

**FINAL JEE-MAIN EXAMINATION – APRIL, 2024**

 (Held On Thursday 04<sup>th</sup> April, 2024)

TIME : 9 : 00 AM to 12 : 00 NOON

**CHEMISTRY**
**TEST PAPER WITH SOLUTION**
**SECTION-A**

61. What pressure (bar) of  $H_2$  would be required to make emf of hydrogen electrode zero in pure water at  $25^\circ C$  ?

- (1)
- $10^{-14}$
- (2)
- $10^{-7}$
- (3) 1    (4) 0.5

**Allen Ans. (1)**
**NTA Ans. (3)**
**Sol.**  $2e^- + 2H^+(aq) \rightarrow H_2(g)$ 

$$E = E^\circ - \frac{0.059}{n} \log \frac{P_{H_2}}{[H^+]^2}$$

$$0 = 0 - \frac{0.059}{2} \log \frac{P_{H_2}}{(10^{-7})^2}$$

$$\log \frac{P_{H_2}}{(10^{-7})^2} = 0$$

$$\frac{P_{H_2}}{10^{-14}} = 1$$

$$P_{H_2} = 10^{-14} \text{ bar}$$

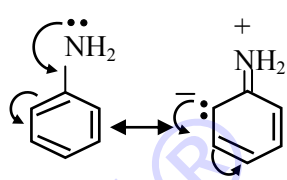
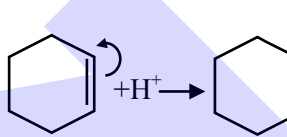
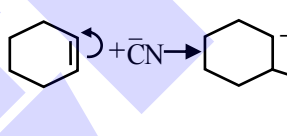
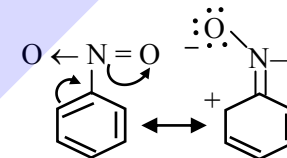
62. The correct sequence of ligands in the order of decreasing field strength is :

- (1)
- $CO > H_2O > F^- > S^{2-}$
- 
- (2)
- $^-OH > F^- > NH_3 > CN^-$
- 
- (3)
- $NCS^- > EDTA^{4-} > CN^- > CO$
- 
- (4)
- $S^{2-} > ^-OH > EDTA^{4-} > CO$

**Ans. (1)**

**Sol.** According to spectrochemical series ligand field strength is  $CO > H_2O > F^- > S^{2-}$

63. Match List -I with List II:

List - I		List - II	
Mechanism steps		Effect	
(A)		(I)	- E effect
(B)		(II)	- R effect
(C)		(III)	+ E effect
(D)		(IV)	+ R effect

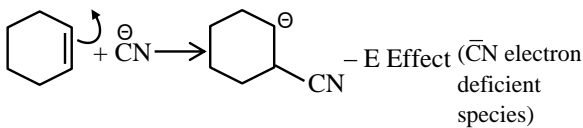
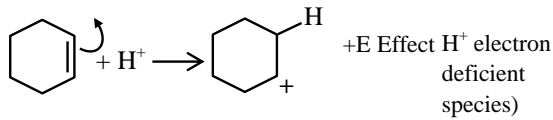
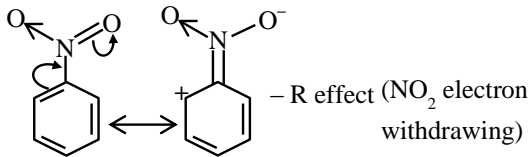
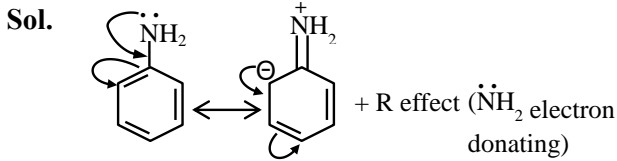
Choose the **correct** answer from the options given below :

- (1) (A) – (IV), (B) – (III), (C) – (I), (D) – (II)
- 
- (2) (A) – (III), (B) – (I), (C) – (II), (D) – (IV)
- 
- (3) (A) – (II), (B) – (IV), (C) – (III), (D) – (I)
- 
- (4) (A) – (I), (B) – (II), (C) – (IV), (D) – (III)

**Ans. (1)**


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64. What will be the decreasing order of basic strength of the following conjugate bases ?



