FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Tuesday 09th April, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

61. The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 'A' × 10^{12} hertz and that has a radiant intensity in that direction of $\frac{1}{\text{'B'}}$ watt per steradian. 'A' and 'B' are respectively

(1) 540 and $\frac{1}{683}$

(2) 540 and 683

(3) 450 and $\frac{1}{683}$

(4) 450 and 683

Ans. (2)

Sol. The candela is the luminous intensity of a source that emits monochromatic radiation of frequency radiation of frequency 540 × 10^{12} Hz and has a radiant intensity in that direction of $\frac{1}{683}$ w/sr. It is unit of Candela.

62. The correct stability order of the following resonance structures of CH_3–CH = CH–CHO is

CH_3–$\overset{\ominus}{C}$H–CH=C(–$\ddot{O}^{\oplus}$)–H (I) ↔ CH_3–$\overset{\oplus}{C}$H–CH=C(–$\ddot{O}^{\ominus}$)–H (II)

↔ CH_3–CH=CH–C(=$\ddot{O}$)–H (III)

(1) II > III > I
(2) III > II > I
(3) I > II > III
(4) II > I > III

Ans. (2)

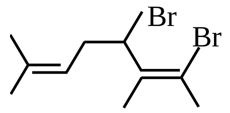
Sol. CH_3–CH=CH–CH(=O) (III)
↓
Non Polar R.S.
More No of covalent bond

CH_3–$\overset{\oplus}{C}$H–CH=CH(–$O^{\ominus}$) (II)
↓
Having –ve charge on more electronegative atom

CH_3–$\overset{\ominus}{C}$H–CH=CH(–$O^{\oplus}$) (I)
↓
Having –ve charge on less electronegative atom

Stability order III > II > I

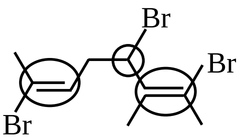
63. Total number of stereo isomers possible for the given structure:



(1) 8 (2) 2
(3) 4 (4) 3

Ans. (1)

Sol.



There are three stereo center
So No of stereoisomer = 2^3 = 8

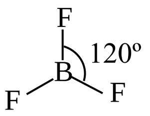
64. The correct increasing order for bond angles among BF_3, PF_3 and $C\ell F_3$ is :

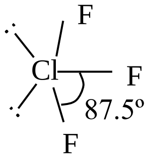
(1) $PF_3 < BF_3 < C\ell F_3$ (2) $BF_3 < PF_3 < C\ell F_3$

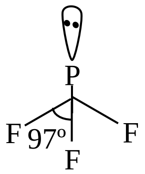
(3) $C\ell F_3 < PF_3 < BF_3$ (4) $BF_3 = PF_3 < C\ell F_3$

Ans. (3)

Sol.







Order of bond angle is

$ClF_3 < PF_3 < BF_3$

65. Match List I with List II

LIST-I (Test)		LIST-II (Observation)	
A.	Br_2 water test	I.	Yellow orange or orange red precipitate formed
B.	Ceric ammonium nitrate test	II.	Reddish orange colour disappears
C.	Ferric chloride test	III.	Red colour appears
D.	2, 4-DNP test	IV.	Blue, Green, Violet or Red colour appear

Choose the correct answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-II, B-III, C-IV, D-I

(3) A-III, B-IV, C-I, D-II

(4) A-IV, B-I, C-II, D-III

Ans. (2)

Sol. (A) Br_2 water test is test of unsaturation in which reddish orange colour of bromine water disappears.

(B) Alcohols given Red colour with ceric ammonium nitrate.

(C) Phenol gives Violet colour with natural ferric chloride.

(D) Aldehyde & Ketone give Yellow/Orange/Red Colour compounds with 2, 4-DNP i.e., 2, 4-Dinitrophenyl hydrazine.

66. Match List I with List II

LIST-I (Cell)		LIST-II (Use/Property/Reaction)	
A.	Leclanche cell	I.	Converts energy of combustion into electrical energy
B.	Ni-Cd cell	II.	Does not involve any ion in solution and is used in hearing aids
C.	Fuel cell	III.	Rechargeable
D.	Mercury cell	IV.	Reaction at anode $Zn \rightarrow Zn^{2+} + 2e^-$

Choose the correct answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-III, B-I, C-IV, D-II

(3) A-IV, B-III, C-I, D-II

(4) A-II, B-III, C-IV, D-I

Ans. (3)

