IIT-JEE 2009 Chemistry Paper I

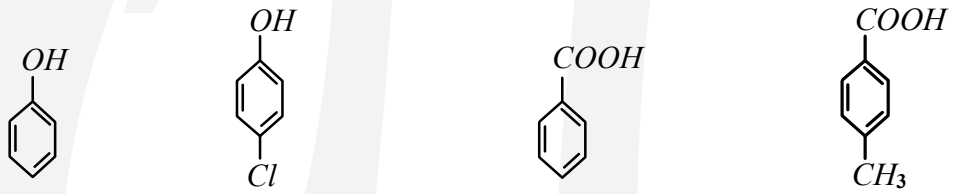
PART I - Chemistry

SECTION I - Straight Objective Type

1. The Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is
   (A) 4.0×10^{-4} (B) 4.0×10^{-5} (C) 5.0×10^{-4} (D) 4.0×10^{-6}

1. **(A)** $P = K_H.x$
   $0.8 \times 5 = 10^5 \times \{x / (10 + x)\}$
   $4 \times 10^{-5} = (x / 10) \quad \therefore x = 4 \times 10^{-4}$

2. The correct acidity order of the following is



(I) (II) (III) (IV)

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

2. **(A)** An acid is more acidic and electron withdrawing group increases acidic character.

3. The reaction of P_4 with X leads selectively to P_4O_6. The X is
   (A) Dry O_2 (B) A mixture of O_2 and N_2
   (C) Moist O_2 (D) O_2 in the presence of aqueous $NaOH$

3. (B) P_4 with limited supply of air gives P_4O_6

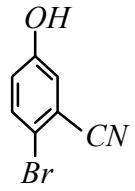
4. Among cellulose, poly(vinyl chloride), nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is
   (A) Nylon (B) Poly(vinyl chloride)
   (C) Cellulose (D) Natural Rubber

4. **(D)**

5. Given that the abundances of isotopes ^{54}Fe, ^{56}Fe and ^{57}Fe are 5%, 90% and 5%, respectively, the astomic mass of *Fe* is
(A) 55.85 (B) 55.95 (C) 55.75 (D) 56.05

5. **(B)** $(5 \times 54 + 56 \times 90 + 57 \times 5) / 100 = 55.95$

6. 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

6. **(B)** – *CN* is the principal functional group.

7. Among the electrolytes Na_2SO_4, $CaCl_2$, $Al_2(SO_4)_3$ and NH_4Cl, the most effective coagulating agent for Sb_2S_3 sol is
(A) Na_2SO_4 (B) $CaCl_2$ (C) $Al_2(SO_4)_3$ (D) NH_4Cl

7. **(C)** Sb_2S_3 is – ve sol and Al^{+3} has the highest coagulating power.

8. The term that corrects for the attractive forces present in a real gas in the van der Waals equation is

(A) nb (B) $\frac{an^2}{V^2}$ (C) $-\frac{an^2}{V^2}$ (D) $-nb$

8. **(B)**

SECTION II - Multiple Type

9. The compound(s) formed upon combustion of sodium metal in excess air is (are)
(A) Na_2O_2 (B) Na_2O (C) NaO_2 (D) $NaOH$

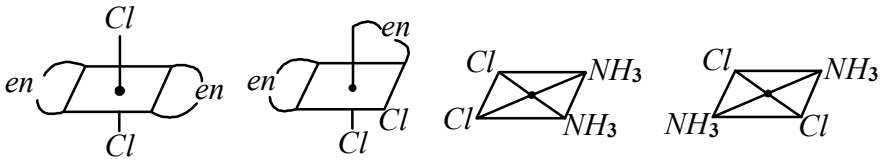
9. **(ABD)** Air contains moisture and hence gives *NaOH*.

10. The correct statement(s) about the compound $H_3C(HO)HC - CH = CH - CH(OH)CH_3$ (***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 sterechemistry about the double bond in ***X*** is *trans*, the number of enantiomers possible for ***X*** is 4
(D) If the sterechemistry about the double bond in ***X*** is *cis*, the number of enantiomers possible for ***X*** is 2

10. **(AD)** It gives three pair of diastereomers.

11. The compound(s) that exhibit(s) geometrical isomerism is (are)
(A) $[Pt(en)Cl_2]$ (B) $[Pt(en)_2]Cl_2$ (C) $[Pt(en)_2Cl_2]Cl_2$ (D) $[Pt(NH_3)_2Cl_2]$

11. **(CD)**



12. 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 lasttice leads to the formation of F-center
(D) Schottky defects have no effect on the physical properties of solids

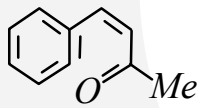
12. **(BC)**

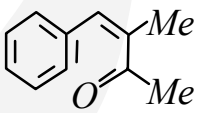
SECTION III - Linked Comprehension Type Paragraph for Questions 13 to 15

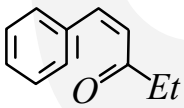
A carbonyl compound ***P*,** which gives iodoform test**,** undergoes reaction with *MeMgBr* followed by dehydration to give an olefin ***Q***. Ozonolysis of ***Q*** leads to a dicarbonyl compound ***R*,** which undergoes intramolecular aldol reaction to give predominantly ***S***.

