_2\text{CrO}_4$  in water at 298 K if the e.m.f. of the cell  $\text{Ag}|\text{Ag}^+$  (saturated  $\text{Ag}_2\text{CrO}_4$  soln.) $||\text{Ag}^+$  (0.1 M) $|\text{Ag}$  is 0.164 V at 298 K.

**(ii)** Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?

OR

**(i)** For the cell reaction,



$$E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.136 \text{ V}, E_{\text{Pb}^{2+}/\text{Pb}}^\circ = -0.126 \text{ V}$$

calculate the ratio of concentration of  $\text{Pb}^{2+}$  to  $\text{Sn}^{2+}$  ion at which the cell reaction will be reversed?

**(ii)** Mention the reactions occurring at

- (a) anode  
(b) cathode

during working of a mercury cell.

Why does the voltage of a mercury cell remain constant during its operation?

**25. (i)** (a) A blackish brown coloured solid 'A' when fused with alkali metal hydroxides in presence of air, produces a dark green coloured compound 'B', which on electrolytic oxidation in alkaline medium gives a dark purple coloured compound 'C'. Identify A, B and C and write the reactions involved.

(b) What happens when an acidic solution of the green compound (B) is allowed to stand for some time? Give the equation involved. What is this type of reaction called?

**(ii)** What is Lanthanoid contraction? What are its two consequences?

OR

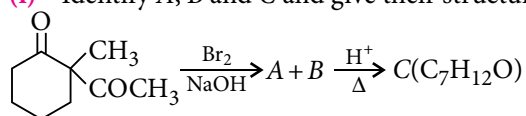
**(i)** A solution of  $\text{KMnO}_4$  on reduction yields either a colourless solution or a brown precipitate or a green solution depending on pH of the solution. What different stages of the reduction do these represent and how are they carried out?

**(ii)** Although  $\text{Cr}^{3+}$  and  $\text{Co}^{2+}$  ions have same number of unpaired electrons but the magnetic moment of  $\text{Cr}^{3+}$  is 3.87 B.M. and that of  $\text{Co}^{2+}$  is 4.87 B.M. Why?

**(iii)** Out of  $\text{Cu}_2\text{Cl}_2$  and  $\text{CuCl}_2$ , which is more stable and why?

**(iv)** What are different oxidation states exhibited by lanthanoids?

**26. (i)** Identify A, B and C and give their structures.



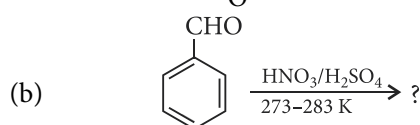
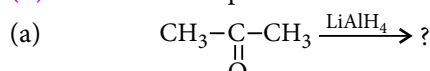
**(ii)** Write the equations involved in the following reactions :

- (a) Stephen reaction                      (b) Etard reaction

OR

**(i)** An organic compound (A) having molecular formula,  $\text{C}_2\text{H}_4\text{O}$  reduces Tollens' reagent. Two moles of (A) react with  $\text{Al}(\text{OC}_2\text{H}_5)_3$  to yield  $\text{C}_4\text{H}_8\text{O}_2$  (B) which reacts with  $\text{NH}_3$  to give  $\text{C}_2\text{H}_6\text{O}$  (C) and  $\text{C}_2\text{H}_5\text{NO}$  (D). Identify A, B, C and D.

**(ii)** Write the main product in the following equations :

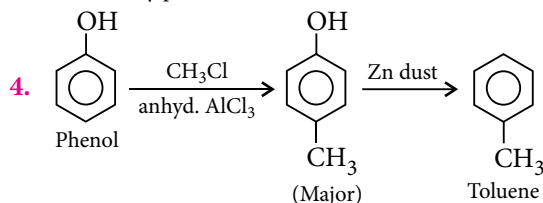


### SOLUTIONS

1.  $\text{NH}_3$  gas will be adsorbed more readily on the surface because it has higher critical temperature than  $\text{CO}_2$  gas.

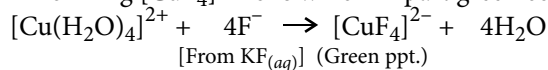
2. It has completely filled  $d$ -orbital ( $d^{10}$ ).

3.  $\text{H}_3\overset{1}{\text{C}}-\overset{2}{\underset{\text{O}}{\parallel}}{\text{C}}-\overset{3}{\text{CH}}=\overset{4}{\text{C}}-\overset{5}{\text{CH}_3}$   
4-Methylpent-3-en-2-one

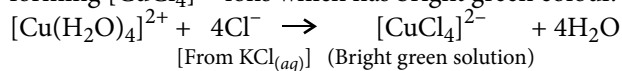


5. Impurity defect is produced when NaCl is doped with  $\text{SrCl}_2$ .

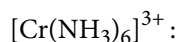
6. **(i)** Aqueous  $\text{CuSO}_4$  solution contains  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$  ions which impart blue colour. When KF is added,  $\text{H}_2\text{O}$  being weak field ligand can be replaced by  $\text{F}^-$  forming  $[\text{CuF}_4]^{2-}$  ions which impart green colour.

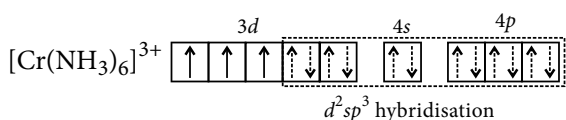


**(ii)** When KCl is added,  $\text{Cl}^-$  ligand replaces  $\text{H}_2\text{O}$  forming  $[\text{CuCl}_4]^{2-}$  ions which has bright green colour.

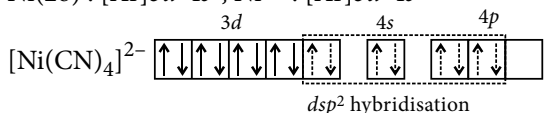
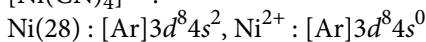
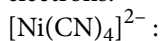


OR

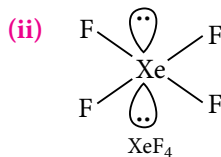




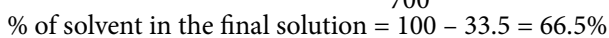
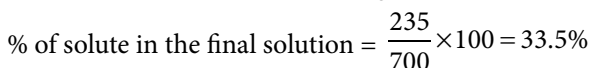
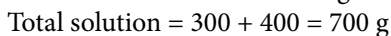
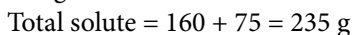
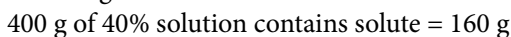
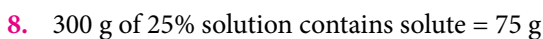
It is paramagnetic due to presence of unpaired electrons.



It is diamagnetic due to absence of unpaired electrons.



Shape : Square planar

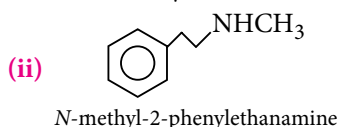
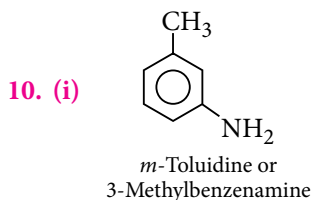


$$k = \frac{2.303}{t} \log \frac{a}{a-x} \Rightarrow k = \frac{2.303}{t} \log \frac{a}{a - \frac{3}{4}a}$$

$$\Rightarrow k = \frac{2.303}{t} \log \frac{a}{0.25a}$$

$$t_{3/4} = \frac{2.303}{2.54 \times 10^{-3} \text{ sec}^{-1}} \times \log \frac{1}{0.25} = 546 \text{ s}$$

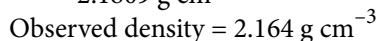
Therefore, the  $3/4^{\text{th}}$  life of the reaction is 546 seconds.



11. Calculated density,  $\rho = \frac{Z \times M}{a^3 \times N_0}$

$$= \frac{4 \times 58.5 \text{ g mol}^{-1}}{(0.5627 \times 10^{-7} \text{ cm})^3 \times (6.022 \times 10^{23} \text{ mol}^{-1})}$$

$$= 2.1809 \text{ g cm}^{-3}$$



As observed density is less than theoretically calculated value, this means that some  $\text{Na}^+$  and  $\text{Cl}^-$  ions are missing from their lattice sites, *i.e.*, there is Schottky defect.

Actual formula units of NaCl per unit cell can be calculated as follows :

$$Z = \frac{a^3 \times \rho \times N_0}{M}$$

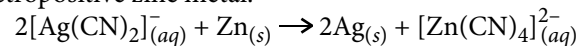
$$= \frac{(0.5627 \times 10^{-7} \text{ cm})^3 \times (2.164 \text{ g cm}^{-3}) \times (6.022 \times 10^{23} \text{ mol}^{-1})}{58.5 \text{ g mol}^{-1}}$$

$$= 3.968$$

$$\therefore \text{Formula units missing per unit cell} = 4 - 3.968 = 0.032$$

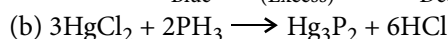
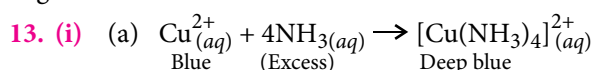
$$\therefore \% \text{ of } \text{Na}^+ \text{ and } \text{Cl}^- \text{ ions missing} = \frac{0.032}{4} \times 100 = 0.8\%$$

12. (i) During leaching Ag is oxidised to  $\text{Ag}^+$  which then combines with  $\text{CN}^-$  ions (from NaCN) to form soluble complex  $[\text{Ag}(\text{CN})_2]^-$ . Silver is then recovered from this complex by displacement method using more electropositive zinc metal.

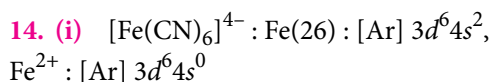


(ii) (a) Carbon is suitable reducing agent for reduction of zinc oxide. Reduction of  $\text{Cr}_2\text{O}_3$  by carbon is not thermodynamically favourable.

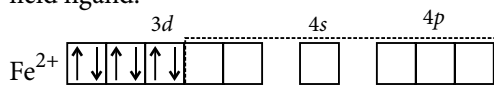
(b) Free energy change for the reduction of copper sulphide to copper by carbon is positive whereas,  $\Delta_r G^\circ$  for the reduction of copper oxide to copper by carbon is negative and hence feasible.



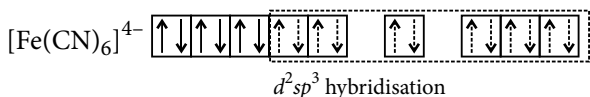
(ii) The oxidation state of P in  $\text{PCl}_4^+$  is +5 while in  $\text{PCl}_4^-$  is +3. The stability of the +5 oxidation state decreases down the group, on the contrary stability of +3 oxidation state increases from top to bottom of the group due to inert pair effect. Hence  $\text{PCl}_4^+$  is more stable and likely to exist.



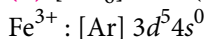
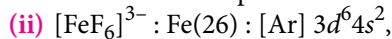
$\text{CN}^-$  ion causes pairing of electrons because it is a strong field ligand.