- (1)  $\text{Cl}^- > \text{OH}^- > \text{RO}^- > \text{CH}_3\text{COO}^-$
- (2)  $\text{RO}^- > ^-\text{OH} > \text{CH}_3\text{COO}^- > \text{Cl}^-$
- (3)  $^-\text{OH} > \text{RO}^- > \text{CH}_3\text{COO}^- > \text{Cl}^-$
- (4)  $\text{Cl}^- > \text{RO}^- > ^-\text{OH} > \text{CH}_3\text{COO}^-$

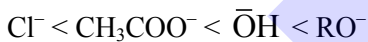
**Ans. (2)**

**Sol.** Strong acid have weak conjugate base

Acidic strength :



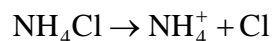
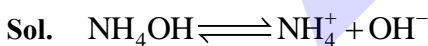
Conjugate base strength :



65. In the precipitation of the iron group (III) in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to :

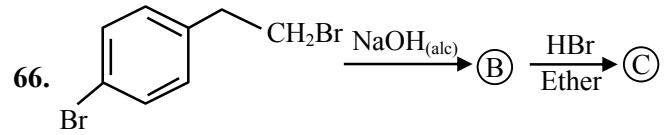
- (1) prevent interference by phosphate ions
- (2) decrease concentration of  $^-\text{OH}$  ions
- (3) increase concentration of  $\text{Cl}^-$  ions
- (4) increase concentration of  $\text{NH}_4^+$  ions

**Ans. (2)**

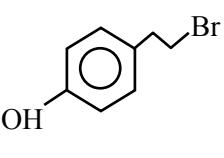
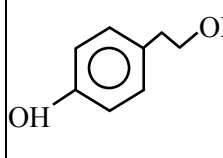
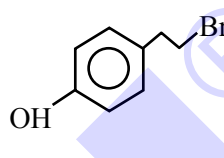
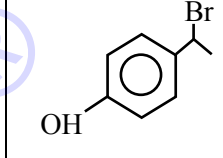
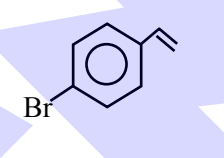
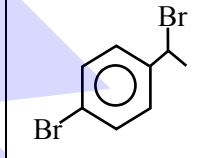
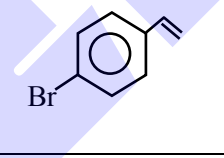
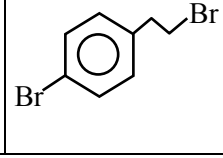


Due to common ion effect of  $\text{NH}_4^+$ ,

$[\text{OH}^-]$  decreases in such extent that only group-III cation can be precipitated, due to their very low  $K_{sp}$  in the range of  $10^{-38}$ .

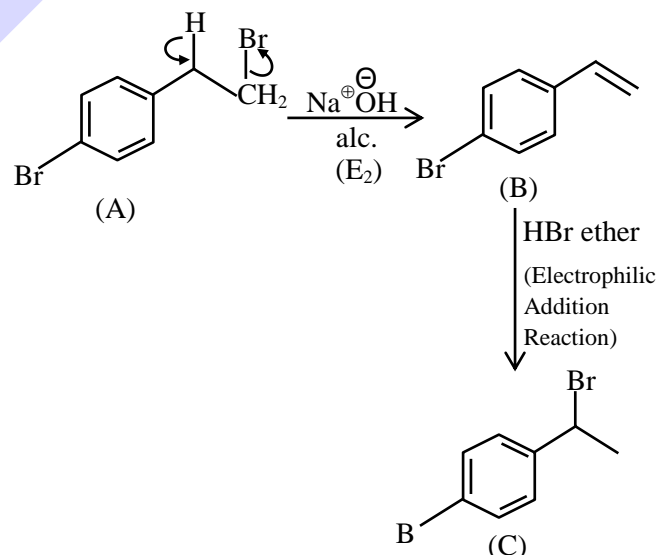


Identify (B) and (C) and how are (A) and (C) related ?

	(B)	(C)	
(1)			functional group isomers
(2)			Derivative
(3)			position isomers
(4)			chain isomers

**Ans. (3)**

**Sol.**



A and C are position isomer.



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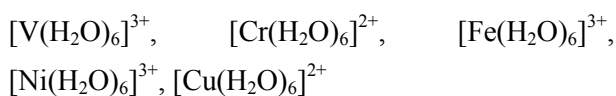
67. One of the commonly used electrode is calomel electrode. Under which of the following categories calomel electrode comes ?