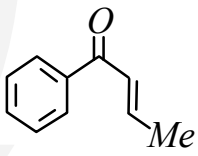
$$P \xrightarrow[2.H^+,H_2O \\ 3.H_2SO_4,\Delta]{1.MeMgBr} \boldsymbol{Q} \xrightarrow[2.Zn,H_2O]{1.O_3} \boldsymbol{R} \xrightarrow[2.\Delta]{1.OH^-} \boldsymbol{S}$$

13. The structure of the carbonyl compound ***P*** is **:**

(A) 

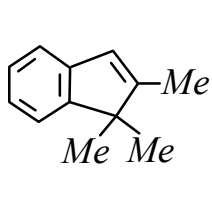
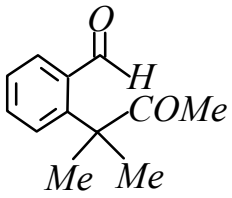
(B) 

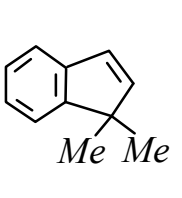
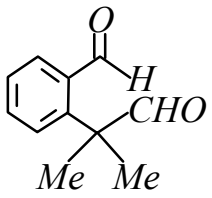
(C) 

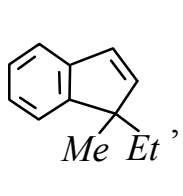
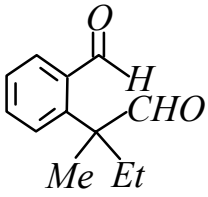
(D) 

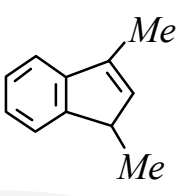
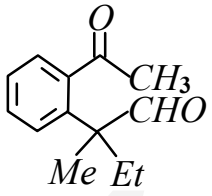
13. **(B)**

14. The structure of the products ***Q*** and ***R***, respectively, are

(A)  , 

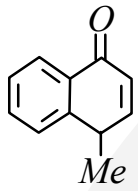
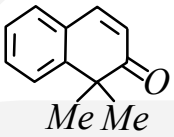
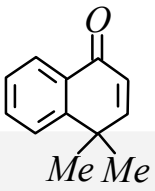
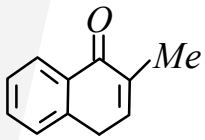
(B)  , 

(C)  , 

(D)  , 

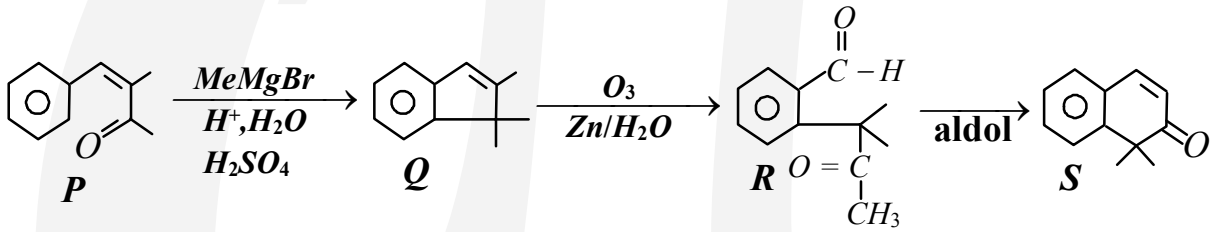
14. **(A)**

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

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

15. **(B)**

13 to 15 (solution)



Paragraph for Questions 16 to 18

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 field 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 ***Y*** with the solution of potassium hexacyanoferrate (III) leads to a brown coloration due to the formation of ***Z***.

16. The compound ***X*** is

(A) $NaNO_3$ (B) $NaCl$ (C) Na_2SO_4 (D) Na_2S

16. **(D)**

17. The compound ***Y*** is

(A) $MgCl_2$ (B) $FeCl_2$ (C) $FeCl_3$ (D) $ZnCl_2$

17. **(C)** $FeCl_3$ gives prussian blue with $K_4[Fe(CN)_6]$

18. The compound ***Z*** is

(A) $Mg_2[Fe(CN)_6]$ (B) $Fe[Fe(CN)_6]$

(C) $Fe_4[Fe(CN)_6]_3$ (D) $K_2Zn_3\ [Fe(CN)_6]_2$

18. **(B)** $Fe^{+3} + [Fe(CN)_6]^{-3} \rightarrow Fe[Fe(CN)_6]$ Brown

SECTION IV - Matrix - Match Type

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

Column I	**Column II**
(A) $CH_3CH_2CH_2CN$	(p) Reduction with $Pd - C$ / H_2
(B) $CH_3CH_2OCOCH_3$	(q) Reduction with $SnCl_2$ / HCl
(C) $CH_3 - CH = CH - CH_2OH$	(r) Development of foul smell on treatment with chloroform and alcoholic KOH
(D) $CH_3CH_2CH_2CH_2NH_2$	(s) Reduction with diisobutylaluminium hydride (DIBAL - H)
	(t) Alkaline hydrolysis

19. **(A) → (pqst) ; (B) → (st) ; (C) → (p) ; (D) → (r)**

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

Column I	**Column II**
(A) B_2	(p) Paramagnetic
(B) N_2	(q) Undergoes oxidation
(C) O^-_2	(r) Undergoes reduction
(D) O_2	(s) Bond order ≥ 2
	(t) Mixing of '*s*' and '*p*' orbitals

20. **(A) → (pqrt) ; (B) → (qrst) ; (C) → (pqr) ; (D) → (pqrs)**

B_2 : Can be oxidised to B_2O_3

B_2 : Can be reduced to Magnesium boride

N_2 : Can give oxide

N_2 : Can be reduced to NH_3

O_2^- : Can be reduced to O_2^{2-} and oxidised to O_2

O_2 : Can be reduced to O^{2-} and oxidised to O^{2+} or O_2^{2+}