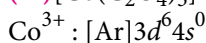
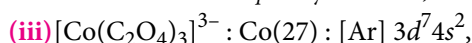
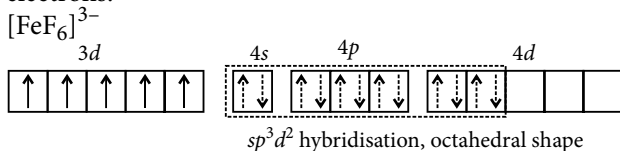




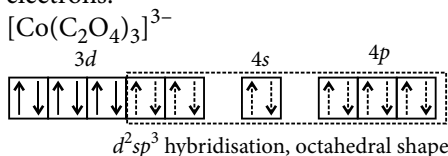
It has octahedral shape and is diamagnetic in nature due to absence of unpaired electrons.



$\text{F}^-$  being a weak field ligand, does not cause pairing of electrons.

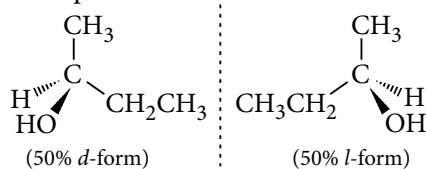


$\text{C}_2\text{O}_4^{2-}$  being a strong field ligand causes pairing of electrons.



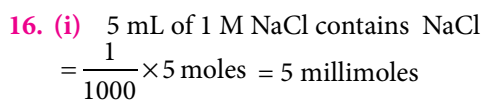
15. (i) (a) An equimolar mixture of a pair of enantiomers is called racemic mixture. A racemic mixture is optically inactive due to external compensation.

Example :



(b) Of the two bromo derivatives,  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{Br}$  and  $(\text{C}_6\text{H}_5)_2\text{CHBr}$ , the  $(\text{C}_6\text{H}_5)_2\text{CHBr}$  is more reactive than  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{Br}$  towards  $\text{S}_{\text{N}}1$  reaction because its carbocation is resonance stabilised by two phenyl groups.

(ii)  $\text{C}_2\text{H}_5\text{Br}$  reacts with  $\text{AgNO}_3$  to give yellow precipitate of  $\text{AgBr}$  while  $\text{C}_6\text{H}_5\text{Br}$  will not.



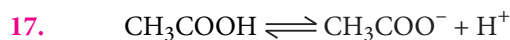
Thus, 100 mL of  $\text{As}_2\text{S}_3$  sol require NaCl for complete coagulation = 5 millimoles

$\therefore$  1 L, i.e., 1000 mL of the sol require NaCl for complete coagulation = 50 millimoles

$\therefore$  By definition, flocculation value of NaCl = 50

(ii) Ice cream is an emulsion of milk or cream in water, i.e., oil-in-water type. Gelatin is added to act as an emulsifier, i.e., it helps to stabilise the emulsion.

(iii) Moist alum coagulates the blood as it is a colloidal sol and alum provides  $\text{Al}^{3+}$  ions. As a result, a clot of blood is formed. Hence, it stops bleeding.



Initial	1 mole	0	0
After disso.	$1 - 0.23$	0.23	0.23

Total no. of moles at eqm. = 1.23 moles

$$\therefore \alpha = \frac{i-1}{n-1} \Rightarrow 0.23 = \frac{i-1}{2-1} \Rightarrow i = 1.23$$

Mass of water (solvent) =  $500 \times 0.997 = 498.5 \text{ g}$

$$\text{No. of moles of acetic acid} = \frac{3 \times 10^{-3} \times 10^3}{60} = 0.05 \text{ g mol}^{-1}$$

$$\therefore \text{Molality of the solution} = \frac{0.05}{498.5} \times 1000 = 0.1$$

$$\Delta T_f = iK_f m = 1.23 \times 1.86 \times 0.1 = 0.228 \text{ K}$$

OR

Here,  $n = 3$  because 1 molecule of  $\text{BaCl}_2$  on dissociation gives three ions.

$W_2 = 12.48 \text{ g}$ ,  $W_1 = 1.0 \text{ kg} = 1000 \text{ g}$

$T_b = 373.0832 \text{ K}$ ,  $K_b$  for  $\text{H}_2\text{O} = 0.52 \text{ K m}^{-1}$

and  $M_2(\text{BaCl}_2) = 208.34 \text{ g mol}^{-1}$

$$\Delta T_b = T_b - T_b^0 = 373.0832 \text{ K} - 373 \text{ K} = 0.0832 \text{ K}$$

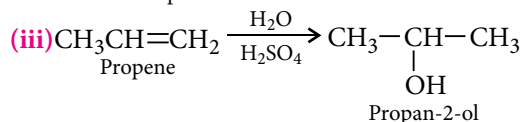
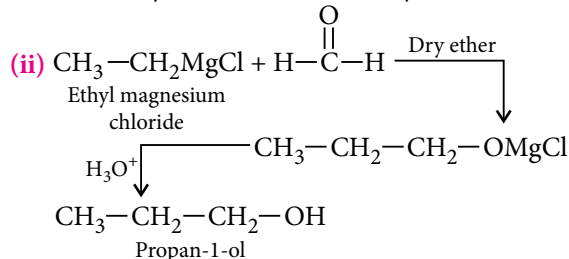
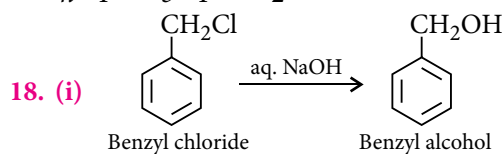
$$M_{2(\text{observed})} = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$$

$$M_{2(\text{observed})} = \frac{0.52 \times 12.48 \times 1000}{0.0832 \times 1000} = 78$$

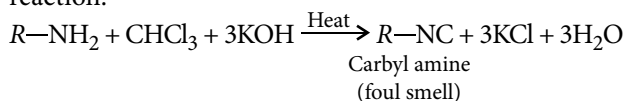
$$M_{2(\text{observed})} = 78 \text{ g mol}^{-1}$$

$$i = \frac{M_{2(\text{calculated})}}{M_{2(\text{observed})}} = \frac{208.34 \text{ g mol}^{-1}}{78 \text{ g mol}^{-1}} = 2.67$$

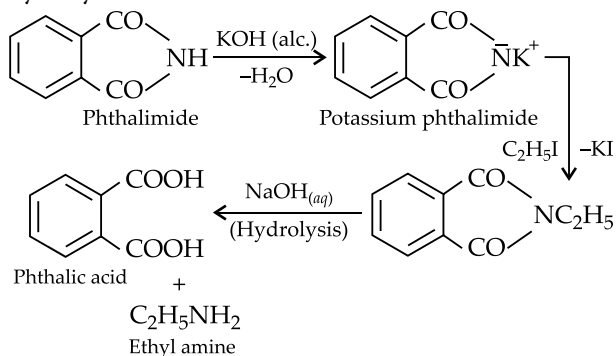
$$\alpha = \frac{i-1}{n-1} = \frac{2.67-1}{3-1} = \frac{1.67}{2} = 0.835 = 83.5\%$$



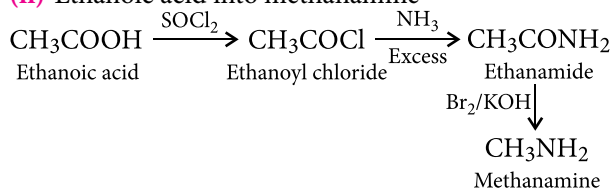
**19. (i) (a) Carbylamine reactions :** Aliphatic and aromatic primary amines on heating with chloroform and alcoholic potassium hydroxide form isocyanides or carbyl amines which are foul smelling substances. Secondary and tertiary amines do not show this reaction.



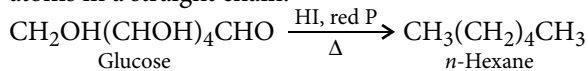
**(b) Gabriel phthalimide synthesis :** In this reaction phthalimide is converted into its potassium salt by treating it with alcoholic potassium hydroxide. Then potassium phthalimide is heated with an alkyl halide to yield an *N*-alkyl phthalimide which is converted to phthalic acid and primary amine by alkaline hydrolysis.



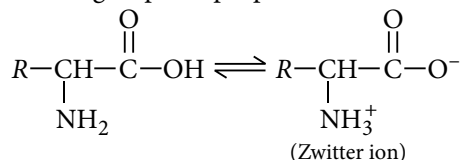
**(ii) Ethanoic acid into methanamine**



**20. (i)** On prolonged heating with HI and red P, glucose gives *n*-hexane which shows it has six carbon atoms in a straight chain.



**(ii)** In aqueous solution carboxylic group loses a proton and amino group accepts proton to form a zwitter ion.



**(iii)** When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get

uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structure are destroyed but 1° structure remains intact.

**21.** From the graph, we find that the reaction is zero order with respect to *R*. Rate of reaction is given as :

$$r = k[Q]^l[R]^m$$

$m = 0$  (for zero order reaction)

$$\therefore r = k[Q]^l[R]^0 \Rightarrow r = k[Q]^l$$

For first order reaction,

$$k_1 t = \ln \left( \frac{a}{a-x} \right)$$

The time taken for 99% reaction of *Q*,

$$kt_{99\%} = \ln \left( \frac{100}{100-99} \right) = \ln \left( \frac{100}{1} \right)$$

$$kt_{99\%} = \ln 100 = \ln 10^2 = 2 \ln 10$$

The time taken for 90% reaction of *Q*,

$$kt_{90\%} = \ln \left( \frac{100}{100-90} \right)$$

$$kt_{90\%} = \ln \left( \frac{100}{10} \right) \Rightarrow kt_{90\%} = \ln 10$$

It means order of reaction w.r.t *Q* is 1 ( $l = 1$ ).

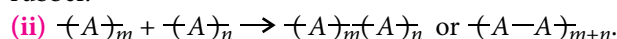
Hence, overall order of reaction =  $l + m \Rightarrow 1 + 0 = 1$

Units of rate constant is  $\text{sec}^{-1}$ .

Rate expression,  $r = k[Q]^1[R]^0 \Rightarrow r = k[Q]^1$

**22. (i)** The polymer is formed by 1,4-addition of 2-methylbuta-1,3-diene (isoprene) and stereochemistry is *cis*-throughout.

Therefore, the polymer is *cis*-polyisoprene *i.e.*, natural rubber.



The polymerisation is chain growth polymerisation. A large number of monomers added together to form a polymer.

**(iii)** The *cis*-polyisoprene molecule consists of various chains held together by weak van der Waals' interactions and has a coiled structure. Hence, it can be stretched like a spring and exhibits elastic properties.

**23. (i)** Ajit expressed concern for his friend's health and scientific approach by suggesting that medicines cure the diseases by eliminating its cause and not by controlling only its symptoms.

**(ii)** Acidity is caused by the substance called histamine. It interacts with the receptors present in the stomach wall and stimulates the release of hydrochloric acid.

**(iii)** Eno is a mixture of sodium bicarbonate and citric acid with only a small amount of anhydrous sodium

carbonate. When the Eno salt is dissolved in water, it releases CO<sub>2</sub> which neutralises the excess acid thereby removing acidity.

(iv) The medicines used to cure acidity are called antacids. An important example of an antacid is ranitidine. It prevents the interaction of histamine with the receptors present in the stomach wall. As a result, less hydrochloric acid is released and the problem of hyperacidity is controlled.