- (1) Metal – Insoluble Salt – Anion electrodes
- (2) Oxidation – Reduction electrodes
- (3) Gas – Ion electrodes
- (4) Metal ion – Metal electrodes

Ans. (1)

Sol. Theory based

68. Number of complexes from the following with even number of unpaired "d" electrons is \_\_\_\_.



[Given atomic numbers : V = 23, Cr = 24, Fe = 26,  
 Ni = 28, Cu = 29]

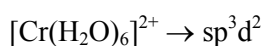
- (1) 2
- (2) 4
- (3) 5
- (4) 1

Ans. (1)

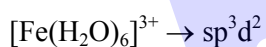
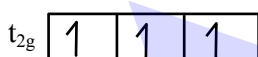
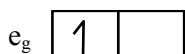
Sol.  $[\text{V}(\text{H}_2\text{O})_6]^{3+} \rightarrow d^2 sp^3$



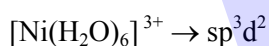
$\text{V}^{3+} :- [\text{Ar}]3d^2, n = 2$  (even number of unpaired  $e^-$ )



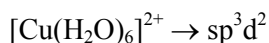
$\text{Cr}^{+2} :- [\text{Ar}]3d^4, n = 4$  (even number of unpaired  $e^-$ )



$n = 5$  (odd number of unpaired  $e^-$ )



$\text{Ni}^{+3} :- [\text{Ar}]3d^7, n = 3$  (odd number of unpaired  $e^-$ )



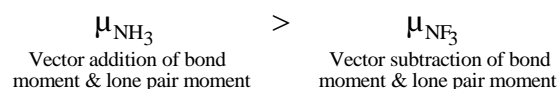
$n = 1$  (odd number of unpaired  $e^-$ )

69. Which one of the following molecules has maximum dipole moment ?

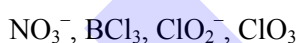
- (1)  $\text{NF}_3$
- (2)  $\text{CH}_4$
- (3)  $\text{NH}_3$
- (4)  $\text{PF}_5$

Ans. (3)

Sol.  $\text{CH}_4$  &  $\text{PF}_5, \mu_{\text{net}} = 0$  (non polar)

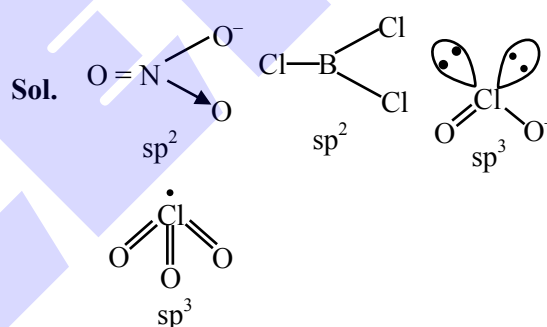


70. Number of molecules/ions from the following in which the central atom is involved in  $sp^3$  hybridization is \_\_\_\_.



- (1) 2
- (2) 4
- (3) 3
- (4) 1

Ans. (1)



71. Which among the following is **incorrect** statement?

- (1) Electromeric effect dominates over inductive effect
- (2) The electromeric effect is, temporary effect
- (3) The organic compound shows electromeric effect in the presence of the reagent only
- (4) Hydrogen ion ( $\text{H}^+$ ) shows negative electromeric effect

Ans. (4)

Sol. Hydrogen ion ( $\text{H}^+$ ) shows positive electromeric effect.



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72. Given below are two statements :

**Statement I :** Acidity of  $\alpha$ -hydrogens of aldehydes and ketones is responsible for Aldol reaction.

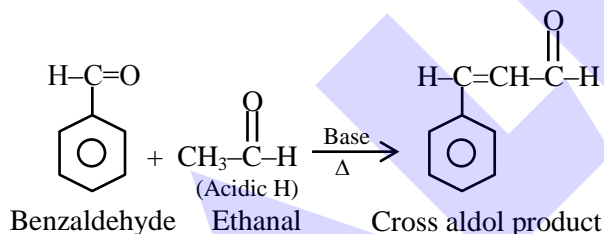
**Statement II :** Reaction between benzaldehyde and ethanal will NOT give Cross – Aldol product.

In the light of above statements, choose the **most appropriate** answer from the options given below.