Sol. A-IV, B-III, C-I, D-II

67. Match List I with List II

LIST-I		LIST-II	
A.	$K_2[Ni(CN)_4]$	I.	sp^3
B.	$[Ni(CO)_4]$	II.	sp^3d^2
C.	$[Co(NH_3)_6]Cl_3$	III.	dsp^2
D.	$Na_3[CoF_6]$	IV.	d^2sp^3

Choose the correct answer from the options given below:

(1) A-III, B-I, C-II, D-IV

(2) A-III, B-II, C-IV, D-I

(3) A-I, B-III, C-II, D-IV

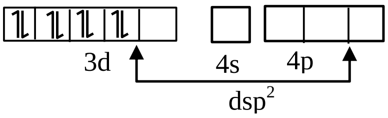
(4) A-III, B-I, C-IV, D-II

Ans. (4)

Sol. **(A)** $K_2 [\overset{+2}{Ni}(CN)_4]$

Ni^{2+} : $[Ar]3d^8\,4s^o$,(CN^- is S.F.L)

Pre hybridization state of Ni^{+2}

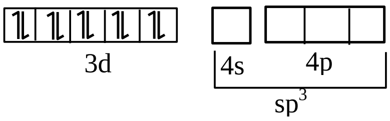


(B) $[Ni(CO)_4]$

Ni : $[Ar]\ 3d^8\,4s^2$

CO is S.F.L , so pairing occur

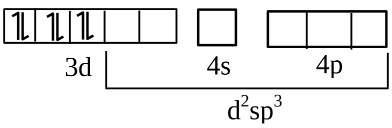
Pre hybridization state of Ni



(C) $[Co(NH_3)_6]Cl_3$

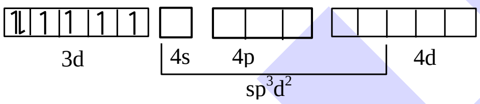
Co^{+3} : $[Ar]3d^6\,4s^0$

With Co^{3+}, NH_3 act as S.F.L



(d) $Na_3\ [CoF_6]$

Co^{3+} : $[Ar]\ 3d^6$ ($F^{\ominus}$: W.F.L)



68. The coordination environment of Ca^{2+} ion in its complex with $EDTA^{4-}$ is :

(1) tetrahedral

(2) octahedral

(3) square planar

(4) trigonal prismatic

Ans. **(2)**

Sol. $EDTA^{4-} \rightarrow$ Hexadentate ligand

$[Ca(EDTA)]^{2-}$

So Coordination environment is octahedral

69. The **incorrect** statement about Glucose is :

(1) Glucose is soluble in water because of having aldehyde functional group

(2) Glucose remains in multiple isomeric form in its aqueous solution

(3) Glucose is an aldohexose

(4) Glucose is one of the monomer unit in sucrose

Ans. **(1)**

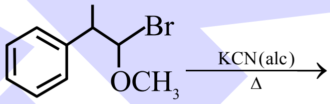
Sol. Glucose is soluble in water due to presence of alcohol functional group and extensive hydrogen bonding.

Glucose exist is open chain as well as cyclic forms in its aqueous solution.

Glucose having 6C atoms so it is hexose and having aldehyde functional group so it is aldose.

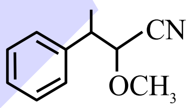
Thus, aldohexose.

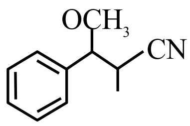
Glucose is monomer unit in sucrose with fructose.

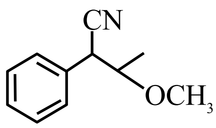
70. 

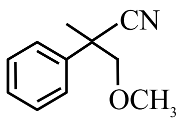
Major Product 'P'

In the above reaction product 'P' is

(1) 

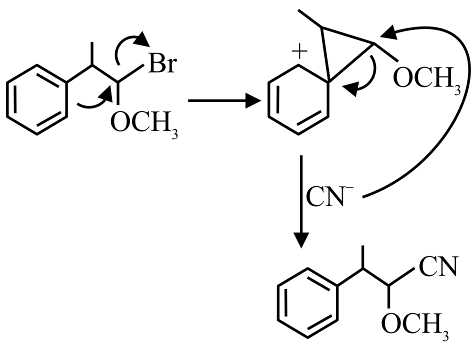
(2) 

(3) 

(4) 

Ans. **(1)**

Sol.



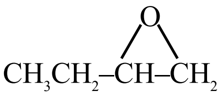
Due to NGP effect of phenyl ring Nucleophilic substitution of Br will occurs.

