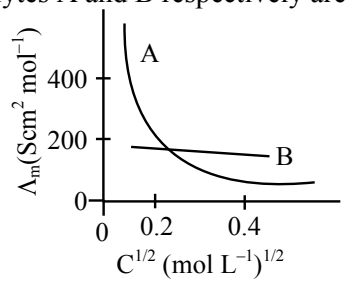
FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Tuesday 09th April, 2024) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

61. The molar conductivity for electrolytes A and B are plotted against $C^{1/2}$ as shown below. Electrolytes A and B respectively are :



	A	B
(1)	Weak electrolyte	weak electrolyte
(2)	Strong electrolyte	strong electrolyte
(3)	Weak electrolyte	strong electrolyte
(4)	Strong electrolyte	weak electrolyte

Ans. (3)

Sol. A → Weak electrolyte

B → Strong electrolyte

62. Methods used for purification of organic compounds are based on :

(1) neither on nature of compound nor on the impurity present.

(2) nature of compound only.

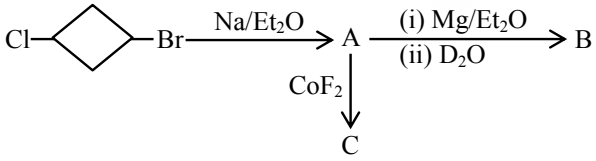
(3) nature of compound and presence of impurity.

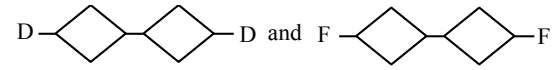
(4) presence of impurity only.

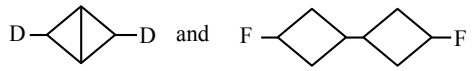
Ans. (3)

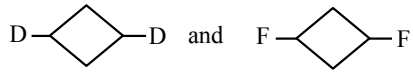
Sol. Organic compounds are purified based on their nature and impruity present in it.

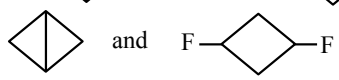
63. In the following sequence of reaction, the major products B and C respectively are :



(1) 

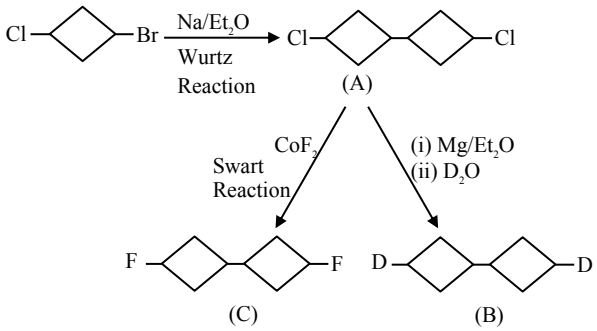
(2) 

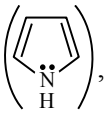
(3) 

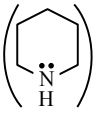
(4) 

Ans. (1)

Sol.



64. Correct order of basic strength of Pyrrole  ,

Pyridine  and Piperidine  is:

(1) Piperidine > Pyridine > Pyrrole

(2) Pyrrole > Pyridine > Piperidine

(3) Pyridine > Piperidine > Pyrrole

(4) Pyrrole > Piperidine >Pyridine

Ans. (1)

Sol. Order of basic strength is

$N(sp^3$, localized lone pair) > $N(sp^2$, localized lone pair) > $N(sp^2$, delocalized lone pair, aromatic)

$\therefore$ Piperidine > Pyridine > Pyrrole

65. In which one of the following pairs the central atoms exhibit sp^2 hybridization ?

(1) BF_3 and NO_2^-

(2) NH_2^- and H_2O

(3) H_2O and NO_2

(4) NH_2^- and BF_3

Ans. (1)

Sol. $BF_3 \rightarrow sp^2$

$NO_2^- \rightarrow sp^2$

$H_2O \rightarrow sp^3$

$NO_2 \rightarrow sp^2$

$NH_2^- \rightarrow sp^3$

66. The F^- ions make the enamel on teeth much harder by converting hydroxyapatite (the enamel on the surface of teeth) into much harder fluoroapatite having the formula.