- (1) Both **Statement I** and **Statement II** are correct.
- (2) Both **Statement I** and **Statement II** are incorrect.
- (3) **Statement I** is incorrect but **Statement II** is correct.
- (4) **Statement I** is correct but **Statement II** is incorrect.

**Ans. (4)**

**Sol.** Aldehyde and ketones having acidic  $\alpha$ -hydrogen show aldol reaction



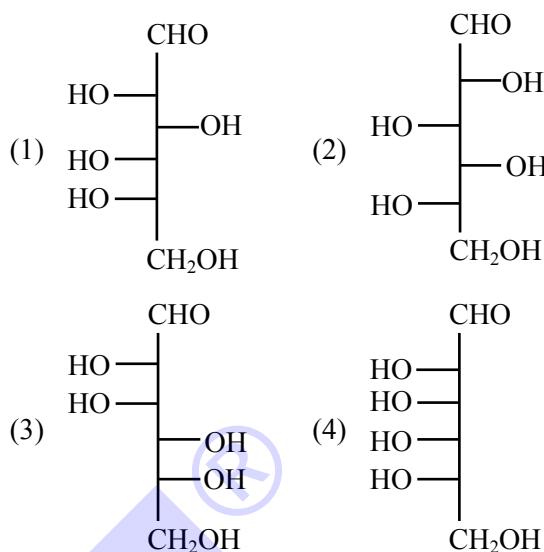
73. Which of the following nitrogen containing compound does not give Lassaigne's test ?

- (1) Phenyl hydrazine      (2) Glycine  
(3) Urea                      (4) Hydrazine

**Ans. (4)**

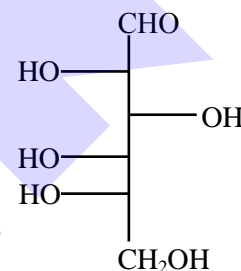
**Sol.** Hydrazine ( $\text{NH}_2\text{-NH}_2$ ) have no carbon so does not show Lassaigne's test.

74. Which of the following is the correct structure of L-Glucose ?



**Ans. (1)**

**Sol.** Structure of L-Glucose is



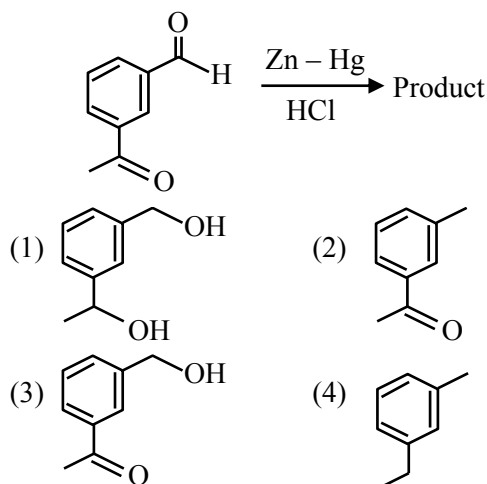
75. The element which shows only one oxidation state other than its elemental form is :

- (1) Cobalt                      (2) Scandium  
(3) Titanium                  (4) Nickel

**Ans. (2)**

**Sol.** Co, Ti, Ni can show +2, +3 and +4 oxidation state, But 'Sc' only shows +3 stable oxidation state.

76. Identify the product in the following reaction :

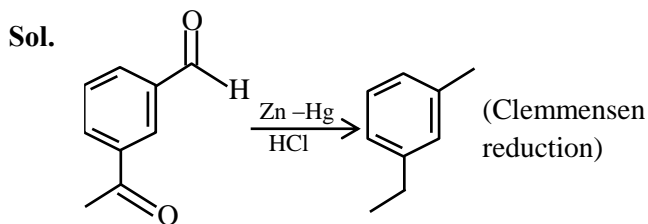


**Ans. (4)**



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77. Number of elements from the following that CANNOT form compounds with valencies which match with their respective group valencies is \_\_\_\_\_.

B, C, N, S, O, F, P, Al, Si

- (1) 7 (2) 5 (3) 6 (4) 3

Ans. (4)

Sol. N, O, F can't extend their valencies upto their group number due to the non-availability of vacant 2d like orbital.