71. Which of the following compound can give positive iodoform test when treated with aqueous KOH solution followed by potassium hypoiodite.

(1) $CH_3CH_2-\overset{O}{\overset{||}{C}}-CH_2CH_3$

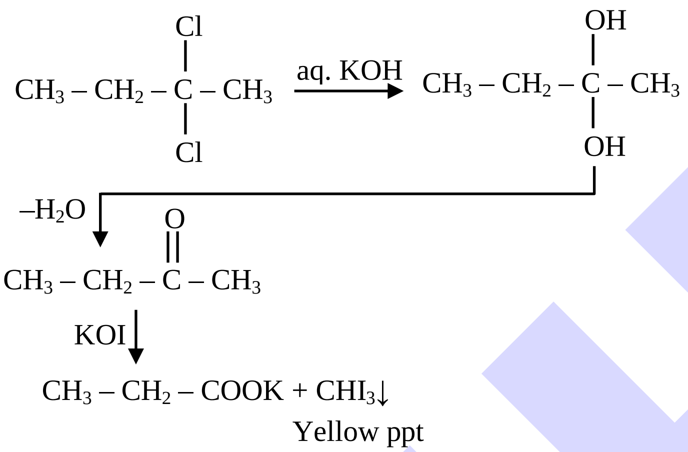
(2) $CH_3CH_2-C(Cl)_2-CH_3$

(3) $CH_3CH_2CH_2CHO$

(4) 

Ans. (2)

Sol.



72. For a sparingly soluble salt AB_2, the equilibrium concentrations of A^{2+} ions and B^- ions are 1.2×10^{-4} M and 0.24×10^{-3} M, respectively. The solubility product of AB_2 is :

(1) 0.069×10^{-12}

(2) 6.91×10^{-12}

(3) 0.276×10^{-12}

(4) 27.65×10^{-12}

Ans. (2)

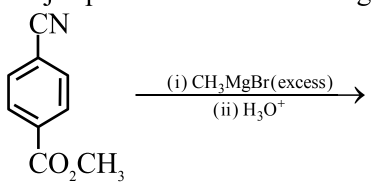
Sol. $AB_{2(s)} \rightleftharpoons A^{+2}_{(aq)} + 2B^-_{(aq)}$

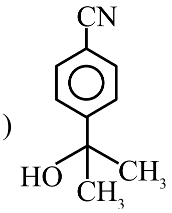
$$K_{sp} = [A^{+2}][B^-]^2$$

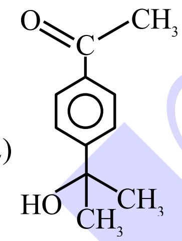
$$= 1.2 \times 10^{-4} \times (2.4 \times 10^{-4})^2$$

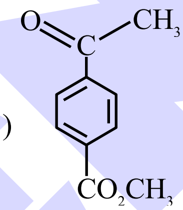
$$= 6.91 \times 10^{-12}\ M^3$$

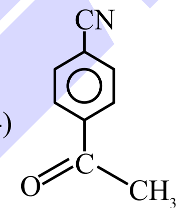
73. Major product of the following reaction is



(1) 

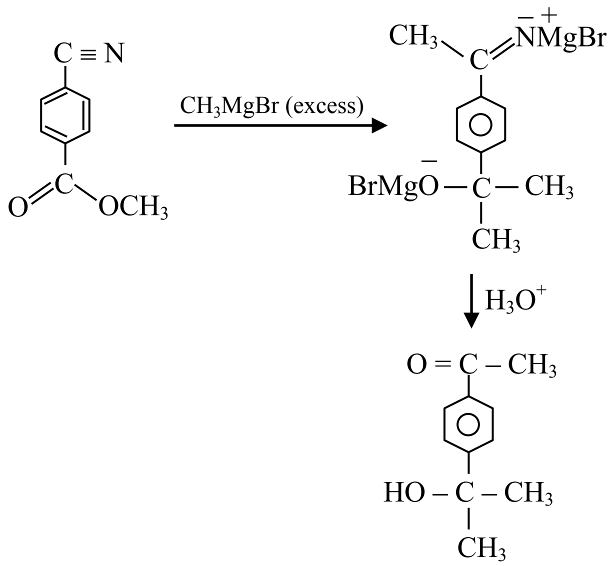
(2) 

(3) 

(4) 

Ans. (2)

Sol.



74. Given below are two statements :

Statement I : The higher oxidation states are more stable down the group among transition elements unlike p-block elements.

