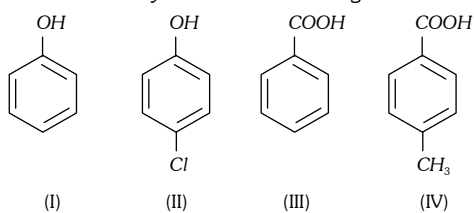


**CHEMISTRY****PART-I  
SECTION-I****Single Correct Choice Type**

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct

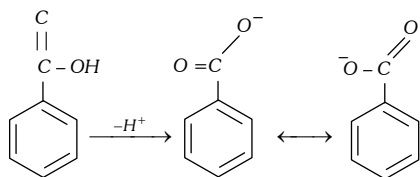
- 1.** Given that the abundances of isotopes  $^{54}\text{Fe}$ ,  $^{56}\text{Fe}$  and  $^{57}\text{Fe}$  are 5%, 90% and 5%, respectively, the atomic mass of Fe is  
 (A) 55.85 (B) 55.95 (C) 55.75 (D) 56.05
- Sol. (B)**  $^{54}\text{Fe} \longrightarrow 5\%$   
 $^{56}\text{Fe} \longrightarrow 90\%$   
 $^{57}\text{Fe} \longrightarrow 5\%$   
 Av. atomic mass =  $x_1A_1 + x_2A_2 + x_3A_3$   
 =  $54 \times 0.05 + 56 \times 0.9 + 57 \times 0.05 = 55.95$
- 2.** The term that corrects for the attractive forces present in a real gas in the vander Waals equation is  
 (A)  $nb$  (B)  $\frac{an^2}{V^2}$  (C)  $-\frac{an^2}{V^2}$  (D)  $-nb$
- Sol. (B)** Correction factor for attractive force in to the real gas is given by  $\frac{an^2}{V^2}$ .
- 3.** Among the electrolytes  $\text{Na}_2\text{SO}_4$ ,  $\text{CaCl}_2$ ,  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{NH}_4\text{Cl}$ , the most effective coagulating agent for  $\text{Sb}_2\text{S}_3$  sol is  
 (A)  $\text{Na}_2\text{SO}_4$  (B)  $\text{CaCl}_2$  (C)  $\text{Al}_2(\text{SO}_4)_3$  (D)  $\text{NH}_4\text{Cl}$
- Sol. (C)** Most effective coagulating agent for  $\text{Sb}_2\text{S}_3$  is  $\text{Al}_2(\text{SO}_4)_3$  because of high charge.
- 4.** The Henry's law constant for the solubility of  $\text{N}_2$  gas in water at 298 K is  $1.0 \times 10^5$  atm. The mole fraction of  $\text{N}_2$  in air is 0.8. The number of moles of  $\text{N}_2$  from air dissolved in 10 moles of water at 298 K and 5 atm pressure is  
 (A)  $4.0 \times 10^{-4}$  (B)  $4.0 \times 10^{-5}$  (C)  $5.0 \times 10^{-4}$  (D)  $4.0 \times 10^{-6}$
- Sol. (A)**  $P_{\text{N}_2} = K_H \times X_{\text{N}_2}$   
 $X_{\text{N}_2} = \frac{1}{10^5} \times 0.8 \times 5 = 4 \times 10^{-5}$  per mole  
 In 10 mole solubility is  $4 \times 10^{-4}$ .
- 5.** The reaction of  $\text{P}_4$  with X leads selectively to  $\text{P}_4\text{O}_6$ . The X is  
 (A) Dry  $\text{O}_2$  (B) A mixture of  $\text{O}_2$  and  $\text{N}_2$   
 (C) Moist  $\text{O}_2$  (D)  $\text{O}_2$  in the presence of aqueous  $\text{NaOH}$
- Sol. (B)**  $\text{P}_4 + 3\text{O}_2 \xrightarrow{\text{In presence of } \text{N}_2} \text{P}_4\text{O}_6$ . Here nitrogen acts as diluent.
- Note :** In dry  $\text{O}_2$  following reactions may take place.  
 $\text{P}_4 + 3\text{O}_2 \longrightarrow \text{P}_4\text{O}_6$   
 $\text{P}_4\text{O}_6 + 2\text{O}_2 \longrightarrow \text{P}_4\text{O}_{10}$ .  
 In moist  $\text{O}_2$  the  $\text{P}_4\text{O}_6$  gets hydrolysed forming  $\text{H}_3\text{PO}_3$ .  
 $\text{P}_4\text{O}_6 + 6\text{H}_2\text{O} \longrightarrow 4\text{H}_3\text{PO}_3$ .  
 In presence of  $\text{NaOH}$ .  
 $\text{P}_4 + 3\text{OH}^- + 3\text{H}_2\text{O} \longrightarrow \text{PH}_3 + 3\text{H}_2\text{PO}_2^-$

