JEE MAIN 4th Attempt

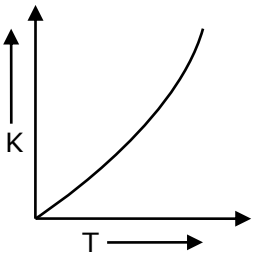
CHEMISTRY

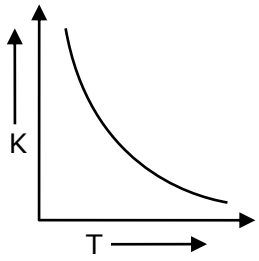
1 SEPTEMBER 2021 [SHIFT – 2]

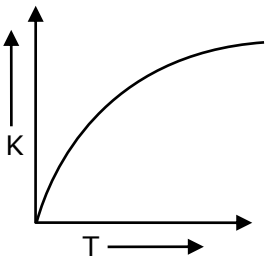
QUESTION WITH SOLUTION

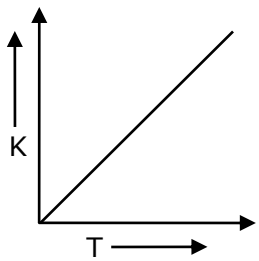
SECTION - A

Q.1 Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction?

(1) 

(2) 

(3) 

(4) 

Sol. 1

By observation we get this plot during measurable temperatures

2. Number of paramagnetic oxides among the following given oxides is _____ Li_2O, CaO, Na_2O_2, KO_2, MgO and K_2O

(1) 3 (2) 1 (3) 2 (4) 0

Sol. 2

$Li_2O \Rightarrow 2Li^+ \; O^{2-}$ $\quad MgO \Rightarrow Mg^{2+} \; O^{-2}$

$CaO \Rightarrow Ca^{2+} \; O^{2-}$ $\quad K_2O \Rightarrow 2K^+ \; O^{2-}$

$Na_2O_2 \Rightarrow 2Na^+ \; O_2^{2-}$

$KO_2 \Rightarrow K^+ \; O_2^{\;0}$

$O_2^{2-} \Rightarrow$ Complete octet, diamagnetic

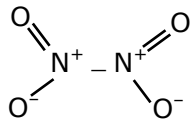
$O^{2-} \Rightarrow \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2px}^2\pi_{2py}^2 \simeq \pi_{2pz}^2\pi_{2py}^{*2} \simeq \pi_{2pz}^{*2}$(dia)

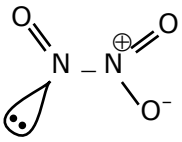
$O_2^- \Rightarrow \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2px}^2\pi_{2py}^2 \simeq \pi_{2pz}^2\pi_{2py}^{*2} \simeq \pi_{2pz}^{*2}$(para)

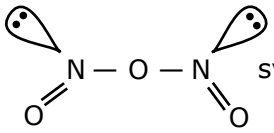
3. The oxide without nitrogen-nitrogen bond is :

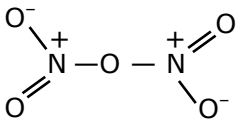
(1) N_2O_5 (2) N_2O_3 (3) N_2O_4 (4) N_2O

Sol. 1

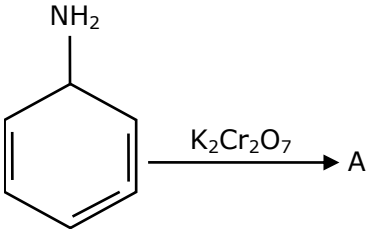
(1) $N \equiv N^+ - O^-$ (2) 

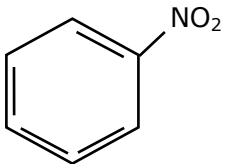

unsymmetrical

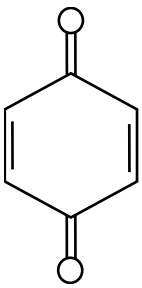
(3) 
symmetrical

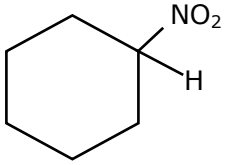
(4) 

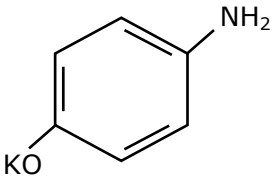
4. Identify A in the following reaction.