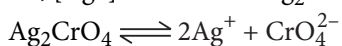
24. (i) The cell is Ag|Ag<sup>+</sup>(c<sub>1</sub>)||Ag<sup>+</sup>(0.1 M)|Ag

$$E_{\text{cell}} = \frac{0.0591}{n} \log \frac{c_2}{c_1} \quad (\text{for concentration cell})$$

$$0.164 = \frac{0.0591}{1} \log \frac{0.1}{c_1} \quad \text{or} \quad \log \frac{0.1}{c_1} = 2.7750$$

$$\text{or} \quad 0.1/c_1 = 5.957 \times 10^2 \quad \text{or} \quad c_1 = 1.679 \times 10^{-4}$$

i.e., [Ag<sup>+</sup>] in saturated Ag<sub>2</sub>CrO<sub>4</sub> sol. = 1.679 × 10<sup>-4</sup> M



$$[\text{Ag}^+] = 1.679 \times 10^{-4} \text{ M},$$

$$[\text{CrO}_4^{2-}] = \frac{[\text{Ag}^+]}{2} = \frac{1.679 \times 10^{-4}}{2} \text{ M}$$

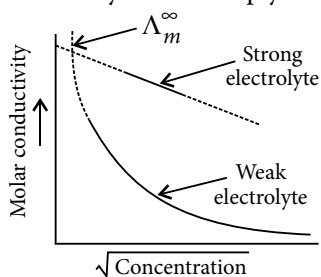
$$K_{sp} = [\text{Ag}^+]^2 [\text{CrO}_4^{2-}]$$

$$= (1.679 \times 10^{-4})^2 \times \left( \frac{1.679 \times 10^{-4}}{2} \right) = 2.37 \times 10^{-12}$$

(ii) **Molar conductivity** : It is defined as the conducting power of all the ions produced by dissolving one mole of an electrolyte in solution.

**Strong electrolyte** : The molar conductivity of strong electrolyte decreases slightly with the increase in concentration. There are strong forces of attraction between the ions of opposite charges due to which the conducting ability of the ions is less in concentrated solutions. With dilution the ions are far apart, interionic attractions become weaker and conductance increases.

**Weak electrolyte** : When the concentration of weak electrolyte becomes very low, its degree of ionisation rises sharply. There is sharp increase in the number of ions in the solution. Hence the molar conductivity of a weak electrolyte rises steeply at low concentration.



OR

(i) For the given cell,

$$E_{\text{cell}}^{\circ} = E_{\text{Pb}^{2+}/\text{Pb}}^{\circ} - E_{\text{Sn}^{2+}/\text{Sn}}^{\circ} = -0.126 - (-0.136) = 0.01 \text{ V}$$

For the given cell reaction,

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} \\ &= 0.01 - \frac{0.0591}{2} \log \frac{[\text{Sn}^{2+}]}{[\text{Pb}^{2+}]} \\ &= 0.01 + 0.0295 \log \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} \end{aligned}$$

At equilibrium,  $E_{\text{cell}} = 0$

$$\therefore 0.01 + 0.0295 \log \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} = 0$$

$$\text{or} \quad \log \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} = \frac{-0.01}{0.0295} = -0.3390$$

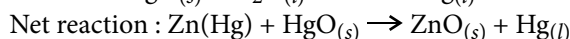
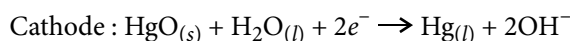
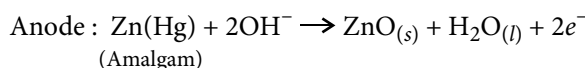
$$\therefore \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} = 0.458$$

Thus, so long as  $\frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} > 0.458$ , the cell reaction as

given will take place. When  $\frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} < 0.458$ ,  $E_{\text{cell}}$  will become -ve, i.e., the reaction will be reversed.

(ii) **Mercury cell** : In this cell the anode is zinc-mercury amalgam, and the cathode is a paste of mercury (II) oxide and electrolyte is a moist paste of KOH - ZnO.

The cell reactions are as follows :

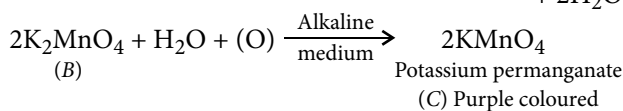


The cell potential remains constant during its life as the overall reaction does not involve any ion in solution whose concentration can change during its use.

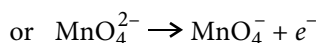


Pyrolusite  
(A) Blackish brown

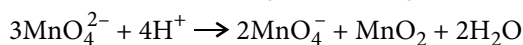
Potassium  
manganate  
(B) Green coloured  
+ 2H<sub>2</sub>O



Potassium permanganate  
(C) Purple coloured  
+ 2KOH



(b) When acidic solution of green compound (B), *i.e.*, potassium manganate is allowed to stand for some time, it disproportionates to give permanganate as follows :



This reaction is called disproportionation reaction.

**(ii) Lanthanoid contraction :** The steady decrease in the atomic and ionic radii of lanthanoid elements with increase in atomic number is called lanthanoid contraction. It is caused due to imperfect shielding of  $4f$ -electrons which is unable to counterbalance the effect of increased nuclear charge.

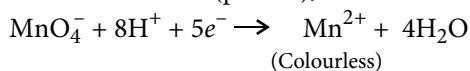
**Consequences of lanthanoid contraction :**

- (a) The basic strength of oxides and hydroxides of lanthanoids decrease with increasing atomic number.  
 (b) Atomic and ionic sizes of  $4d$  transition series elements and  $5d$  series elements are similar. *e.g.*, atomic radii of zirconium (Zr) is same as that of hafnium (Hf).

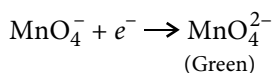
OR

**(i)** Oxidising behaviour of  $\text{KMnO}_4$  depends on pH of the solutions.

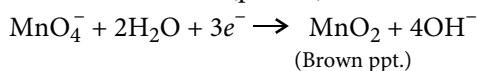
In acidic medium ( $\text{pH} < 7$ ),



In alkaline medium ( $\text{pH} > 7$ ),



In neutral medium ( $\text{pH} = 7$ ),



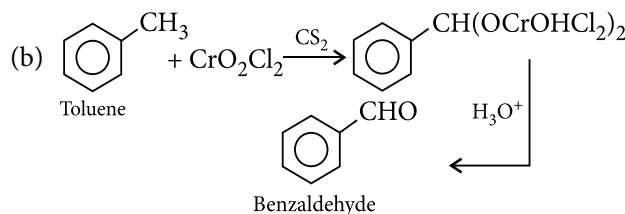
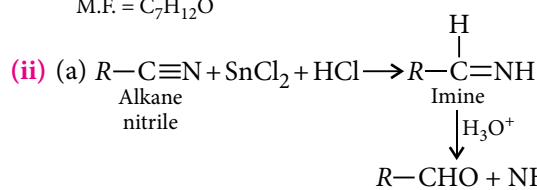
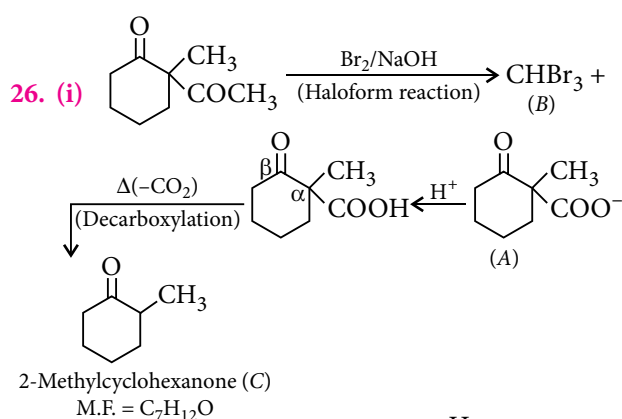
**(ii)** Due to symmetrical electronic configuration there is no orbital contribution in  $\text{Cr}^{3+}$  ion. However, appreciable contribution takes place in  $\text{Co}^{2+}$  ion.

**(iii)**  $\text{CuCl}_2$  is more stable than  $\text{Cu}_2\text{Cl}_2$ .  $\text{Cu}^{2+}$  is more stable than  $\text{Cu}^+$  due to the higher negative  $\Delta_{\text{hyd}}H^\circ$  value of  $\text{Cu}^{2+}_{(\text{aq})}$  than  $\text{Cu}^+_{(\text{aq})}$ .

**(iv)** Lanthanum and all the lanthanoids predominantly show +3 oxidation state. However, some of the lanthanoids also show +2 and +4 oxidation states due to attainment of stable empty ( $4f^0$ ), half-filled ( $4f^7$ ) and fully filled ( $4f^{14}$ ) sub shell.

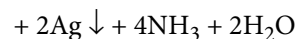
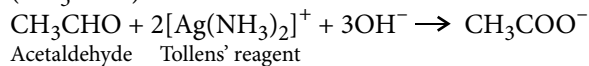
*e.g.*  $\text{Ce}^{4+} : 4f^0$ ,  $\text{Eu}^{2+} : 4f^7$

$\text{Tb}^{4+} : 4f^7$ ,  $\text{Yb}^{2+} : 4f^{14}$

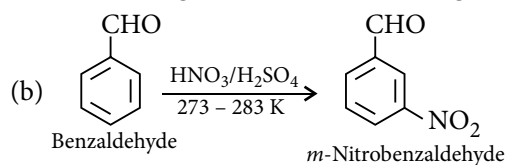
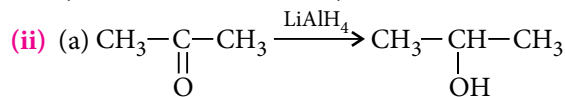
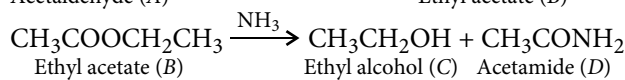
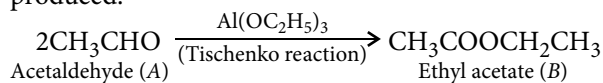


OR

**(i)** Since compound (A) with M.F.  $\text{C}_2\text{H}_4\text{O}$  reduces Tollens' reagent, it must be an aldehyde, *i.e.*, acetaldehyde ( $\text{CH}_3\text{CHO}$ ).



In presence of  $\text{Al}(\text{OC}_2\text{H}_5)_3$ , aldehydes undergo Tischenko reaction to give esters. Thus, when two moles of acetaldehyde ( $\text{CH}_3\text{CHO}$ ) react in presence of  $\text{Al}(\text{OC}_2\text{H}_5)_3$ , ethyl acetate (B) with M.F.  $\text{C}_4\text{H}_8\text{O}_2$  is produced.



# NEET | JEE

## ESSENTIALS

**Class  
XI**

Maximize your chance of success, and high rank in NEET, JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

## Unit 8

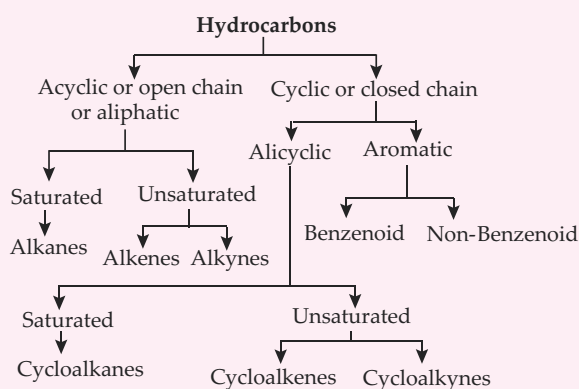
## HYDROCARBONS ENVIRONMENTAL CHEMISTRY

### HYDROCARBONS

#### INTRODUCTION

- Organic compounds composed of only carbon and hydrogen are called hydrocarbons.
- Hydrocarbons are considered to be the parent organic compounds while all other compounds are thought to have been derived from them by replacement of one or more of their hydrogen atoms by appropriate functional groups.