6. The correct acidity order of the following is

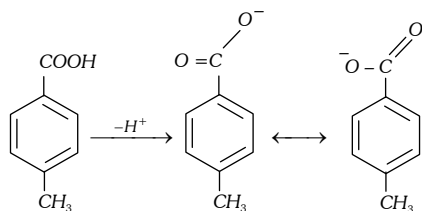


- (A) (III) > (IV) > (II) > (I)      (B) (IV) > (III) > (I) > (II)      (C) (III) > (II) > (I) > (IV)      (D) (II) > (III) > (IV) > (I)

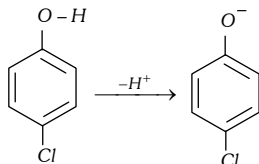
Sol. (A)



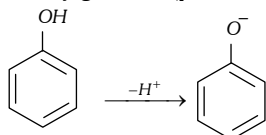
More stable conjugate base (carboxylate anion,  $-ve$  charge always on oxygen atom).



More stable conjugate base (carboxylate anion,  $-ve$  charge always on oxygen atom). + I and hyperconjugative effect of  $-CH_3$  group decreases stability of benzoate anion.



Less stable conjugate base (phenoxide ion is less resonance stabilized than benzoate anion).  $-Cl$  group exhibits  $-I$  effect.

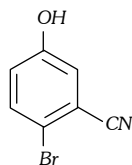


Less stable conjugate base (phenoxide ion is less resonance stabilized than benzoate anion).

7. Among cellulose, poly(vinyl chloride), nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is  
 (A) Nylon                      (B) Poly(vinyl chloride)                      (C) Cellulose                      (D) Natural Rubber

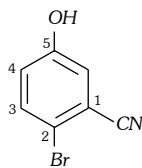
Sol. (D) The natural rubber has intermolecular forces which are weak dispersion force (vander Waals forces of attraction) and is an example of an elastomer (polymer).

8. The IUPAC name of the following compound is



- (A) 4-Bromo-3-cyanophenol      (B) 2-Bromo-5-hydroxybenzonitrile      (C) 2-Cyano-4-hydroxybromobenzene      (D) 6-Bromo-3-hydroxybenzonitrile

Sol. (B)



2-Bromo-5-hydroxybenzonitrile (  $-\text{CN}$  group gets higher priority over  $-\text{OH}$  and  $-\text{Br}$  )

## SECTION-II

### Multiple Correct choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/are correct.

9. The correct statement(s) regarding defects in solids is (are)
- (A) Frenkel defect is usually favoured by a very small difference in the sizes of cation and anion
  - (B) Frenkel defect is a dislocation defect
  - (C) Trapping of an electron in the lattice leads to the formation of F-center
  - (D) Schottky defects have no effect on the physical properties of solids

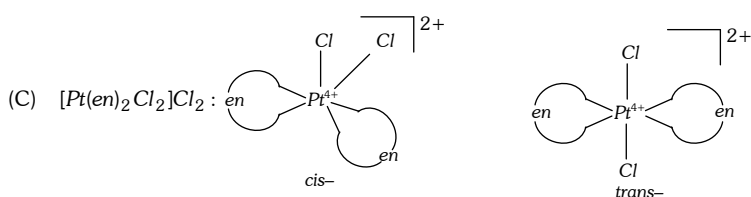
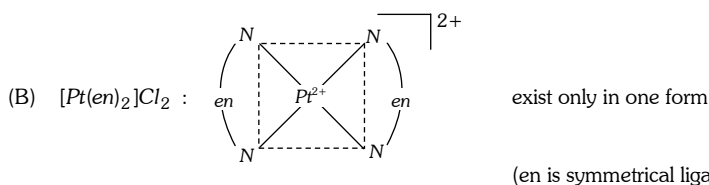
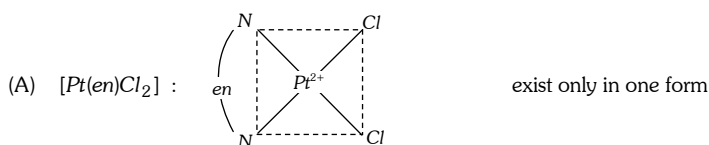
Sol. (B,C) Frenkel defect is a dislocation defect.