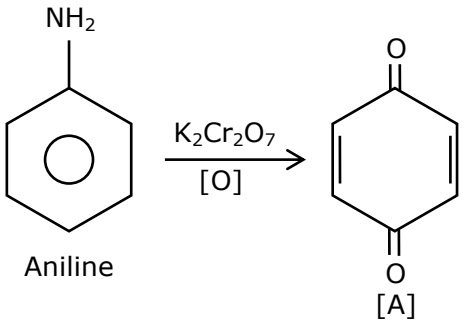
(1) 

(2) 

(3) 

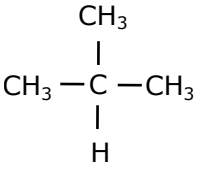
(4) 

Sol. 2

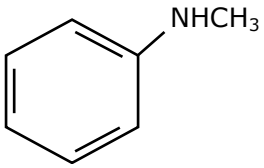

Aniline

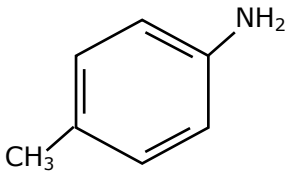
[A]

5. Which one of the following gives the most stable Diazonium salt?

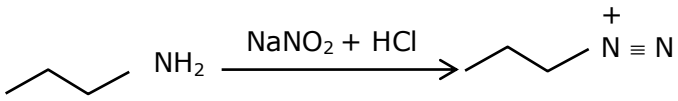
(1) 

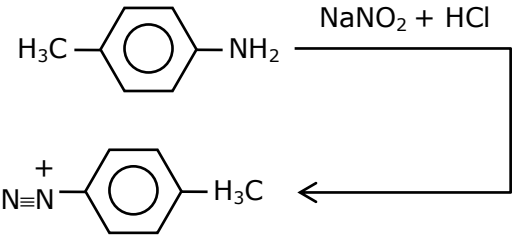
(B) $CH_3 - CH_2 - CH_2 - NH_2$

(C) 

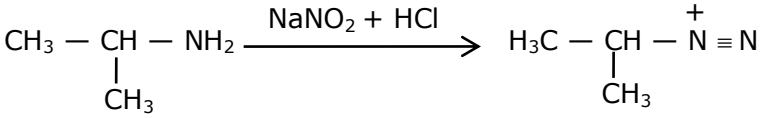
(D) 

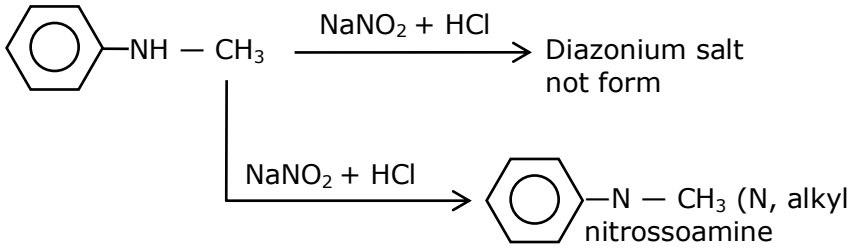
Sol. 4

(1) 

(2) 

(Most stable) +H-efect

(3) 

(4) 

Q.6 Given below are two statements:

Statement I : The nucleophilic addition of sodium hydrogen sulphite to an aldehyde or a ketone involves proton transfer to form a stable ion.

Statement II: The nucleophilic addition of hydrogen cyanide to an aldehyde or a ketone yields amine as final product.

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

(1) Statement I is false but Statement II is true.

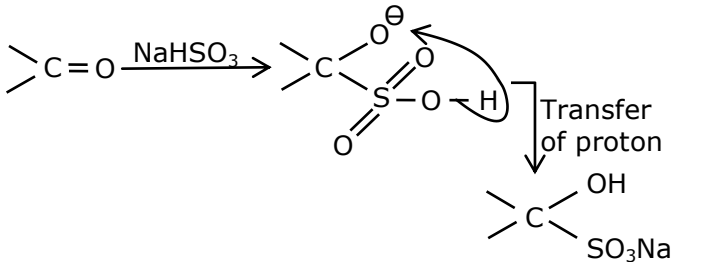
(2) Statement I is true but Statement II is false.

(3) Both Statement I and Statement II are true.

(4) Both Statement I and Statement II are false.