(1) $[3(Ca_3(PO_4)_2).CaF_2]$

(2) $[3(Ca_2(PO_4)_2).Ca(OH)_2]$

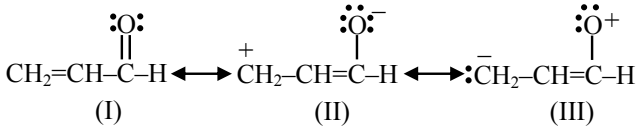
(3) $[3(Ca_3(PO_4)_3).CaF_2]$

(4) $[3(Ca_3(PO_4)_2).Ca(OH)_2]$

Ans. (1)

Sol. Fluoroapatite $\Rightarrow [3Ca_3(PO_4)_2.CaF_2]$

67. Relative stability of the contributing structures is :



(1) (I) > (III) > (II)

(2) (I) > (II) > (III)

(3) (II) > (I) > (III)

(4) (III) > (II) > (I)

Ans. (2)

Sol. (1) Neutral structures are more stable than charged ones. Therefore I is more stable than II and III.

(2) +ve charge on less electronegative atom is more stable i.e., $C^{\oplus}$ is more stable than $O^{\oplus}$

$\therefore$ Order is I > II > III

68. Given below are two statements :

Statement (I) : The oxidation state of an element in a particular compound is the charge acquired by its atom on the basis of electron gain enthalpy consideration from other atoms in the molecule.

Statement (II) : $p\pi$-$p\pi$ bond formation is more prevalent in second period elements over other periods.

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

(1) Both **Statement I** and **Statement II** are incorrect

(2) **Statement I** is correct but **Statement II** is incorrect

(3) Both **Statement I** and **Statement II** are correct

(4) **Statement I** is incorrect but **Statement II** is correct

Ans. (4)

Sol. Oxidation state of an element in a particular compound is defined by the charge acquired by its atom on the basis of electronegativity consideration from other atoms in molecule.

69. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)** :

Assertion (A) : S_N2 reaction of $C_6H_5CH_2Br$ occurs more readily than the S_N2 reaction of CH_3CH_2Br.

Reason (R) : The partially bonded unhybridized p-orbital that develops in the trigonal bipyramidal transition state is stabilized by conjugation with the phenyl ring.

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

(1) **(A)** is not correct but **(R)** is correct

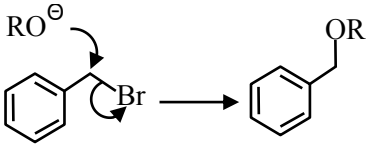
(2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**

(3) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

(4) **(A)** is correct but **(R)** is not correct

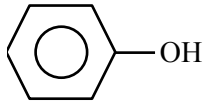
Ans. (3)

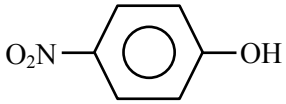
Sol. The benzyl group acts in much the same way using the π-system of the benzene ring for conjugation with the p-orbital in the transition state.

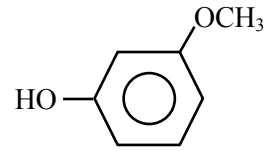


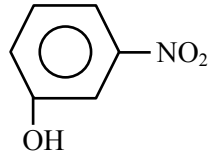
benzyl bromide

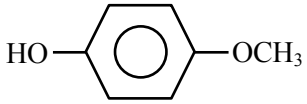
70. For the given compounds, the correct order of increasing pK_a value :

(A) 

(B) 

(C) 

(D) 

(E) 

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

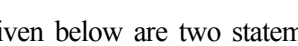
Ans. **BONUS**
NTA Ans. (4)

Sol. Acidic strength order :-
B > D > C > A > E
Correct pKa Order :
B < D < C < A < E
All options are incorrect.

71. Given below are two statements : one is labelled as **Assertion (A) :** and the other is labelled as **Reason (R).**
Assertion (A) : Both rhombic and monoclinic sulphur exist as S_8 while oxygen exists as O_2.
Reason (R) : Oxygen forms pπ-pπ multiple bonds with itself and other elements having small size and high electronegativity like C, N, which is not possible for sulphur.
In the light of the above statements, choose the **most appropriate** answer from the options given below :
(1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.
(2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.
(3) **(A)** is correct but **(R)** is not correct.
(4) **(A)** is not correct but **(R)** is correct.