Trapping of an electron in the lattice leads to the formation of F-center.

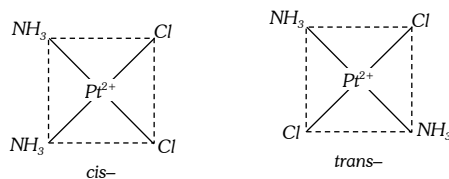
10. The compound(s) that exhibit(s) geometrical isomerism is(are)

- (A)  $[\text{Pt}(\text{en})\text{Cl}_2]$
- (B)  $[\text{Pt}(\text{en})_2]\text{Cl}_2$
- (C)  $[\text{Pt}(\text{en})_2\text{Cl}_2]\text{Cl}_2$
- (D)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

Sol. (C,D)

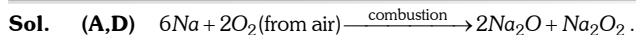


- (D)  $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$  : Pt is in +2 oxidation state having  $5d^8$  configuration. Hence the hybridisation of complex is  $dsp^2$  and geometry is square planar.



11. The compound(s) formed upon combustion of sodium metal in excess air is(are)

- (A)  $\text{Na}_2\text{O}_2$
- (B)  $\text{Na}_2\text{O}$
- (C)  $\text{NaO}_2$
- (D)  $\text{NaOH}$



- 12.** The correct statement(s) about the compound  $\text{H}_3\text{C}(\text{HO})\text{HC} - \text{CH} = \text{CH} - \text{CH}(\text{OH})\text{CH}_3$  (X) is(are)
- (A) The total number of stereoisomers possible for X is 6  
 (B) The total number of diastereomers possible for X is 3  
 (C) If the stereochemistry about the double bond in X is *trans*, the number of enantiomers possible for X is 4  
 (D) If the stereochemistry about the double bond in X is *cis*, the number of enantiomers possible for X is 2

**Sol. (A,D)** (X) has configurations

- (1) R Z R  
 (2) S Z S  
 (3) R Z S  
 (4) R E R  
 (5) S E S  
 (6) R E S

### SECTION-III

#### Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

#### Paragraph for Question Nos. 13 to 15

*p*-Amino-*N,N*-dimethylaniline is added to a strongly acidic solution of **X**. The resulting solution is treated with a few drops of aqueous solution of **Y** to yield blue coloration due to the formation of methylene blue. Treatment of the aqueous solution of **Y** with the reagent potassium hexacyanoferrate(II) leads to the formation of an intense blue precipitate. The precipitate dissolves on excess addition of the reagent. Similarly, treatment of the solution of **Y** with the solution of potassium hexacyanoferrate (III) leads to a brown coloration due to the formation of **Z**.

**13.** The compound **X** is

- (A)  $\text{NaNO}_3$                       (B)  $\text{NaCl}$                       (C)  $\text{Na}_2\text{SO}_4$                       (D)  $\text{Na}_2\text{S}$

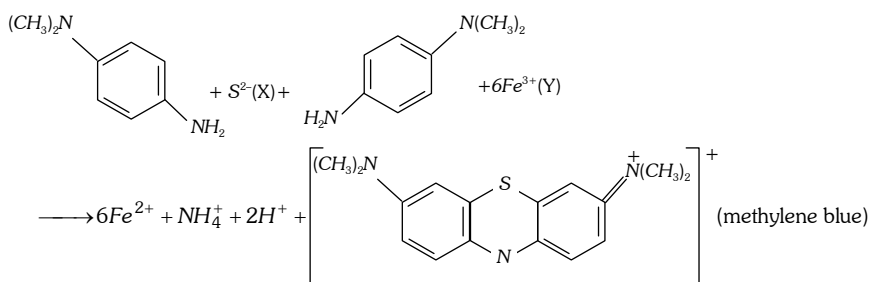
**Sol. (D)**

**14.** The compound **Y** is

- (A)  $\text{MgCl}_2$                       (B)  $\text{FeCl}_2$                       (C)  $\text{FeCl}_3$                       (D)  $\text{ZnCl}_2$