Statement II : Copper can not liberate hydrogen from weak acids.

In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement I and Statement II are false

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are true

(4) Statement I is true but Statement II is false

Ans. (3)

Sol. On moving down the group in transition elements, stability of higher oxidation state increases, due to increase in effective nuclear charge.

$\Rightarrow E^{o}_{Cu^{+2}/Cu} = 0.34$ V

$\Rightarrow E^{o}_{H^{+}/H_2} = 0$

SRP : $Cu^{2+} > H^{+}$

Cu can't liberate hydrogen gas from weak acid.

75. The **incorrect** statement regarding ethyne is

(1) The C–C bonds in ethyne is shorter than that in ethene

(2) Both carbons are sp hybridised

(3) Ethyne is linear

(4) The carbon-carbon bonds in ethyne is weaker than that in ethene

Ans. (4)

Sol. The carbon-carbon bonds in ethyne is stronger than that in ethene.

(H–C≡C–H) Ethyne is linear and carbon atoms are SP hybridised.

76. Match List I with List II

List-I (Element)		List-II (Electronic Configuration)	
A.	N	I.	[Ar] $3d^{10}4s^2\ 4p^5$
B.	S	II.	[Ne] $3s^2\ 3p^4$
C.	Br	III.	[He] $2s^2\ 2p^3$
D	Kr	IV.	[Ar] $3d^{10}\ 4s^2\ 4p^6$

Choose the correct answer from the options given below :

(1) A-IV, B-III, C-II, D-I

(2) A-III, B-II, C-I, D-IV

(3) A-I, B-IV, C-III, D-II

(4) A-II, B-I, C-IV, D-III

Ans. (2)

Sol. (A) ${}_{7}N : [He]2s^2 2p^3$

(B) ${}_{16}S : [Ne]2s^2 3p^4$

(C) ${}_{35}Br : [Ar]3d^{10} 4s^2 4p^5$

(D) ${}_{36}Kr : [Ar]3d^{10} 4s^2 4p^6$

77. Match List I with List II

List-I		List-II	
A.	Melting point [K]	I.	Tl > In > Ga > Al > B
B.	Ionic Radius [M^{+3}/pm]	II.	B > Tl > Al ≈ Ga > In
C.	$\Delta_i H_1$ [kJ mol^{-1}]	III.	Tl > In > Al > Ga > B
D	Atomic Radius [pm]	IV.	B > Al > Tl > In > Ga

Choose the correct answer from the options given below :

(1) A-III, B-IV, C-I, D-II

(2) A-II, B-III, C-IV, D-I

(3) A-IV, B-I, C-II, D-III

(4) A-I, B-II, C-III, D-IV

Ans. (3)

Sol. Melting point : B > $A\ell$ > $T\ell$ > In > Ga

Ionic radius (M^{+3}/pm) : $T\ell$ > In > Ga > $A\ell$ > B

$(\Delta_{IE}H)_1\left[\frac{kJ}{mol}\right]$: B > $T\ell$ > $A\ell$ ≈ Ga > In

Atomic radius (in pm) : $T\ell$ > In > $A\ell$ > Ga > B

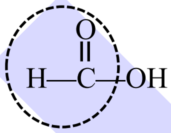
78. Which of the following compounds will give silver mirror with ammoniacal silver nitrate?

(A) Formic acid
(B) Formaldehyde
(C) Benzaldehyde
(D) Acetone

Choose the correct answer from the options given below :

(1) C and D only
(2) A, B and C only
(3) A only
(4) B and C only

Ans. **(2)**

Sol. Apart from aldehyde, Formic acid 

also gives silver mirror test with ammonical silver nitrate.

79. Which out of the following is a correct equation to show change in molar conductivity with respect to concentration for a weak electrolyte, if the symbols carry their usual meaning :

(1) $\Lambda^2_m C - K_a\Lambda^{\circ 2}_m + K_a\Lambda_m\Lambda^{\circ}_m = 0$

(2) $\Lambda_m - \Lambda^{\circ}_m + AC^{\frac{1}{2}} = 0$

(3) $\Lambda_m - \Lambda^{\circ}_m - AC^{\frac{1}{2}} = 0$

(4) $\Lambda^2_m C + K_a\Lambda^{\circ 2}_m - K_a\Lambda_m\Lambda^{\circ}_m = 0$

Ans. **(1)**

Sol. $HA(aq) \rightleftharpoons H^+(aq) + A^-(aq)$

$$K_a = \frac{\alpha^2 C}{1-\alpha}$$

$$\alpha^2 C + K_a\alpha - K_a = 0$$

$$\left(\frac{\lambda_m}{\lambda_m^{\infty}}\right)^2 C + K_a\frac{\lambda_m}{\lambda_m^{\infty}} - K_a = 0$$

$$\lambda_m^2 C + K_a\lambda_m\lambda_m^{\infty} - K_a\left(\lambda_m^{\infty}\right)^2 = 0$$