#### CLASSIFICATION



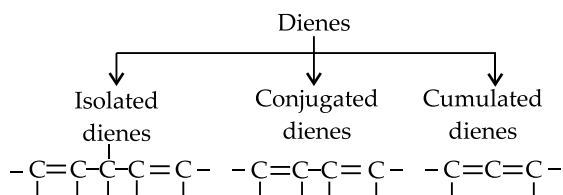
#### ALKANES

- The saturated hydrocarbons are represented by the general formula  $C_nH_{2n+2}$ .
- The normal alkanes are colourless gases ( $C_1$  to  $C_4$ ), colourless liquids ( $C_5$  to  $C_{17}$ ) and from  $C_{18}$  onwards colourless solids.
- As branching increases, melting and boiling points decrease. The boiling point increases steadily with increase in molecular mass.
- Density of alkanes also increases with size of the molecule.
- They are generally insoluble in polar solvents like water but soluble in non-polar solvents like ether, chloroform, etc.
- They are relatively unreactive towards most of the reagents such as acids, bases, oxidising and reducing agents. However under drastic conditions *i.e.*, at high temperature and pressure undergoes different types of reactions like halogenation, nitration, sulphonation, pyrolysis etc.

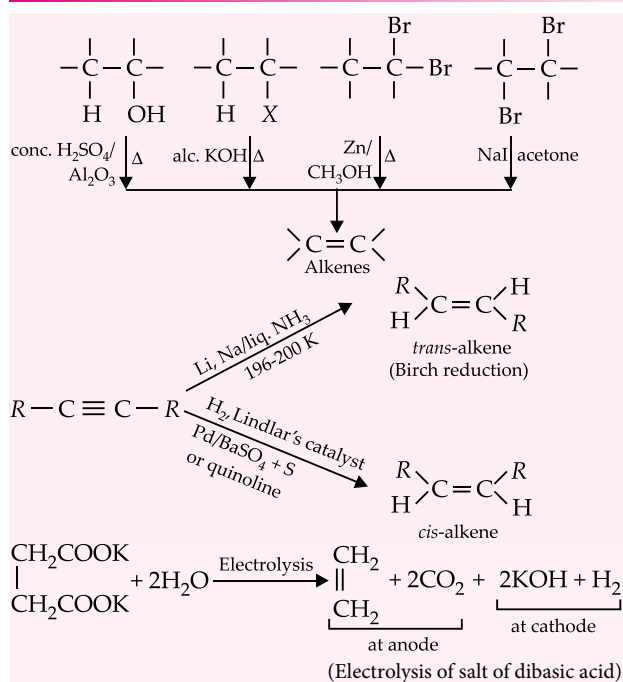
Methods of preparation	Chemical properties
<b>1. By hydrogenation of unsaturated hydrocarbons (Sabatier &amp; Senderen's reaction):</b> $C_nH_{2n} + H_2 \xrightarrow[\Delta]{Ni} C_nH_{2n+2}$ $C_nH_{2n-2} + 2H_2 \xrightarrow[\Delta]{Ni} C_nH_{2n+2}$	<b>1. Halogenation:</b> $CH_4 + 4Cl_2 \xrightarrow{h\nu} CCl_4 + 4HCl$
<b>2. Wurtz reaction:</b> $RX + 2Na + XR \xrightarrow[\text{ether}]{\text{dry}} R-R + 2NaX$	<b>2. Nitration:</b> $R-H + HONO_2 \xrightarrow[\text{Nitroalkane}]{\text{high temp. (Fuming)}} R-NO_2 + H_2O$
<b>3. Corey-House synthesis:</b> $RBr + LiR'_2Cu \rightarrow RR' + R'Cu + LiBr$	<b>3. Sulphonation:</b> $R-H + HOSO_3H \xrightarrow[\text{Prolonged heating}]{SO_3} RSO_3H + H_2O$
<b>4. Kolbe's electrolysis:</b> $2RCOOK + 2H_2O \xrightarrow{\text{electrolysis}} R-R + 2CO_2 + 2KOH + H_2$	<b>4. Complete combustion:</b> $C_nH_{2n+2} + \left(\frac{3n+1}{2}\right) O_2 \rightarrow nCO_2 + (n+1)H_2O$
<b>5. From Grignard's reagent:</b> $RX + Mg \xrightarrow{\text{dry ether}} R-Mg-X$ $R-Mg-X + HOH \xrightarrow{H^+} R-H + Mg \begin{matrix} OH \\ X \end{matrix}$	<b>5. Incomplete combustion:</b> $CH_4 + O_2 \xrightarrow[\text{Carbon black}]{\text{Burn (Limited)}} C + 2H_2O$
<b>6. From carbonyl compounds (Clemmensen reduction):</b> $R-\overset{\overset{O}{  }}{C}-CH_3 \xrightarrow[\text{conc. HCl}]{Zn/Hg} RCH_2CH_3$	<b>6. Catalytic oxidation:</b> $2CH_4 + O_2 \xrightarrow[100 \text{ atm}/200^\circ C]{Cu \text{ tube}} 2CH_3OH$
<b>ALKANES</b>	<b>7. Aromatisation:</b> $C_6H_{14} \xrightarrow[600^\circ C/15 \text{ atm}]{Cr_2O_3/Al_2O_3} \text{Benzene} + 4H_2$
	<b>8. Pyrolysis:</b> $CH_4 \xrightarrow{1000^\circ C} C + 2H_2$ $C_2H_6 \xrightarrow[Cr_2O_3 + Al_2O_3]{500^\circ C} CH_2=CH_2 + H_2$

## ALKENES (OLEFINS)

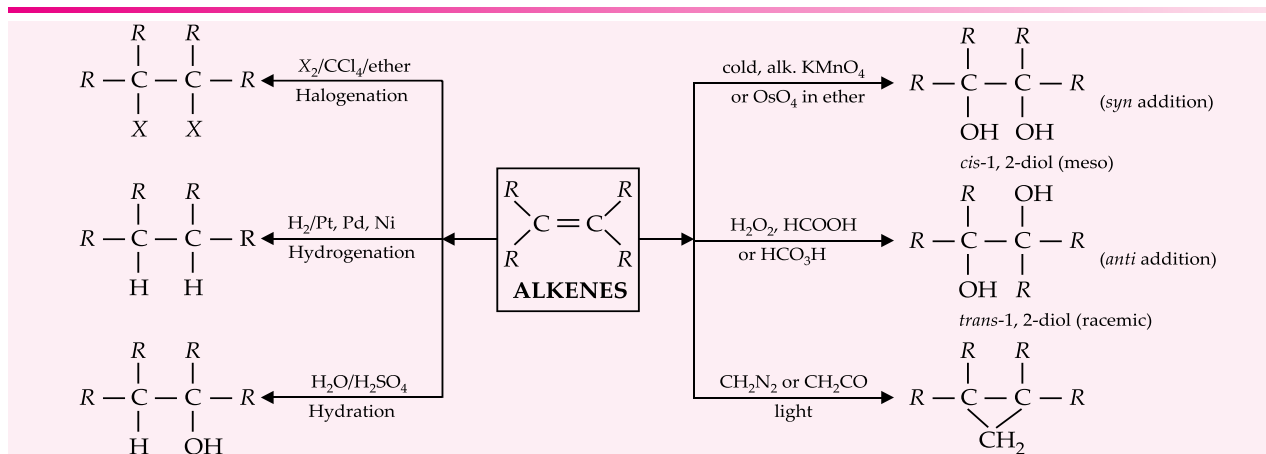
- The open chain hydrocarbons which contain lesser number of hydrogen atoms than the corresponding alkanes containing same number of carbon atoms are called *unsaturated hydrocarbons*.
- The member which contain two hydrogen atoms less than the corresponding saturated hydrocarbons are known as alkenes (olefins). These are represented by general formula  $C_nH_{2n}$ .
- Organic compounds containing  $C=C$  are known as *alkenes*. Alkenes with two double bonds are known as *dienes*.



## PREPARATION



## CHEMICAL PROPERTIES



## ALKYNES (ACETYLENES)

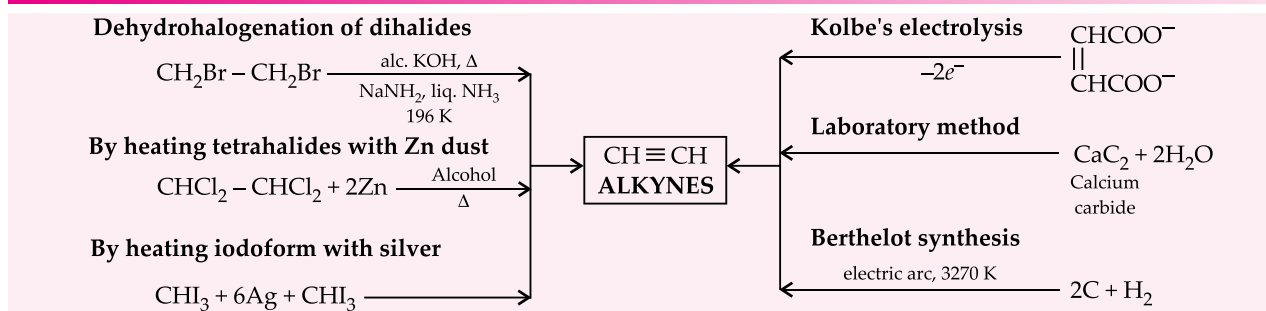
Alkynes contain four hydrogen atoms less than the corresponding alkanes and are characterised by the presence of a triple bond in the molecule. The first and the most important member of this series is

acetylene,  $HC\equiv CH$ . Hence, the alkynes ( $C_nH_{2n-2}$ ) are also called *acetylenes*.

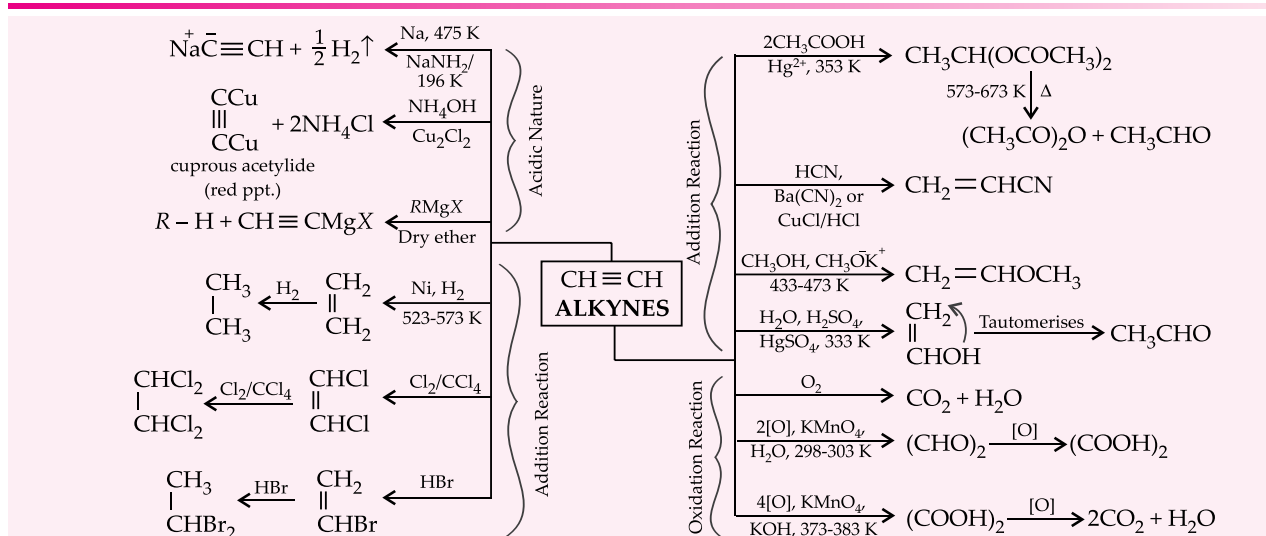
**Acidic nature :** Acetylene is acidic in nature. As, *s*-character increases, acidic nature increases.