**Sol. (C)**

**Solution (13 and 14)**



The compound **X** is  $\text{Na}_2\text{S}$  and **Y** is  $\text{FeCl}_3$ .

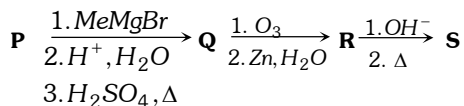
**15.** The compound **Z** is

- (A)  $\text{Mg}_2[\text{Fe}(\text{CN})_6]$                       (B)  $\text{Fe}[\text{Fe}(\text{CN})_6]$                       (C)  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$                       (D)  $\text{K}_2\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$

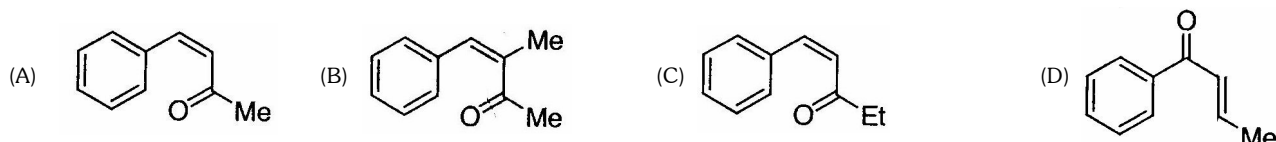
**Sol. (B)**  $\text{Fe}^{3+} + [\text{Fe}(\text{CN})_6]^{3-} \longrightarrow \text{Fe}[\text{Fe}(\text{CN})_6]$  (brown colouration) (Z).

### Paragraph for Question Nos. 16 to 18

A carbonyl compound **P**, which gives positive iodoform test, undergoes reaction with  $MeMgBr$  followed by dehydration to give an olefin **Q**. Ozonolysis of **Q** leads to a dicarbonyl compound **R**, which undergoes intramolecular aldol reaction to give predominantly **S**.

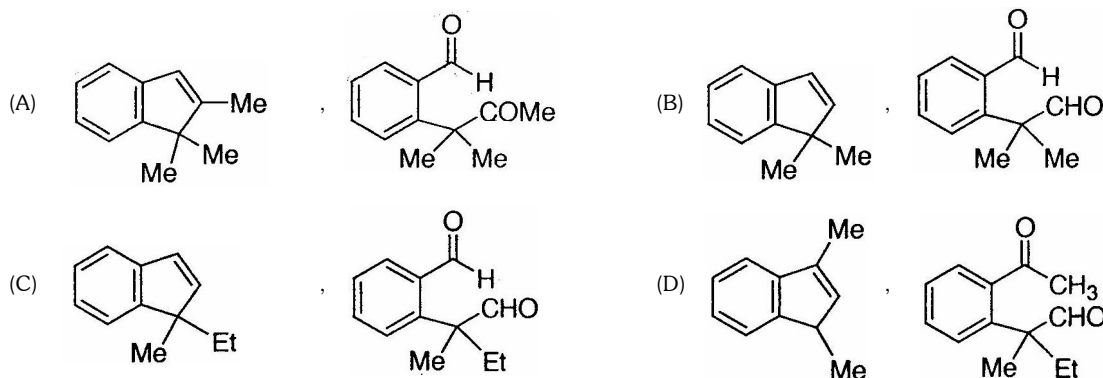


16. The structure of the carbonyl compound **P** is



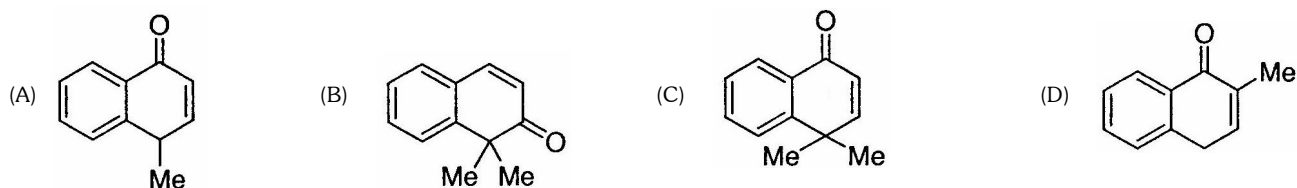
Sol. (B)