80. The electronic configuration of Einsteinium is :
(Given atomic number of Einsteinium = 99)

(1) [Rn] $5f^{12}\ 6d^0\ 7s^2$
(2) [Rn] $5f^{11}\ 6d^0\ 7s^2$
(3) [Rn] $5f^{13}\ 6d^0\ 7s^2$
(4) [Rn] $5f^{10}\ 6d^0\ 7s^2$

Ans. **(2)**

Sol. Einsteinium (atomic No = 99) : [Rn] $5f^{11}\ 6d^0\ 7s^2$

SECTION-B

81. Number of oxygen atoms present in chemical formula of fuming sulphuric acid is _______.

Ans. **(7)**

Sol. Fuming sulphuric acid is a mixture of
conc. $H_2SO_4 + SO_3$ Or $H_2S_2O_7$
So, Number of Oxygen atoms = 7

82. A transition metal 'M' among Sc, Ti, V , Cr, Mn and Fe has the highest second ionisation enthalpy. The spin only magnetic moment value of M^+ ion is ______ BM (Near integer)
(Given atomic number Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26)

Ans. **(6)**

Sol. Among given metals, Cr has maximum IE_2 because Second electron is removed from stable configuration $3d^5$

Cr^+ : [Ar] $3d^5\ 4s^0$

∴ No of unpaired e^- in Cr^+ is 5, n = 5

So, Magnetic moment = $\sqrt{n(n+2)}$ B.M

$= \sqrt{5(5+2)} = 5.92$ BM ≈ 6

83. The vapour pressure of pure benzene and methyl benzene at 27°C is given as 80 Torr and 24 Torr, respectively. The mole fraction of methyl benzene in vapour phase, in equilibrium with an equimolar mixture of those two liquids (ideal solution) at the same temperature is____ $\times 10^{-2}$ (nearest integer)

Ans. (23)

Sol. $X_{methylbenzene} = 0.5$

$$Y_{methylbenzene} = \frac{P_{methylbenzene}}{P_{total}}$$

$$Y_{methylbenzene} = \frac{0.5\times 24}{0.5\times 80 + 0.5\times 24}$$

$$= \frac{12}{40+12} = 0.23 = 23\times 10^{-2}$$

84. Consider the following test for a group-IV cation.

$M^{2+} + H_2S \rightarrow$ A (Black precipitate) + byproduct

A + aqua regia $\rightarrow$ B + NOCl + S + H_2O

B + KNO_2 + $CH_3COOH \rightarrow$ C + byproduct

The spin only magnetic moment value of the metal complex C is ______BM.

(Nearest integer)

Ans. (0)

Sol. $Co^{2+} + H_2S \rightarrow CoS\downarrow$ (Black)

(A)

CoS + Aqua-regia $\rightarrow Co^{2+}$ (aq) + NOCl + S + H_2O

(A) (B)

Co^{2+} (aq) + KNO_2 + CH_3COOH

$\downarrow$

$K_3[Co(NO_2)_6]$ + NO + S + H_2O

In $K_3[Co(NO_2)_6]$, Co^{+3} : $3d^6\ 4s^0$

Co^{3+} : d^2sp^3 Hybridisation

Number of unpaired e^- = 0

Magnetic moment = $\sqrt{n(n+2)} = 0$ B.M

85. Consider the following first order gas phase reaction at constant temperature

$A(g) \rightarrow 2B(g) + C(g)$

If the total pressure of the gases is found to be 200 torr after 23 sec. and 300 torr upon the complete decomposition of A after a very long time, then the rate constant of the given reaction is____ $\times 10^{-2}\ s^{-1}$ (nearest integer)

[Given : $\log_{10}(2) = 0.301$]

Ans. (3)