Ans. **(3)**

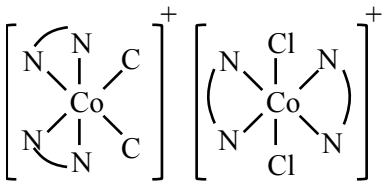
Sol. Oxygen can form 2pπ-2pπ multiple bond with itself due to its small size while sulphur cannot form multiple bond with itself as 3pπ-3pπ bond will be unstable due to large size of sulphur, but sulphur can form multiple bond with small size atom like C and N.
eg. S=C=S



72. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**
Assertion (A): The total number of geometrical isomers shown by $[Co(en)_2Cl_2]^+$ complex ion is three
Reason (R): $[Co(en)_2Cl_2]^+$ complex ion has an octahedral geometry.
In the light of the above statements, choose the **most appropriate** answer from the options given below :
(1) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**.
(2) **(A)** is correct but **(R)** is not correct.
(3) **(A)** is not correct but **(R)** is correct.
(4) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**.

Ans. **(3)**

Sol. $[Co(en)_2Cl_2]^+$ has octahedral geometry with two geometrical isomers.



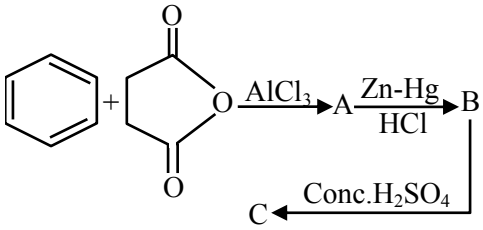
cis trans

73. The electronic configuration of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct ?
(1) Cu(II) is less stable
(2) Stability of Cu(I) and Cu(II) depends on nature of copper salts
(3) Cu(II) is more stable
(4) Cu(I) and Cu(II) are equally stable

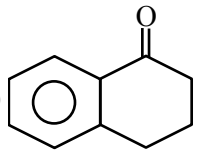
Ans. **(3)**

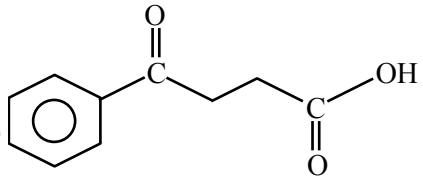
Sol. Cu(II) is more stable than Cu(I) because hydration energy of Cu^{+2} ion compensate IE_2 of Cu.

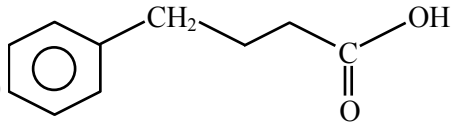
74.

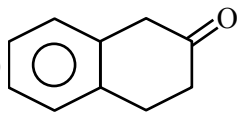


What is the structure of C ?

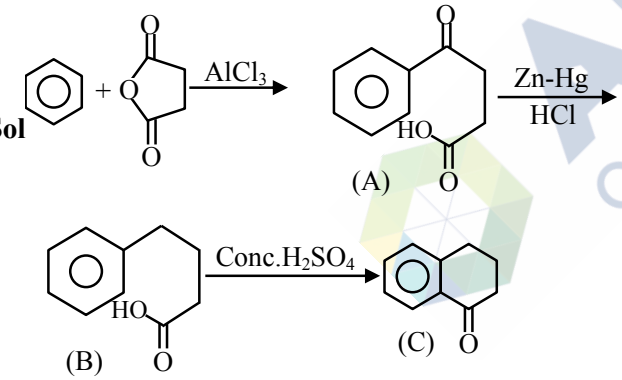
(1) 

(2) 

(3) 

(4) 

Ans. (1)

Sol 

75. Compare the energies of following sets of quantum numbers for multielectron system.

(A) n = 4, l = 1 (B) n = 4, l = 2

(C) n = 3, l = 1 (D) n = 3, l = 2

(E) n = 4, l = 0

Choose the correct answer from the options given below :