Hybridisation :  $sp > sp^2 > sp^3$  (acidic nature)  
*s*-character : 50% 33.3% 25%

## PREPARATION



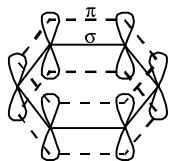
## CHEMICAL PROPERTIES



## AROMATIC HYDROCARBONS (ARENES)

### Structure of benzene :

- All six carbon atoms in benzene are  $sp^2$  hybridised.
- The  $sp^2$  hybrid orbitals overlap with each other and with  $s$ -orbitals of the six hydrogen atoms forming C – C and C – H  $\sigma$  bonds respectively.
- All  $\sigma$ -bonds in benzene lie in one plane and all bond angles are  $120^\circ$ .
- One half of  $\pi$ -molecular orbital lies above and the other half lies below the plane of the  $\sigma$ -bond.



- **Aromaticity (Huckel Rule) :** Huckel rule of aromaticity is applied to all the ring systems whether they have benzene ring or not and possess the following characteristics :

- Planarity
- Complete delocalisation of  $\pi$ -electrons in the ring.
- Presence of  $(4n + 2)\pi$ -electrons in the ring where  $n = 0, 1, 2, 3, \dots$

For example,



Benzene

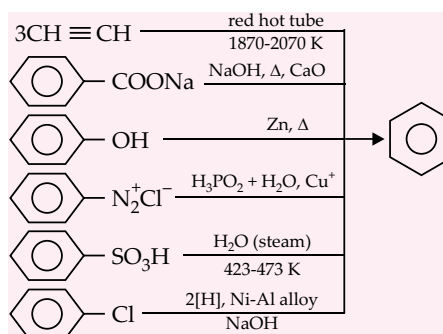


Cyclopentadienyl  
anion  
( $n = 1, 6 \pi$  electrons)

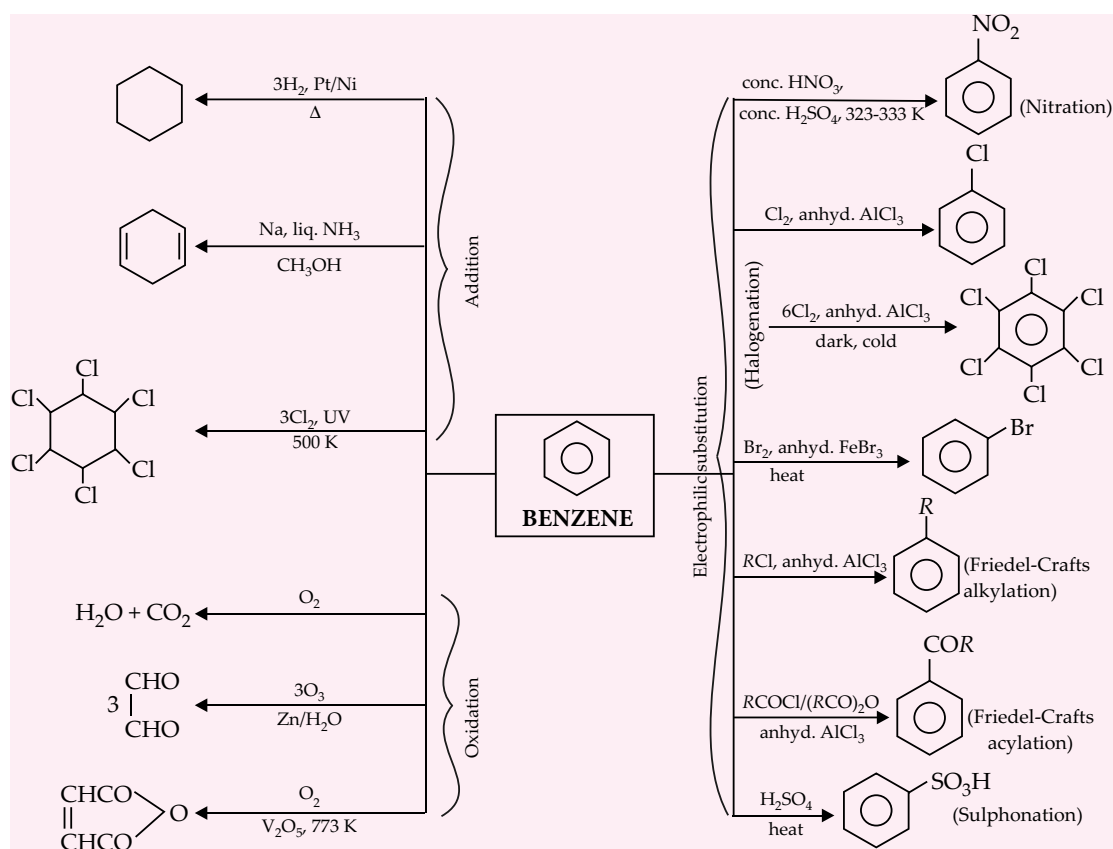


Cycloheptatrienyl  
cation

## PREPARATION



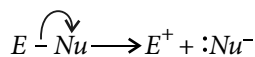
## CHEMICAL PROPERTIES



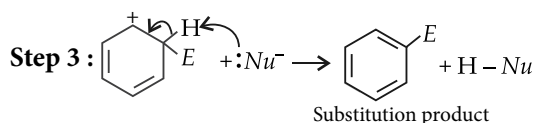
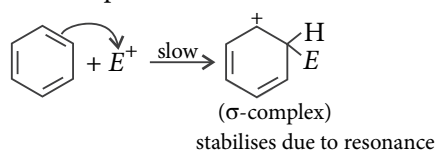


➤ **Mechanism of electrophilic substitution reactions:** Benzene undergoes substitution because it is an electron rich system due to delocalised  $\pi$ -electrons.

**Step 1:** Formation of an electrophile

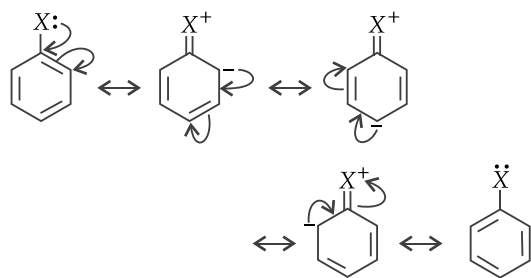


**Step 2:** Electrophile attacks on aromatic ring to form  $\sigma$ -complex.



➤ **Directive influence:**

➤ Groups with positive mesomeric effect (+M) increases electron density at *o*- and *p*-positions due to delocalisation.

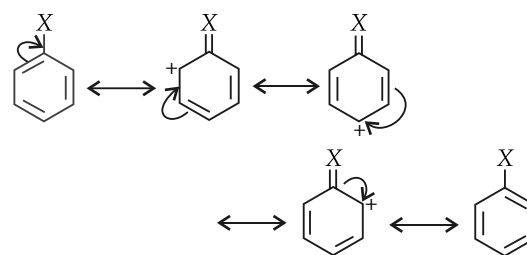


(here X may be - OH, - F, - Cl, - Br, - I)

Thus, electrophile attacks on *o*- and *p*-positions because these are electron rich positions while

nucleophile will attack on *m*-position because *m*-position is less electron rich.

➤ Groups with negative mesomeric effect (-M) decreases electron density on *o*- and *p*-positions, so electrophile will attack on *m*-position and nucleophile will attack on *o*- and *p*-positions.



(here, X may be - NO<sub>2</sub>, - SO<sub>3</sub>H, - CN.)

## PHYSICAL PROPERTIES

- Aromatic hydrocarbons are non-planar molecules.
- These are colourless liquids or solids with characteristic aroma.
- These are immiscible with water but miscible in organic solvents and burn with sooty flame.
- Boiling point of arenes increases with increase in the molecular size due to increase in van der Waals' forces of attraction.
- Melting point depends on molecular size and symmetry. Among *o*-, *m*- and *p*-xylenes, *p*-isomer has highest melting point.

## ENVIRONMENTAL CHEMISTRY

### INTRODUCTION

➤ Environmental chemistry is the branch of chemistry that deals with the study of various chemical processes taking place in the various segments of the environment. It is the study of sources, transportation, reactions, effects and fates of the chemical species occurring in one or more segments of the environment.

### COMPONENTS OF ENVIRONMENT

➤ **Atmosphere:** Cover of gases upto the height of

1600 km from the surface of earth.

#### Regions of atmosphere

Region	Altitude from earth's surface	Temperature range	Gases/Species present
Troposphere	0-11 km	Decreases from 15 to -56°C	N <sub>2</sub> , O <sub>2</sub> , CO <sub>2</sub> , H <sub>2</sub> O vapours
Stratosphere or (ozonosphere)	11-50 km	Increases from -56 to -2°C	N <sub>2</sub> , O <sub>2</sub> , O <sub>3</sub> O-atoms

Meso-sphere	50-85 km	Decreases from -2 to -92°C	$N_2, O_2, O_2^+, NO^+$
Thermo-sphere	85-500 km	Increases from -92 to 1200°C	$O_2^+, O^+, NO^+, e^-$

- **Hydrosphere:** Water bodies (sea, oceans, rivers, lakes, etc.) covers about 75% of earth's surface.
- **Lithosphere:** Solid part consisting of soil, rocks, mountains, etc.
- **Biosphere:** Part where living organisms interact with lithosphere, hydrosphere and atmosphere.
- **Abiotic components (non-living):** Lithosphere, hydrosphere, atmosphere.
- **Biotic components (living):** plants, animals and human beings.

## TYPES OF POLLUTANTS

- ↪ A substance present in the environment in greater proportion than its natural abundance, resulting into harmful effects is called a pollutant.
- ↪ *Primary pollutants* are those which after their

formation enter the environment and remains as such. For example, NO.

- ↪ *Secondary pollutants* are those harmful materials which are formed by chemical reactions between the primary pollutants in the atmosphere or hydrosphere. For example - PAN.
- ↪ *Biodegradable pollutants* are materials which are easily decomposed by microorganisms either by nature itself or by suitable treatment and thus are not harmful but if these are present in excess in the environment, they become pollutants. For example, cow-dung.
- ↪ *Non-biodegradable pollutants* are materials which do not degrade or degrade very slowly but their presence even in very small amounts in the environment is harmful. For example, Hg, Al.

## AIR POLLUTION

- ↪ **Air Pollution:** It is the addition of undesirable materials into the atmosphere either due to natural phenomena or due to human activity on the earth which adversely affect the quality of the air and hence affects the life on the earth.