17. The structures of the products **Q** and **R**, respectively, are



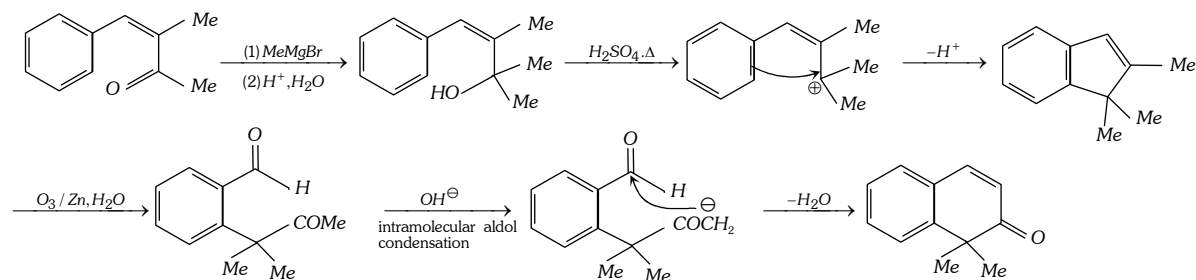
Sol. (A)

18. The structure of the product **S** is



Sol. (B)

Solution. (16, 17 and 18)



## SECTION - IV

### Matrix - Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statements(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example :

If the correct matches are A-p, s and t; B - q and r; C - p and q; and D- s and t; then the correct darkening of bubbles will look like the following.

	p	q	r	s	t
A	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

19. Match each of the diatomic molecules in **Column I** with its property/properties in **Column II**.

#### Column I

- (A)  $B_2$   
(B)  $N_2$   
(C)  $O_2^-$   
(D)  $O_2$

#### Column II

- (p) Paramagnetic  
(q) Undergoes oxidation  
(r) Undergoes reduction  
(s) Bond order  $\geq 2$   
(t) Mixing of 's' and 'p' orbitals

Sol. (A  $\rightarrow$  p, r, t); (B  $\rightarrow$  s, t); (C  $\rightarrow$  p, q, r); (D  $\rightarrow$  p, r, s).

- (A)  $B_2$   $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^1 = \pi 2p_y^1$   
Bond order = 1 Paramagnetic
- (B)  $N_2$   $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2 \sigma 2p_z^2$   
Bond order = 3 Diamagnetic
- (C)  $O_2^-$   $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^2 = \pi^* 2p_y^1$   
Bond order = 1.5 Paramagnetic
- (D)  $O_2$   $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$   
Bond order = 2 Paramagnetic

20. Match each of the compounds in **Column I** with its characteristic reaction(s) in **Column II**

#### Column I

- (A)  $CH_3CH_2CH_2CN$   
(B)  $CH_3CH_2COCH_3$   
(C)  $CH_3 - CH = CH - CH_2OH$   
(D)  $CH_3CH_2CH_2CH_2NH_2$

#### Column II

- (p) Reduction with  $Pd - C / H_2$   
(q) Reduction with  $SnCl_2 / HCl$   
(r) Development of foul smell on treatment with chloroform and alcoholic  $KOH$   
(s) Reduction with diisobutylaluminium hydride (DIBAL-H)  
(t) Alkaline hydrolysis

Sol. (A  $\rightarrow$  p, q, s, t); (B  $\rightarrow$  p, s, t); (C  $\rightarrow$  p); (D  $\rightarrow$  r).

- (A)  $CH_3CH_2CH_2CN \xrightarrow{Pd-C/H_2} CH_3CH_2CH_2CH_2NH_2$  (p)  
 $\xrightarrow{SnCl_2/HCl} CH_3CH_2CH_2CH_2NH_2$  (q)