Sol. $A(g) \rightarrow 2B(g) + C(g)$

$P_{23} = P_0 + 2x = 200$

$P_\infty = 3P_0 = 300$

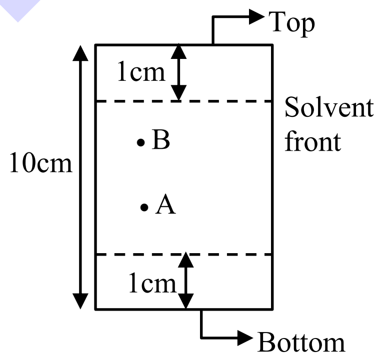
$P_0 = 100$

$$K = \frac{1}{t}\ln\frac{P_\infty - P_0}{P_\infty - P_t}$$

$$K = \frac{2.3}{23}\log\frac{300-100}{300-200}$$

$$= \frac{2.3\times 0.301}{23} = 0.0301 = 3.01\times 10^{-2}\sec^{-1}$$

86.



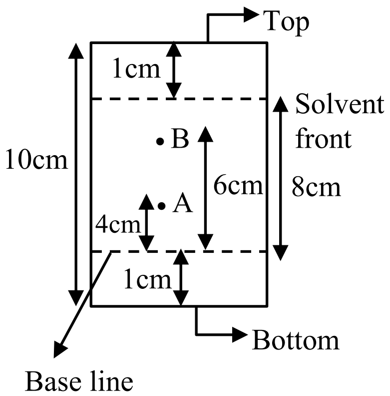
In the given TLC, the distance of spot A & B are 5 cm & 7 cm, from the bottom of TLC plate, respectively.

R_f value of B is x $\times 10^{-1}$ times more than A. The value of x is_____.

Ans. (15)

Sol.

$$R_f = \frac{\text{Distance moved by substance from base line}}{\text{Distance moved by solvent from base line}}$$



$(R_f)_A = \frac{4}{8}$ $\quad (R_f)_B = \frac{6}{8}$

$$\frac{(R_f)_B}{(R_f)_A} = \frac{6}{8} \times \frac{8}{4}$$

$(R_f)_B = 1.5\ (R_f)_A$

$x = 15$

87. Based on Heisenberg's uncertainty principle, the uncertainty in the velocity of the electron to be found within an atomic nucleus of diameter 10^{-15} m is ______ $\times 10^9$ ms^{-1} (nearest integer)

[Given : mass of electron = 9.1×10^{-31} kg, Plank's constant (h) = 6.626×10^{-34} Js]

(Value of $\pi = 3.14$)

Ans. (58)

Sol. $m\Delta V.\Delta x = \frac{h}{4\pi}$

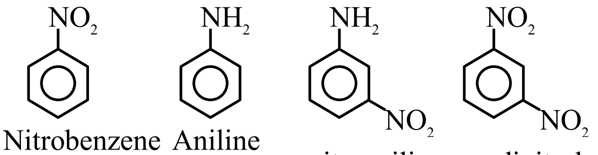
$$\Delta V = \frac{6.626\times10^{-34}}{9.1\times10^{-31}\times10^{-15}\times4\times3.14}$$

$= 57.97\times10^{+9}$ m/sec

88. Number of compounds from the following which **cannot** undergo Friedel-Crafts reactions is :____
toluene, nitrobenzene, xylene, cumene, aniline, chlorobenzene, m-nitroaniline, m-dinitrobenzene

Ans. (4)

Sol. Compounds which can not undergo Friedel Crafts reaction are



Nitrobenzene Aniline m-nitroaniline m-dinitrobenzene

89. Total number of electron present in (π^*) molecular orbitals of O_2 , O_2^+ and O_2^- is_______.

Ans. (6)

Sol. O_2 (16e) : $(\sigma_{1s})^2(\sigma^*_{1s})^2(\sigma_{2s})^2(\sigma^*_{2s})^2$

$$(\sigma_{2p})^2\left[(\pi_{2p})^2=(\pi_{2p})^2\right],\left[(\pi^*_{2p})^1=(\pi^*_{2p})^1\right]$$

Number of e$^-$ present in (π^*) of O_2 = 2

Number of e$^-$ present in (π^*) of O_2^+ = 1

Number of e$^-$ present in (π^*) of O_2^- = 3

So total e$^-$ in $(\pi^*) = 2 + 1 + 3 = 6$

90. When $\Delta H_{vap} = 30$ kJ/mol and ΔS_{vap}=75 J mol^{-1} K^{-1}, then the temperature of vapour, at one atmosphere is ______K.

Ans. (400)

Sol. At equilibrium $\Delta G_{PT} = 0$

$\Delta H_{vap} = T\Delta S_{vap}$

$30\times1000 = T\times75$

$T = 400K$