(1) (B) > (A) > (C) > (E) > (D)

(2) (E) > (C) < (D) < (A) < (B)

(3) (E) > (C) > (A) > (D) > (B)

(4) (C) < (E) < (D) < (A) < (B)

Ans. (4)

Sol. Energy level can be determined by comparing $(n + \ell)$ values

(A) $n = 4, \ell = 1 \Rightarrow (n + \ell) = 5$

(B) $n = 4, \ell = 2 \Rightarrow (n + \ell) = 6$

(C) $n = 3, \ell = 1 \Rightarrow (n + \ell) = 4$

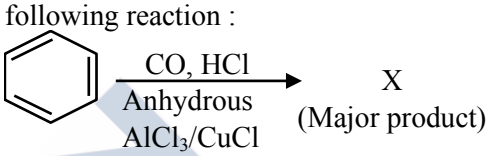
(D) $n = 3, \ell = 2 \Rightarrow (n + \ell) = 5$

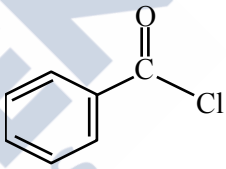
(E) $n = 4, \ell = 0 \Rightarrow (n + \ell) = 4$

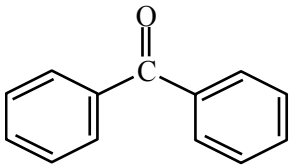
For same value of $(n + \ell)$, orbital having higher value of n, will have more energy.

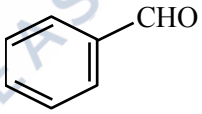
(B) > (A) > (D) > (E) > (C)

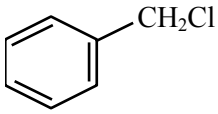
76. Identify major product "X" formed in the following reaction :



(1) 

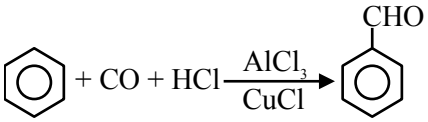
(2) 

(3) 

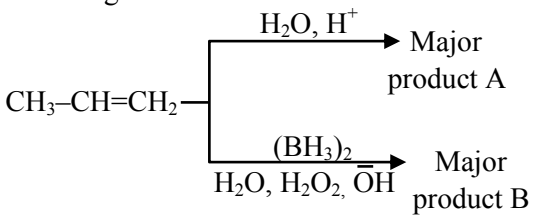
(4) 

Ans. (3)

Sol. This is Gattermann-Koch reaction



77. Identify the product A and product B in the following set of reactions.



(1) A-$CH_3CH_2CH_2$–OH, B-$CH_3CH_2CH_2$–OH

(2) A-$CH_3CH_2CH_2$–OH, B-$CH_3\underset{\underset{OH}{|}}{CH}–CH_3$

(3) A- $CH_3\underset{\underset{OH}{|}}{CH}–CH_3$, B-$CH_3CH_2CH_2$–OH

(4) A-$CH_3CH_2CH_3$, B-$CH_3CH_2CH_3$

Ans. (3)

Sol. **(1) Hydration Reaction :**

$$CH_3-CH=CH_2+H^+ \longrightarrow \underset{\text{(More stable)}}{CH_3-\overset{+}{C}H-CH_3}$$

$$CH_3-\overset{+}{C}H-CH_3 + H_2O \longrightarrow \underset{\text{(A)}}{(CH_3-\underset{OH}{\underset{|}{C}}H-CH_3)} + H^+$$

(2) Hydroboration Oxidation Reaction :

$$3CH_3-CH=CH_2 + B_2H_6 \xrightarrow{THF} 2(CH_3CH_2CH_2)_3B$$

$$(CH_3CH_2CH_2)_3B + 3H_2O_2 \xrightarrow{OH^-} \underset{\text{(B)}}{3CH_3CH_2CH_2OH} + H_3BO_3$$

78. On reaction of Lead Sulphide with dilute nitric acid which of the following is **not** formed ?

(1) Lead nitrate (2) Sulphur

(3) Nitric oxide (4) Nitrous oxide

Ans. (4)

Sol. $PbS + HNO_3 \rightarrow Pb(NO_3)_2 + NO + S + H_2O$

Nitrous oxide (N_2O) is not formed during the reaction.