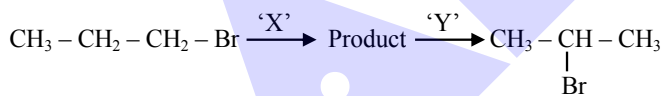
78. The Molarity (M) of an aqueous solution containing 5.85 g of NaCl in 500 mL water is : (Given : Molar Mass Na : 23 and Cl : 35.5 gmol<sup>-1</sup>)

- (1) 20 (2) 0.2  
(3) 2 (4) 4

Ans. (2)

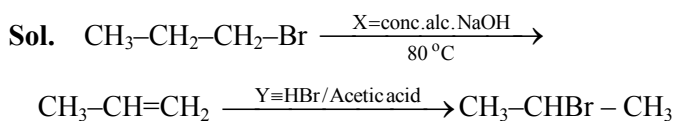
Sol. 
$$M = \frac{n_{\text{NaCl}}}{V_{\text{sol}} \text{ (in L)}}$$
  
$$M = \frac{5.85}{0.5} = 0.2\text{M}$$

79. Identify the correct set of reagents or reaction conditions 'X' and 'Y' in the following set of transformation.



- (1) X = conc.alc. NaOH, 80°C, Y = Br<sub>2</sub>/CHCl<sub>3</sub>  
(2) X = dil.aq. NaOH, 20°C, Y = HBr/acetic acid  
(3) X = conc.alc. NaOH, 80°C, Y = HBr/acetic acid  
(4) X = dil.aq. NaOH, 20°C, Y = Br<sub>2</sub>/CHCl<sub>3</sub>

Ans. (3)



80. The correct order of first ionization enthalpy values of the following elements is :

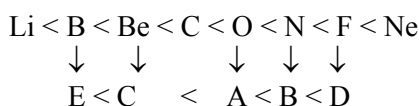
- (A) O (B) N  
(C) Be (D) F  
(E) B

Choose the correct answer from the options given below :

- (1) B < D < C < E < A (2) E < C < A < B < D  
(3) C < E < A < B < D (4) A < B < D < C < E

Ans. (2)

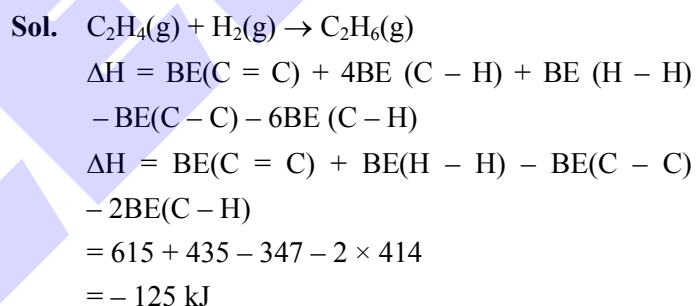
Sol. Correct order of I<sup>st</sup> IE



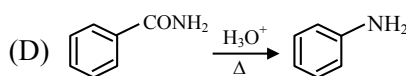
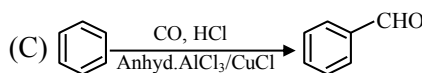
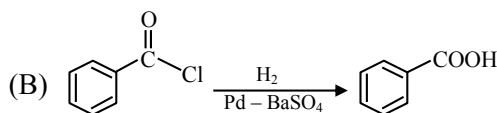
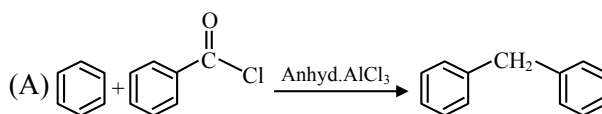
### SECTION-B

81. The enthalpy of formation of ethane (C<sub>2</sub>H<sub>6</sub>) from ethylene by addition of hydrogen where the bond-energies of C – H, C – C, H – H are 414 kJ, 347 kJ, 615 kJ and 435 kJ respectively is - \_\_\_\_\_ kJ.