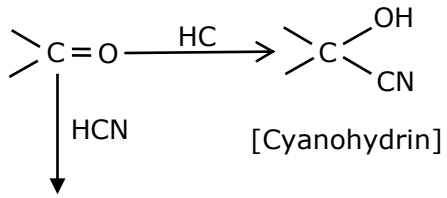
Sol. 2

Statement I : Correct



(White crystalline soluble ppt)

Statement II :



[Cyanohydrin]

amin — Wrong statemet

K(Amine not formed)

Q.7 Hydrogen peroxide reacts with iodine in basic medium to give :

(1) IO_4^- (2) I^- (3) IO_3^- (4) IO^-

Sol. 2

$I_2 + H_2O_2 + 2HO^- \rightarrow 2I^- + 2H_2O + O_2$

Q.8 In the given chemical reaction, colors of the Fe^{2+} and Fe^{3+} ions, are respectively :

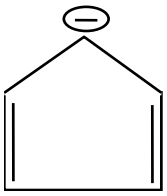
$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$

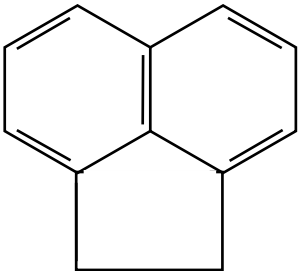
(1) Green, Yellow (2) Green, Orange (3) Yellow, Orange (4) Yellow, Green

Sol. 1

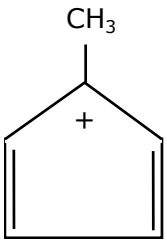
Colour of Fe^{2+} is observed green and Fe^{3+} is yellow

Q.9 Which one of the following compounds is aromatic in nature ?

(1) 

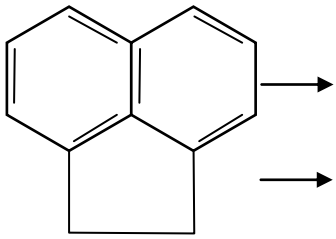
(2) 

(3) 

(4) 

Sol. 1

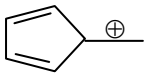
(1) (Acenaphthene)



→ 10 πe– in cyclic conjugation

→ Aromatic

(2)  ® 4πe– in ring conjugation ⇒ Anti Aromatic

(3)  CH_3 ⇒ $4\pi e^-$ in ring conjugation ⇒ Antiaromatic

(4)  ⇒ $6\pi e^-$ in ring conjugation ⇒ Aromatic

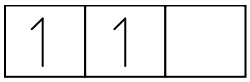
Cyclopentadienyl anion

Q.10 The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{z+}) are –0.8 Δ_0 and 3.87 BM, respectively. Identify (M^{z+}):

(1) Mn^{4+} (2) Co^{2+} (3) Cr^{3+} (4) V^{3+}

Sol. 2

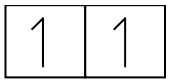
$V^{3+} \Rightarrow \square\square e_g = 2 \times 0.4\,\Delta_0$



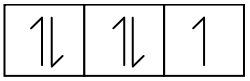
t_{2g} $= -0.8\,\Delta_0$

$= 2$ unpaired e^-

$\mu = 2.89 Bm$

$CO^{2+} \Rightarrow$  e_g $[2\times0.6\Delta_0 - 5\times0.4\Delta_0]$

$= -0.8\,\Delta_0$



t_{2g} 3 unparied $e^- \Rightarrow \mu = 3.87$ BM

hence d^7 configuration is of Co^{2+}.

Q.11 In the following sequence of reactions,

$$C_3H_6 \xrightarrow{H^+/H_2O} A \xrightarrow[\text{dil KOH}]{KIO} B + C$$

The compounds B and C respectively are :

(1) CI_3COOK, HCOOH (2) CI_3COOK, CH_3I

(3) CHI_3, CH_3 COOK (4) CH_3I, HCOOK

Sol. 3

$$\underset{(C_3H_6)}{CH_3 - CH = CH_2} \xrightarrow{H^{\oplus}/H_2O} \underset{(A)}{CH_3 - \overset{OH}{\overset{|}{C}}H - CH_3}$$

(Iodoform) KOI/dil KOH

$$\boxed{CHI_3} + CH_3 - \overset{O}{\overset{||}{C}} - \overset{\ominus\oplus}{O}K$$