Pollutants	Major Sources	Effects
CO	Incomplete combustion of carbonaceous matter in automobile engines and defective furnaces, incomplete combustion of agricultural and slash matter, volcanic eruptions, forest fires.	Carbon monoxide is toxic. It binds with haemoglobin in red blood cells and prevents them from combining with oxygen. Low levels of CO cause headaches and dizziness. Concentrations of ~1% causes death in minutes.
NO <sub>x</sub>	Combustion of fuel, natural-forest fires, anthro-stationary combustion sources (factories and power plants), transportation.	Toxic to living tissues, harmful to paints, textiles and metals.
SO <sub>x</sub>	Anthro-stationary combustion sources, industries, volcanic eruptions and also found in metal ores, coal and decay products.	They are respiratory tract irritants, low concentration causes throat and eye-irritation, causes breathlessness, affect larynx.
CFC's	CFC's were used primarily as refrigerants, in aerosol sprays and in the plastics industry. Freons are stable (lasts for over 80 years), inflammable and inert (in the lower atmosphere).	React with stratospheric ozone. When CFC's are broken down, chlorine free radicals are produced which can react with more than 100,00 molecules of ozone thus, depleting the ozone layer.
Particulates	Volcanic eruptions, fly ash, smelting and mining operations, smoke from incomplete combustion, dust from crushers and grinders.	Inhalation of metallic particles leads to respiratory disorders like asthma, bronchitis, lung cancer, etc.

## INFOSHOTS

### A new approach to recycle greenhouse gas!

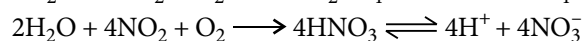
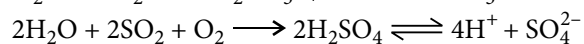
Professor of molecular biology & biochemistry at the Ayala School of Biological Sciences, the researchers found that they could successfully express the reductase component of the nitrogenase enzyme alone in the bacterium *Azotobacter vinelandii* and directly use this bacterium to convert CO<sub>2</sub> to CO. The intracellular environment of the bacterium was shown to favor the conversion of CO<sub>2</sub> in a way that would be more applicable to the future development of strategies for large-scale production of CO. The findings were surprising to the group, as nitrogenase was only previously believed to convert nitrogen (N<sub>2</sub>) to ammonia (NH<sub>3</sub>) within the bacterium under similar conditions. The intracellular environment of the bacterium *Azotobacter vinelandii* favors other reduction reactions, due in part to its well-known oxygen protection mechanisms and presence of physiological electron donors. The bacterium could reduce CO<sub>2</sub> and release CO as a product, which makes it an attractive whole-cell system that could be explored further for new ways of recycling atmospheric CO<sub>2</sub> into biofuels and other commercial chemical products. These findings of Hu's group establish the nitrogenase enzyme as a fascinating template for developing approaches to energy-efficient and environmentally-friendly fuel production. Researcher's observation that a bacterium can convert CO<sub>2</sub> to CO opens up new avenues for biotechnological adaptation of this reaction into a process that effectively recycles the greenhouse gas into the starting material for biofuel synthesis that will help us simultaneously combat two major challenges we face nowadays: global warming and energy shortages.

### GREENHOUSE EFFECT AND GLOBAL WARMING

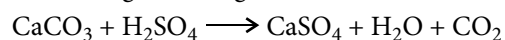
- ↪ The retention of heat by the earth and atmosphere from the sun and its prevention to escape into the outer space is known as *greenhouse effect*.
  - Greenhouse gases such as CO<sub>2</sub>, ozone, methane, chlorofluorocarbon compounds and water vapour form a thick cover around the earth which prevents the IR rays emitted by the earth to escape.
  - It gradually leads to increase in temperature of atmosphere.
- ↪ **Consequences of Greenhouse Effect**
  - Global warming would result in rise in sea level due to increased rate of melting of glaciers and floods.
  - Spread of some tropical diseases.
  - New weather patterns.
- ↪ **Control and prevention**
  - *Catalytic converters* : Devices attached to a vehicle's exhaust system to convert CO and hydrocarbons into water and carbon dioxide.
  - *Scrubbers* : Pollutant-laden air is passed through a mixture of water and lime which traps particulates and sulphur oxide gases.
  - HCFC's and HFC's are used in place of CFC's because they are largely destroyed in the lower region of the atmosphere.

### ACID RAIN

- ↪ The oxides of C, N and S present in the atmosphere, dissolve in water and produce acids and lower the pH of water to below 5.6.

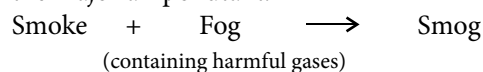


The acids are toxic to vegetation, react with marble and damage buildings.



### SMOG

- ↪ The word *smog* is derived from smoke and fog. It is the major air pollutant.

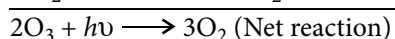
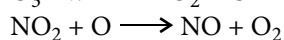
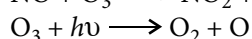
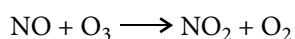
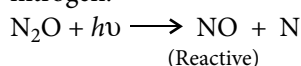


Classical smog	Photochemical smog
Also called as <i>London smog</i> .	Also called as <i>Los Angeles smog</i> .
Formed due to oxides of sulphur.	Formed due to oxides of nitrogen.
Contains primary pollutants.	Contains secondary pollutants.
Causes bronchitis and problems in lungs.	Causes irritation in eyes.
It is reducing in nature.	It is oxidising in nature.

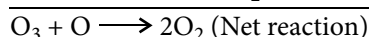
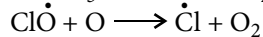
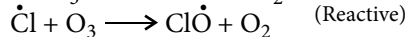
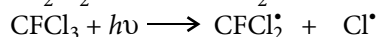
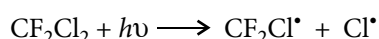
## STRATOSPHERIC POLLUTION

### Ozone depletion :

- The ozone layer, existing between 20 to 35 km above the earth's surface, shield the earth from the harmful UV radiations from the sun. The UV radiations cause skin cancer, cataract of eye, and harmful to vegetation.
- Depletion of ozone is caused by oxides of nitrogen.



- The presence of oxides of nitrogen increase the decomposition of O<sub>3</sub>. Depletion of ozone by chlorofluoro-carbons.



## WATER POLLUTION

- Water pollution is defined as, the contamination of water by foreign substances which makes it harmful for health of animals, plants or aquatic life and makes it unfit for domestic, industrial and agricultural use.

### Effects of water pollution :

- High concentrations of fluoride (over 10 ppm) are poisonous and harmful to bones and teeth.
- Excess nitrate in drinking water can lead to 'blue baby' syndrome.
- Excess sulphate (> 500 ppm) causes laxative effect.

### Remedial measures :

- Degradation of organic content of waste water by microbial oxidation.
- Removal of phosphates, coagulation, filtration and disinfection using chlorine for improving the quality of waste water.
- Sewage treatment should be improved.
- Settlement of the filtered waste water to remove

suspended solids, oily and greasy material which floats on the surface can be skimmed off.

- **Biochemical Oxygen Demand (BOD) :** It is defined as, the amount of free oxygen required for biological oxidation of the organic matter by aerobic conditions at 20°C for a period of five days. Its unit is mg/L or ppm. An average sewage has BOD value of 100 to 150 mg/L.

- **Chemical Oxygen Demand (COD) :** It is a measure of all types of oxidisable impurities (biologically oxidisable and biologically inert organic matter such as cellulose) present in the sewage. COD values are higher than BOD values.

## SOIL POLLUTION

- The addition of substances in an indefinite proportion which changes the productivity of the soil is known as *soil pollution*.

### Sources of soil pollution :

- Agricultural pollutants : Chemicals like pesticides, fertilizers, fumigants, insecticides, herbicides, fungicides.
- Domestic refuse and industrial wastes.
- Radioactive wastes from research centres and hospitals.
- Soil conditioners containing toxic metals like Hg, Pb, As, Cd etc.
- Pollutants present in air from chemical works.

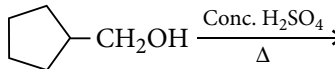
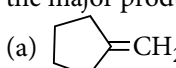
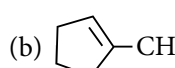
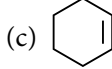
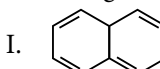
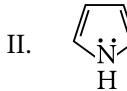
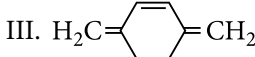
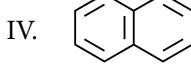
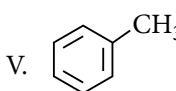
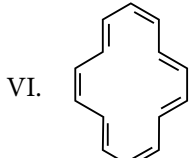
### Effects of soil pollution :

- Pollution runs-off into rivers and kills the fishes, plants and other aquatic life.
- Crops and fodder grown on polluted soil may pass on the pollutants to the consumers.
- Soil structure is damaged (clay ionic structure impaired).

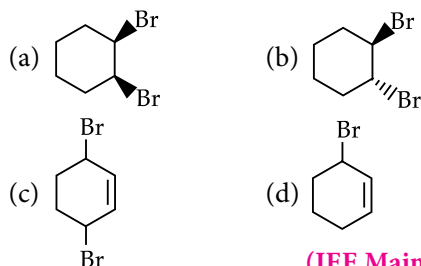
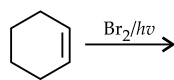
### Control of soil pollution :

- Reuse and recycle unwanted items. The less rubbish we create, the less chance the waste will end up in our soil.
- Make use of organic fertilizers and organic pesticides, because they are usually made of natural substances so are biodegradable.
- Insist on buying natural and organic food, because chemical pesticides and fertilizers are not used in their growing process.
- Cut down the usage of paper or use recycled paper.

# SPEED PRACTICE

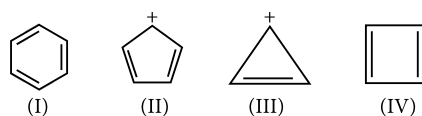
- An alkane  $C_7H_{16}$  is produced by the reaction of lithium di(3-pentyl)cuprate with ethyl bromide. The structural formula of the product is  
 (a) 3-ethylpentane (b) 2-methylpentane  
 (c) 3-methylhexane (d) 2-methylhexane.
- Mesopause represents the point of temperature inversion between  
 (a) troposphere and stratosphere  
 (b) mesosphere and thermosphere  
 (c) stratosphere and mesosphere  
 (d) troposphere and mesosphere.
- The reaction of propene with HOCl ( $Cl_2 + H_2O$ ) proceeds through the intermediate :  
 (a)  $CH_3-CH^+-CH_2-OH$   
 (b)  $CH_3-CH^+-CH_2-Cl$   
 (c)  $CH_3-CH(OH)-CH_2^+$   
 (d)  $CH_3-CHCl-CH_2^+$   
 (JEE Main 2016 offline)
- The concentration of fluoride, lead, nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of  
 (a) fluoride (b) lead (c) nitrate (d) iron.  
 (JEE Main 2016 offline)
- How many geometrical isomers are possible in the following two alkenes ?  
 (i)  $CH_3-CH=CH-CH=CH-CH_3$   
 (ii)  $CH_3-CH=CH-CH=CH-Cl$   
 (a) 4 and 4 (b) 4 and 3  
 (c) 3 and 3 (d) 3 and 4
- Among the following statements which one is incorrect?  
 (a) Suspended particulate matter (SPM) is an important pollutant released by diesel vehicles.  
 (b) Soot particles (size <  $5 \mu$ ) cause fibrosis of the lung lining.  
 (c)  $H_2SO_4$  particulates have size of 500-1000 nm.  
 (d) Photochemical smog is formed by oxides of sulphur, smoke and dust particles.
- For the reaction,  

  
 the major product is  
 (a)  (b)   
 (c)  (d) None of these.
- Main pollutants released from iron and steel industry are  
 (a) CO,  $CO_2$  and  $SO_2$  (b) NO,  $SO_2$  and  $H_2S$   
 (c)  $CO_2$ ,  $H_2S$  and  $NO_2$  (d)  $CO_2$ ,  $NO_2$  and  $SO_2$
- Which of the following can be used as the halide component for Friedel—Crafts reaction?  
 (a) Chlorobenzene (b) Bromobenzene  
 (c) Chloroethene (d) Isopropyl chloride  
 (NEET Phase-II 2016)
- Which of the following practices will not come under green chemistry?  
 (a) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.  
 (b) Using  $H_2O_2$  for bleaching purpose instead of using chlorine based bleaching agents.  
 (c) Using bicycle for travelling small distance instead of using petrol/diesel based vehicles.  
 (d) Using plastic cans for neatly storing substances.
- Which of the following compounds are aromatic according to Huckel's rule?  
 I.  II.   
 III.  IV.   
 V.  VI.   
 (a) I, II, IV, V only (b) II, IV, V, VI only  
 (c) II, III, V only (d) IV, V and VI only

12. Bromination of cyclohexene under conditions given below yields



(JEE Main 2016 online)

13. Which of the following species are antiaromatic?

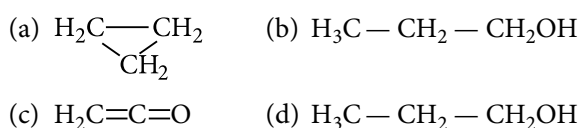


- (a) I, II (b) II, III  
(c) I, IV (d) II, IV

14. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value

- (a) slightly higher than that when the thunderstorm is not there  
(b) uninfluenced by occurrence of thunderstorm  
(c) which depends upon the amount of dust in air  
(d) slightly lower than that of rain water without thunderstorm.