79. Identify the **incorrect** statements regarding primary standard of titrimetric analysis

(A) It should be purely available in dry form.

(B) It should not undergo chemical change in air.

(C) It should be hygroscopic and should react with another chemical instantaneously and stoichiometrically.

(D) It should be readily soluble in water.

(E) $KMnO_4$ & NaOH can be used as primary standard.

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

(1) (C) and (D) only (2) (B) and (E) only

(3) (A) and (B) only (4) (C) and (E) only

Ans. (4)

Sol. $KMnO_4$ & NaOH → Secondary standard.

Primary standard should not be Hygroscopic.

80. 0.05M $CuSO_4$ when treated with 0.01M $K_2Cr_2O_7$ gives green colour solution of $Cu_2Cr_2O_7$. The [SPM : Semi Permeable Membrane]

$K_2Cr_2O_7$	$CuSO_4$
Side X	SPM Side Y

Due to osmosis :

(1) Green colour formation observed on side Y.

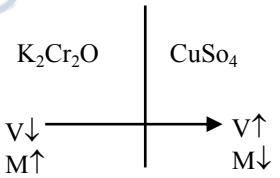
(2) Green colour formation observed on side X.

(3) Molarity of $K_2Cr_2O_7$ solution is lowered.

(4) Molarity of $CuSO_4$ solution is lowered.

Ans. (4)

Sol. Only solvent Molecules are allowed to pass through the SPM.



SECTION-B

81. The heat of solution of anhydrous $CuSO_4$ and $CuSO_4 \cdot 5H_2O$ are –70 kJ mol^{-1} and +12 kJ mol^{-1} respectively.

The heat of hydration of $CuSO_4$ to $CuSO_4 \cdot 5H_2O$ is –x kJ. The value of x is_____.

Ans. (82)

Sol.

(1) $CuSO_4(s) + 5H_2O \xrightarrow{x} CuSO_4.5H_2O$

(2) $CuSO_4.5H_2O + H_2O \xrightarrow{12} CuSO_4(aq)$

$CuSO_4 + H_2O \xrightarrow{-70} CuSO_4(aq)$

from (1) & (2)

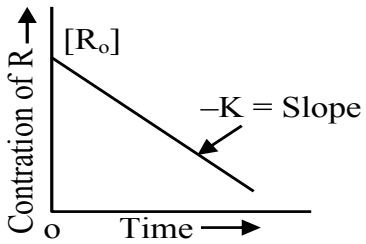
$-70 = x + 12$

$x = -82$

82. Given below are two statements :

Statement I : The rate law for the reaction A + B → C is rate (r) = k[A]^2[B]. When the concentration of both A and B is doubled, the reaction rate is increased "x" times.

Statement II :



The figure is showing "the variation in concentration against time plot" for a "y" order reaction.

The value of x + y is _____.

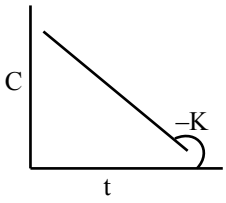
Ans. (8)