Ans. (125)



82. The number of correct reaction(s) among the following is \_\_\_\_\_.



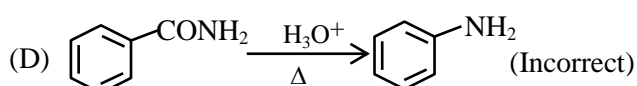
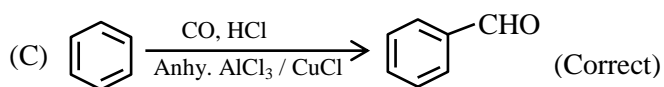
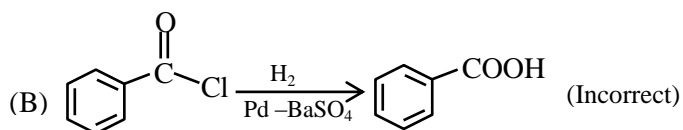
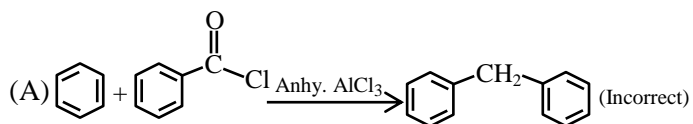
Ans. (1)



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Sol.

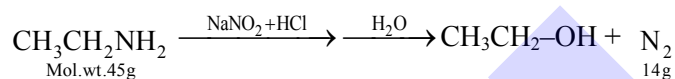


83. X g of ethylamine is subjected to reaction with  $\text{NaNO}_2/\text{HCl}$  followed by water; evolved dinitrogen gas which occupied 2.24 L volume at STP.

X is \_\_\_\_\_  $\times 10^{-1}$  g.

Ans. (45)

Sol.



given :  $\text{N}_2$  evolved is 2.24 L i.e. 0.1 mole.

i.e.  $\text{CH}_3\text{CH}_2\text{NH}_2$  (ethyl amine) will be 4.5 g

(=0.1 mole)

Hence the answer =  $45 \times 10^{-1}$  g

84. The de-Broglie's wavelength of an electron in the 4<sup>th</sup> orbit is \_\_\_\_\_  $\pi a_0$ . ( $a_0$  = Bohr's radius)

Ans. (8)

 Sol.  $2\pi r_n = n\lambda_d$ 

$$2\pi a_0 \frac{n^2}{Z} = n\lambda_d$$

$$2\pi a_0 \frac{4^2}{1} = 4\lambda_d$$

$$\lambda_d = 8\pi a_0$$

85. Only 2 mL of  $\text{KMnO}_4$  solution of unknown molarity is required to reach the end point of a titration of 20 mL of oxalic acid (2 M) in acidic medium. The molarity of  $\text{KMnO}_4$  solution should be \_\_\_\_\_ M.

Allen Ans. (8)

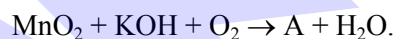
NTA Ans. (50)

 Sol.  $\text{eq.}(\text{KMnO}_4) = \text{eq.}(\text{H}_2\text{C}_2\text{O}_4)$ 

$$M \times 2 \times 5 = 2 \times 20 \times 2$$

$$M = 8M$$

86. Consider the following reaction



Product 'A' in neutral or acidic medium disproportionate to give products 'B' and 'C' along with water. The sum of spin-only magnetic moment values of B and C is \_\_\_\_\_ BM.

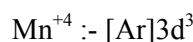
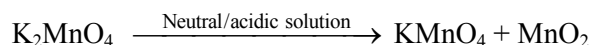
(nearest integer)

(Given atomic number of Mn is 25)

Ans. (4)

 Sol.  $\text{MnO}_2 + \text{KOH} + \text{O}_2 \rightarrow \text{K}_2\text{MnO}_4 + \text{H}_2\text{O}$ 

(A)



$$n = 3, \mu = \sqrt{3(3+2)} = 3.87 \text{ B.M.}$$

Nearest integer is (4)

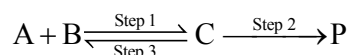


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87. Consider the following transformation involving first order elementary reaction in each step at constant temperature as shown below.



Some details of the above reaction are listed below.

Step	Rate constant (sec <sup>-1</sup> )	Activation energy (kJ mol <sup>-1</sup> )
1	k <sub>1</sub>	300
2	k <sub>2</sub>	200
3	k <sub>3</sub>	E <sub>a3</sub>

If the overall rate constant of the above transformation (k) is given as  $k = \frac{k_1 k_2}{k_3}$  and the

overall activation energy (E<sub>a</sub>) is 400 kJ mol<sup>-1</sup>, then the value of E<sub>a3</sub> is \_\_\_\_\_ kJ mol<sup>-1</sup> (nearest integer)