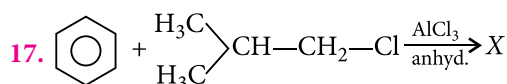
15. Which of the following compounds shall not produce propene by reaction with HBr followed by elimination or direct only elimination reaction?



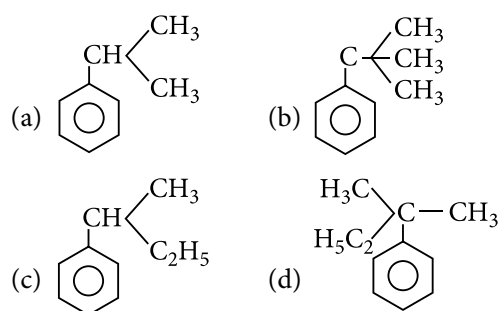
(NEET Phase-II 2016)

16. Biochemical Oxygen Demand, (BOD) is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be

- (a) rich in dissolved oxygen  
(b) poor in dissolved oxygen  
(c) highly polluted  
(d) not suitable for aquatic life



Identify X in the above reaction.



18. Which one of the following substances used in dry cleaning is a better strategy to control environmental pollution?

- (a) Sulphur dioxide (b) Carbon dioxide  
(c) Nitrogen dioxide (d) Tetrachloroethylene

(JEE Main 2016 online)

19. Which of the following is not an example of green chemistry?

- (a) Catalytic dehydrogenation of the diethanol amine without using cyanide and formaldehyde.  
(b) Replacement of CFCs by CO<sub>2</sub> as blowing agent in the manufacture of polystyrene foam sheets.  
(c) Reacting methylamine and phosgene to produce methyl isocyanate.  
(d) Replacement of organotins by 'sea-nine' as anti fouling compound in sea marines.

20. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane, is

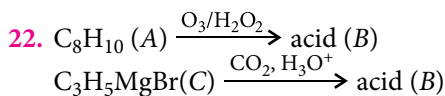
- (a) the eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain  
(b) the staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain  
(c) the staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain  
(d) the eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain.

(NEET Phase-I 2016)

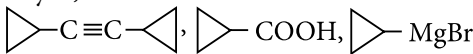
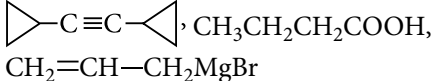
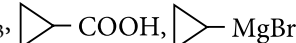
21. Sewage containing organic waste should not be disposed in water bodies because it causes major water pollution. Fishes in such a polluted water die because of

- (a) large number of mosquitoes  
(b) increase in the amount of dissolved oxygen

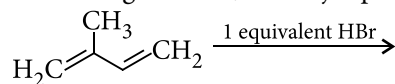
- (c) decrease in the amount of dissolved oxygen in water  
(d) clogging of gills by mud.

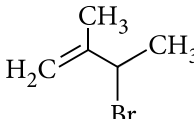
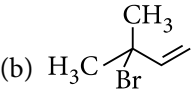
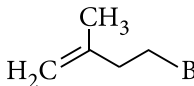
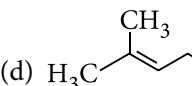


Identify A, B and C.

- (a)   
(b)   
(c)  $CH_3-CH_2-CH_2-CH_3$ ,  $CH_3CH_2CH_2COOH$ ,  $CH_2=CH-CH_2MgBr$   
(d)  $CH_3CH_2CH_2CH_3$ , 

23. In the following reaction, the major product is



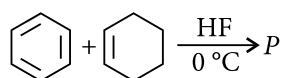
- (a)  (b)   
(c)  (d) 

(JEE Advanced 2015)

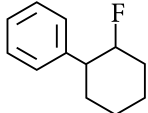
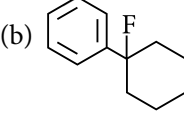
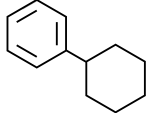
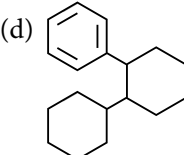
24. The Nobel prize in Chemistry in 2005 was awarded for the work

- (a) concerning the reduction of hazardous wastes in creating new chemicals  
(b) concerning the formation and decomposition of ozone  
(c) concerning the recycling of CFCs  
(d) concerning the climate change.

25. In the given reaction,

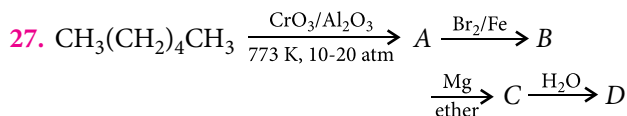


the product P is


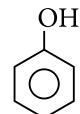
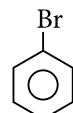
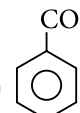
- (a)  (b)   
(c)  (d) 

(NEET Phase-II 2016)

26. Excess nitrate in drinking water can cause  
(a) methemoglobinemia (b) kidney damage  
(c) liver damage (d) laxative effect.


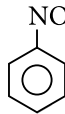
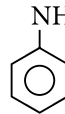
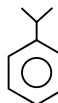


What is D ?

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

28. Which of the following statements is false?

- (a) Limestone acts as sink for  $SO_x$ .  
(b)  $SO_x$  can be removed from the gases by passing through a solution of citrate ions.  
(c) Ammonia acts as a sink for  $NO_x$ .  
(d) The average residence time of NO is one month.

29.      
(i) (ii) (iii) (iv)

The correct order towards electrophilic substitution reaction is

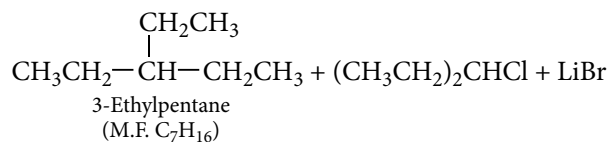
- (a) (iv) > (iii) > (ii) > (i)  
(b) (i) > (ii) > (iii) > (iv)  
(c) (iii) > (ii) > (i) > (iv)  
(d) (iii) > (iv) > (i) > (ii)

30. Which of the following arenes has the highest melting point?

- (a) *o*-Xylene (b) *p*-Xylene  
(c) *m*-Xylene (d) Toluene

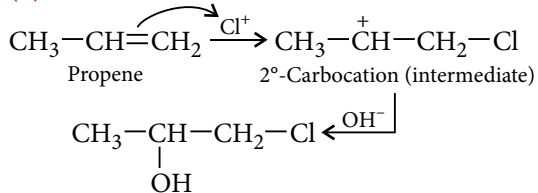
### SOLUTIONS

1. (a):  $[(CH_3CH_2)_2CH]_2CuLi + BrCH_2CH_3 \xrightarrow[\text{House reaction}]{\text{Corey}}$   
Lithium di(3-pentyl)cuprate Ethyl bromide



2. (b): The point of temperature inversion between mesosphere and thermosphere is called mesopause.

3. (b):  $\text{HOCl} \rightarrow \text{OH}^- + \text{Cl}^+$



4. (c): Fluoride, lead and iron are present within their permissible limits but nitrate ion which has permissible value of 50 ppm, is present in much higher amount *i.e.*, 100 ppm which makes the water unfit for drinking.

5. (d): When the ends of alkene containing  $n$  double bonds are different, the number of geometrical isomers is  $2^n$ .

Thus for  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{Cl}$   
number of geometrical isomers =  $2^2 = 4$

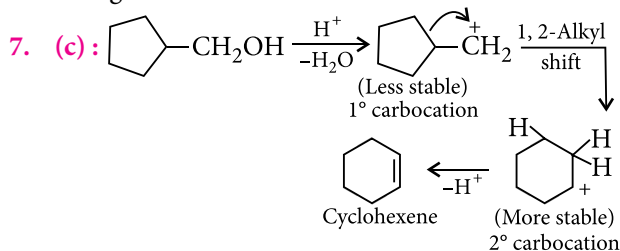
When the ends of alkene containing  $n$  double bonds are same, then the number of geometrical isomers =  $2^{n-1} + 2^{p-1}$

where  $p = \frac{n}{2}$  for even  $n$  and  $\frac{n+1}{2}$  for odd  $n$ , thus for

$\text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}_3$   
number of geometrical isomers

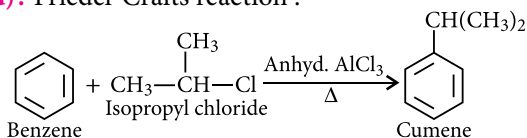
$$= 2^{2-1} + 2^{2-1} = 2^1 + 2^0 = 2 + 1 = 3.$$

6. (d): When climate is warm, dry and sunny, the oxides of nitrogen and unsaturated hydrocarbons are converted into the components such as PAN which form photochemical smog, by the action of sunlight.



8. (a): Iron and steel industry use coke as a reductant in a blast furnace which contains C and S. On oxidation, these are converted to CO, CO<sub>2</sub> and SO<sub>2</sub> gases respectively.

9. (d): Friedel-Crafts reaction :



Chlorobenzene, bromobenzene and chloroethene, are not suitable halide components because lone

pair of electrons of halogen are delocalised with  $\pi$ -bonds to attain double bond (C=X) character.

10. (d): Using plastic cans for neatly storing substance will not come under green chemistry.

11. (b): I has  $8\pi$  electrons, does not follow Huckel's rule. Hence, it is not aromatic.

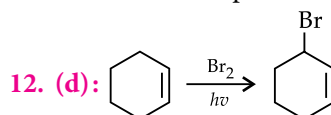
II has  $6\pi$  delocalised electrons. Hence, is aromatic.

III has  $6\pi$  electrons in conjugation but not in the ring, non-aromatic.

IV  $10\pi$  electrons in planar ring, aromatic.

V It has  $6\pi$  delocalised electrons in one six membered planar ring, which follows Huckel's rule due to which it will be aromatic.