Sol. r = K[A]^2|B|

if conc. are doubled

r' = K[2A]^2[2B]^1

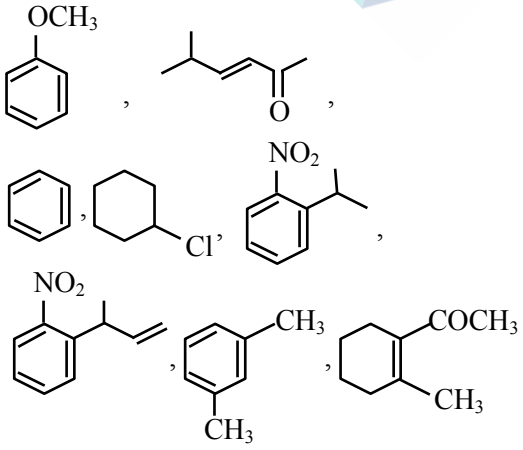
r' = 8r ⇒ x = 8



⇒ Zero order, y = 0

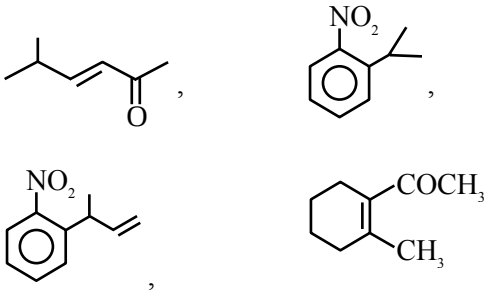
x + y = 8

83. How many compounds among the following compounds show inductive, mesomeric as well as hyperconjugation effects?



Ans. (4)

Sol.



84. The standard reduction potentials at 298 K for the following half cells are given below :

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$, E° = 1.33V

Fe^{3+} (aq) + $3e^- \rightarrow$ Fe E° = –0.04V

Ni^{2+} (aq) + $2e^- \rightarrow$ Ni E° = –0.25V

Ag^+ (aq) + $e^- \rightarrow$ Ag E° = 0.80V

Au^{3+} (aq) + $3e^- \rightarrow$ Au E° = 1.40V

Consider the given electrochemical reactions,

The number of metal(s) which will be oxidized be $Cr_2O_7^{2-}$, in aqueous solution is _____.

Ans. (3)

Sol. Fe, Ni, Ag will be oxidized due to lower S.R.P.

85. When equal volume of 1M HCl and 1M H_2SO_4 are separately neutralised by excess volume of 1M NaOH solution. X and y kJ of heat is liberated respectively. The value of y/x is _____.

Ans. (2)

Sol. $H^+ + OH^- \rightarrow H_2O \Rightarrow x$

$2H^+ + 2OH^- \rightarrow 2H_2O \Rightarrow 2x = y$

y/x = 2

86. Molarity (M) of an aqueous solution containing x g of anhyd. $CuSO_4$ in 500 mL solution at 32 °C is 2×10^{-1} M. Its molality will be _____ $\times 10^{-3}$ m. (nearest integer).

[Given density of the solution = 1.25 g/mL.]

Allen Ans. (164)

NTA Ans. (81) BONUS

Sol. $M_{soln} = v_{soln} \times d_{soln}$

$= 500 \times 1.25 = 625g$

Mass of solute (x) = 0.2 × 0.5 × 159.5

= 15.95

$n_{solute} = 0.1$,

Mass of solvent = Mass of solution – Mass of solute

= 625 – 15.95

= 609.05

$$m = \frac{0.1}{\frac{609.05}{1000}}$$

$m = 0.164 = 164 \times 10^{-3}$

87. The total number of species from the following in which one unpaired electron is present, is _____.

$N_2, O_2, C_2^-, O_2^-, O_2^{2-}, H_2^+, CN^-, He_2^+$

Ans. (4)

Sol. One unpaired e^- is present in : C_2^-; O_2^-; H_2^+; He_2^+

88. Number of ambidentate ligands among the following is _____.

$NO_2^-, SCN^-, C_2O_4^{2-}, NH_3, CN^-, SO_4^{2-}, H_2O.$

Ans. (3)

Sol. Ligands which have two different donor sites but at a time connects with only one donor site to central metal are ambidentate ligands.

Ambidentate ligands are NO_2^- ; SCN^- ; CN^-

89. Total number of essential amino acid among the given list of amino acids is _____.

Arginine, Phenylalanine, Aspartic acid, Cysteine, Histidine, Valine, Proline

Ans. (4)

Sol. Essential Amino acids are :-

Arginine, Phenylalanine, Histidine, Valine

90. Number of colourless lanthanoid ions among the following is _____.

Eu^{3+}, Lu^{3+}, Nd^{3+}, La^{3+}, Sm^{3+}

Ans. (2)

Sol. La^{+3} – $[Xe]4f^0$

Nd^{+3} – $[Xe]4f^3$

Sm^{+3} – $[Xe]4f^5$

Eu^{+3} – $[Xe]4f^6$

Lu^{+3} – $[Xe]4f^{14}$

La^{+3} and Lu^{+3} do not show any colour because no unpaired electron is present.