Ans. (100)

$$\text{Sol. } K = \frac{K_1 K_2}{K_3}$$

$$Ae^{\frac{-E_a}{RT}} = \frac{A_1 e^{\frac{-E_{a1}}{RT}} A_2 e^{\frac{-E_{a2}}{RT}}}{A_3 e^{\frac{-E_{a3}}{RT}}}$$

$$Ae^{\frac{-E_a}{RT}} = \frac{A_1 A_2}{A_3} e^{\frac{-(E_{a1} + E_{a2} - E_{a3})}{RT}}$$

$$E_a = E_{a1} + E_{a2} - E_{a3}$$

$$400 = 300 + 200 - E_{a3}$$

$$E_{a3} = 100 \text{ kJ/mole}$$

88. 2.5 g of a non-volatile, non-electrolyte is dissolved in 100 g of water at 25°C. The solution showed a boiling point elevation by 2°C. Assuming the solute concentration is negligible with respect to the solvent concentration, the vapour pressure of the resulting aqueous solution is \_\_\_\_\_ mm of Hg (nearest integer)

[Given : Molal boiling point elevation constant of water (K<sub>b</sub>) = 0.52 K. kg mol<sup>-1</sup>,

1 atm pressure = 760 mm of Hg, molar mass of water = 18 g mol<sup>-1</sup>]

Ans. (707)

$$\text{Sol. } 2 = 0.52 \times m$$

$$m = \frac{2}{0.52}$$

According to question, solution is much diluted

$$\text{so } \frac{\Delta P}{P^\circ} = \frac{n_{\text{solute}}}{n_{\text{solvent}}}$$

$$\frac{\Delta P}{P^\circ} = \frac{m}{1000} \times M_{\text{solvent}}$$

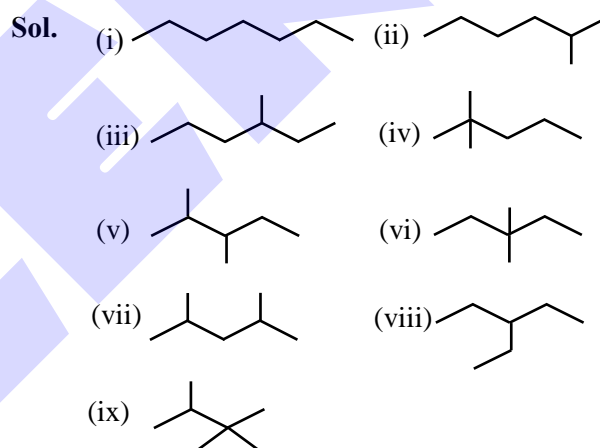
$$\Delta P = P^\circ \times \frac{m}{1000} \times M_{\text{solvent}}$$

$$= 760 \times \frac{2}{1000} \times 18 = 52.615$$

$$P_5 = 760 - 52.615 = 707.385 \text{ mm of Hg}$$

89. The number of different chain isomers for C<sub>7</sub>H<sub>16</sub> is \_\_\_\_\_.

Ans. (9)



90. Number of molecules/species from the following having one unpaired electron is \_\_\_\_\_.



Ans. (2)

Sol. According to M.O.T.

$$O_2 \rightarrow \text{no. of unpaired electrons} = 2$$

$$O_2^{-1} \rightarrow \text{no. of unpaired electron} = 1$$

$$NO \rightarrow \text{no. of unpaired electron} = 1$$

$$CN^{-1} \rightarrow \text{no. of unpaired electron} = 0$$

$$O_2^{2-} \rightarrow \text{no. of unpaired electron} = 0$$



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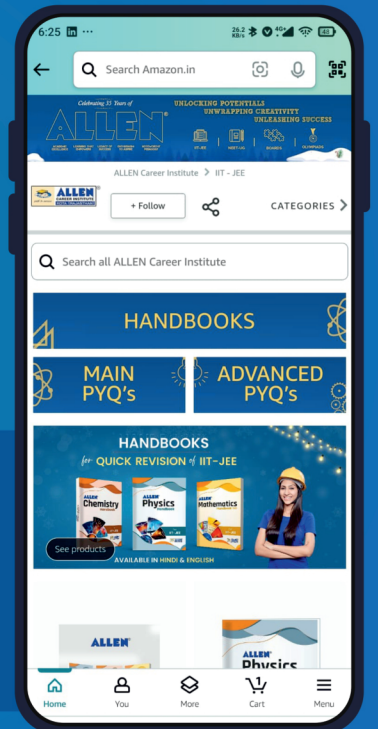
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