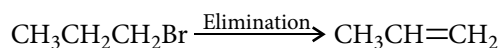
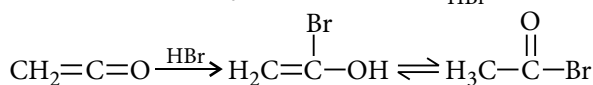
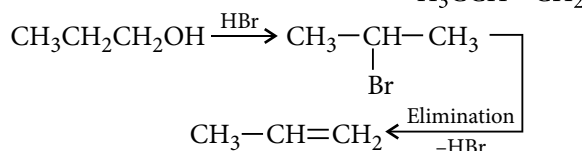
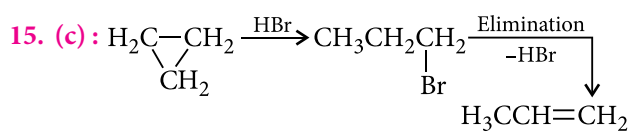
VI  $14\pi$  electrons are in conjugation and are present in a ring so, Huckel's rule is being followed. Hence, compound will be aromatic.



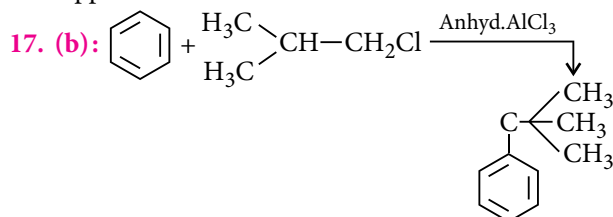
In presence of U.V. light allylic C—H bond undergoes bromination.

13. (d): Both (II and IV) contain  $4\pi$  delocalised electrons and hence are anti-aromatic.

14. (d): Normal rain water has a pH value 5.6. Thunderstorm forms NO which after oxidation gives HNO<sub>3</sub>. Thus, rain water accompanying thunderstorm has a pH lower than 5.6.



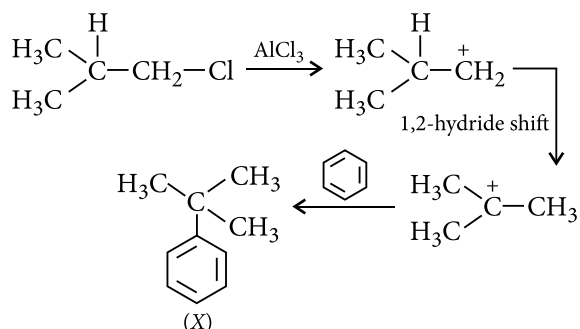
16. (a): Clean water would have BOD value of less than 5 ppm.





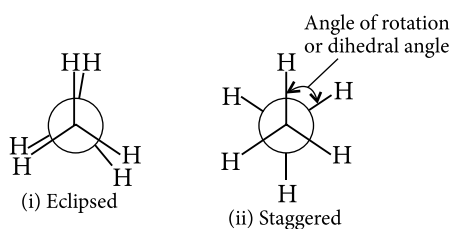
This reaction is an example of Friedel–Crafts reaction.

**Mechanism :**



18. (b): Liquid carbon dioxide is better to replace conventional halogenated solvents (potentially carcinogenic). These detergents are developed in a way that one end of the molecule is soluble in non-polar substances like grease, oil stains and the other end dissolves in liquid carbon dioxide.
19. (c): Reaction of methylamine and phosgene to produce MIC (methyl isocyanate) is not an example of green chemistry.

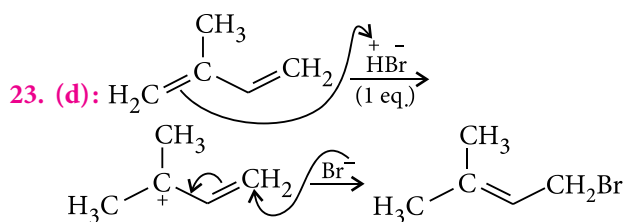
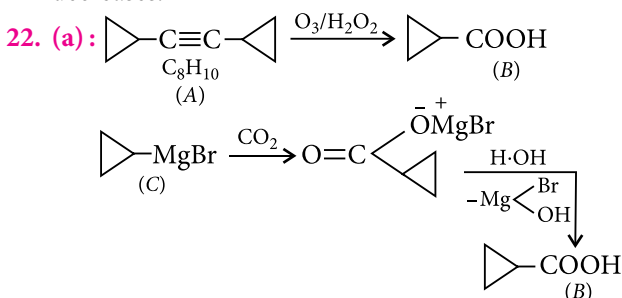
20. (b):



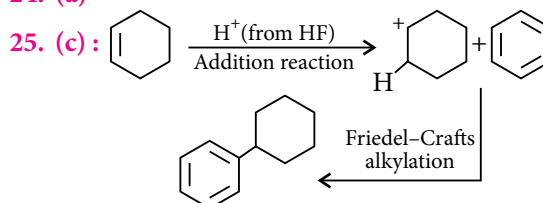
Newman's projections of ethane

Magnitude of torsional strain depends upon the angle of rotation about C—C bond. Staggered form has the least torsional strain and the eclipsed form has the maximum torsional strain. Therefore, the staggered conformation of ethane is more stable than the eclipsed conformation.

21. (c): Sewage containing organic waste should not be disposed in water bodies because it causes major water pollution. Fishes in such a polluted water die because the amount of dissolved oxygen in water decreases.

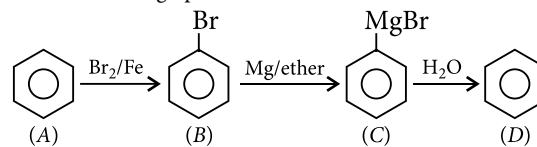
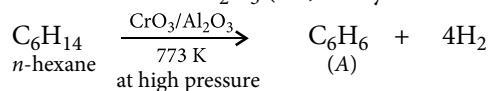


24. (a)



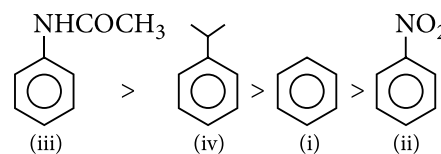
26. (a)

27. (a): Benzene can be prepared by cyclisation of long chain alkanes on heating at 500 - 550°C under high pressure in presence of catalyst CrO<sub>3</sub> supported on alumina or Pt - Al<sub>2</sub>O<sub>3</sub> (i.e., catalytic reforming)



28. (d): The average residence time of NO is 4 days.

29. (d): The more nucleophilic compound among the given will undergo more rapid electrophilic substitution reaction. -NHCOCH<sub>3</sub> group is more electron releasing group than -CH(CH<sub>3</sub>)<sub>2</sub> group, exhibit more rapid electrophilic substitution reaction. Hence, the correct order is



30. (b): Being symmetrical, *p*-xylene has the highest melting point.

**MPP-8 CLASS XII**

**ANSWER KEY**

1. (c)    2. (b)    3. (c)    4. (b)    5. (b)  
 6. (a)    7. (b)    8. (b)    9. (a)    10. (c)  
 11. (b)    12. (a)    13. (a)    14. (c)    15. (a)  
 16. (d)    17. (c)    18. (b)    19. (c)    20. (a,b,c,d)  
 21. (a,b,c)    22. (a,b,c)    23. (a,b,c,d)    24. (1)    25. (6)  
 26. (1)    27. (b)    28. (b)    29. (a)    30. (b)



# CROSSWORD



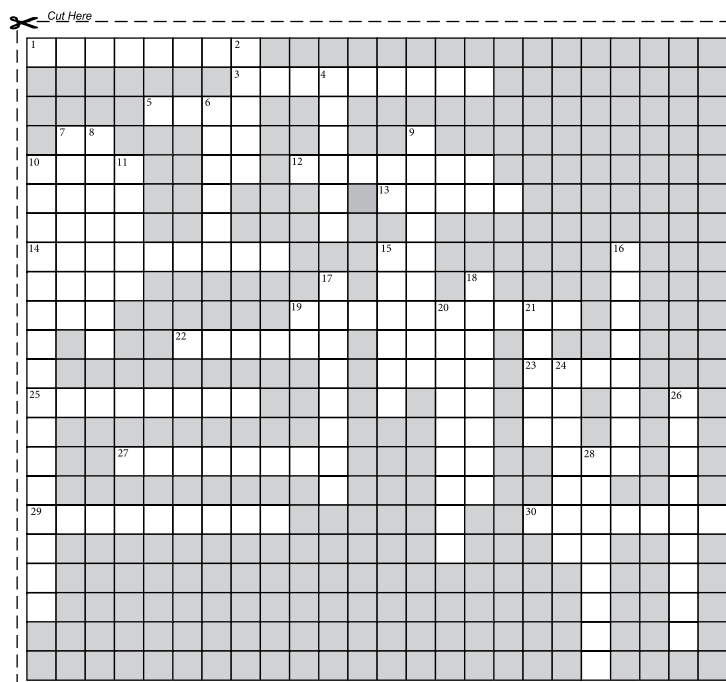
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## ACROSS

- An alternative name for amylase. (8)
- An aromatic amine used in the manufacture of dyes and drugs. (9)
- A white crystalline compound used as a nitrogenous fertilizer. (4)
- Reactive intermediate, containing a formally divalent carbon atoms. (7)
- Sum of powers of molar concentrations of the reacting species in the rate law expression. (5)
- A class of organic salts obtained by the treatment of an alcohol with  $CS_2$  in the presence of an alkali. (9)
- A mineral having the composition  $(Fe, Mn)WO_4$ . (10)
- A low melting alloy of tin and lead which is used in joining metals. (6)
- A gemstone consisting of a quartz like form of hydrated silica. (4)
- A process in which a sulphide ore is heated in the presence of air. (8)
- Scientist who proposed the theory of relativity. (8)
- Scientist who framed the periodic table of the elements based on their atomic masses. (9)
- A thermodynamic state function which is used to measure the randomness of the molecules. (7)

## DOWN

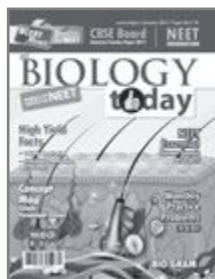
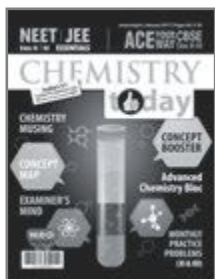
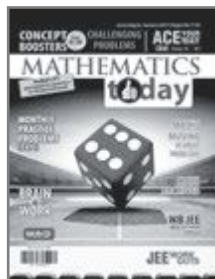
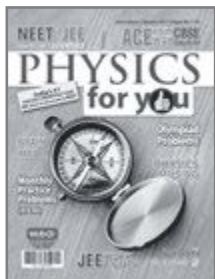
- Conversion of toluene to benzaldehyde in presence of chromyl chloride is given by \_\_\_\_\_ reaction. (5)
- An enzyme found in kidney and liver. (6)
- Solvent used to separate the components of a mixture in column chromatography. (6)
- A substance whose solution is employed to estimate the concentration of an unknown solution. (7)
- A principal ore of antimony. (8)
- A basic salt of copper used as a pigment, fungicide and mordant in dyeing. (9)
- Scientist who discovered the first antibiotic penicillin. (16)



- An organic reaction used for the preparation of symmetrical alkanes only. (5)
- A solution whose pH is not altered to a greater extent by the addition of acid or base. (6)
- A substance which increases the reaction rate without undergoing any chemical change. (8)
- A quadridentate macrocyclic ligand which is an important part of haemoglobin structure. (8)
- A process used for extracting metals from their oxides by reduction with carbon at high temperatures. (8)
- A process which exhibits no exchange of heat between system and its surroundings. (9)
- A common source of soda ash. (5)
- Light consists of a stream of particles called. (7)
- Solids which are isotropic and often considered as supercooled liquids. (9)
- The region of maximum electron density. (8)



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