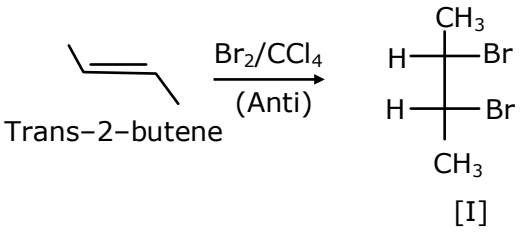
(B) (C)

Q.12 The stereoisomers that are formed by electrophilic addition of bromine to trans-but-2-ene is /are :

(1) 2 enantiomers (2) 2 enantiomers and 2 mesomers

(3) 2 identical mesomers (4) 1 racemic and 2 enantiomers

Sol. **3**



Trans–2–butene

[I]

meso product

Q.13 Identify the element for which electronic configuration in +3 oxidation state is $[Ar]3d^5$:

(1) Co (2) Mn (3) Fe (4) Ru

Sol. **3**

$Fe^{3+}[Ar]3d^5$

Q.14 The potassium ferrocyanide solution gives a Prussian blue colour, when added to :

(1) $CoCl_2$ (2) $FeCl_2$ (3) $FeCl_3$ (4) $CoCl_3$

Sol. **3**

$FeCl_3 + K_4[Fe(CN)_6] \rightarrow \underset{\text{Prussion blue}}{Fe_4[Fe(CN)_6]_3}$

Q.15 Match **List –I** with **List –II**.

List -I (Colloid Preparation Method)		**List-II (Chemical Reaction)**	
(a)	Hydrolysis	(i)	$2AuCl_3 + 3HCHO + 3H_2O \rightarrow 2Au(sol) + 3HCOOH + 6HCl$
(b)	Reduction	(ii)	$As_2O_3 + 3H_2s \rightarrow As_2S_3(sol) + 3H_2O$
(c)	Oxidation	(iii)	$SO_2 + 2H_2S \rightarrow 3S(sol) + 2H_2O$
(d)	Double Decomposition	(iv)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$

Choose the most appropriate answer from the options given below

(1) (a) –(iv), (b)-(i), (c) – (iii), (d) – (ii)

(2) (a) –(iv), (b)-(ii), (c) – (iii), (d) – (i)

(3) (a) –(i), (b)-(iii), (c) – (ii), (d) – (iv)

(4) (a) –(i), (b)-(ii), (c) – (iv), (d) – (iii)

Sol. **1**

According to type of reactions for preparation, colloids have been classified

Q.16 Water sample is called cleanest on the basis of which one of the BOD values given below :

(1) 21 ppm (2) 15 ppm (3) 3 ppm (4) 11 ppm

Sol. **3**

Clean water could have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

Q.17 Experimentally reducing a functional group cannot be done by which of the following reagents ?

(1) Na/H_2 (2) $Pd\text{-}C/H_2$ (3) $Pt\text{-}C/H_2$ (4) Zn/H_2O

Sol. 1

Solution NaH_2 is not reducing agent

Q.18 In the following sequence of reactions a compound A, (molecular formula $C_6H_{12}O_2$) with a straight chain structure gives a C_4 carboxylic acid. A is.

$$A \xrightarrow[H_3O^+]{LiAlH_4} B \xrightarrow{\text{Oxidation}} C_4 - \text{Carboxylic acid}$$

(1) $CH_3 - CH_2 - COO - CH_2 - CH_2 - CH_3$

(2) $CH_3 - CH_2 - CH_2 - COO - CH_2 - CH_3$

(3) $CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2 - O - CH = CH_2$

(4) $CH_3 - CH_2 - CH_2 - O - CH = CH - CH_2 - OH$

Sol. 2

$$CH_3 - CH_2 - CH_2 - \underset{\displaystyle O}{\underset{||}{C}} - O - CH_2 - CH_3$$

$$\downarrow \quad (1)\ LiAlH_4,\ (2)\ H3O$$

$$CH_3 - CH_2 - CH_2 - CH_2 - OH + CH_3 - CH_2 -$$

(B)

$$\downarrow [O]$$

$$CH_3 - CH_2 - CH_2 - \underset{\displaystyle O}{\underset{||}{C}} - OH \qquad [C_4 \text{carboxylic acid}]$$

Q.19 Calamine and Malachite, respectively, are the ores of :

(1) Aluminium and Zinc (2) Copper and Iron

(3) Zinc and Copper (4) Nickel and Aluminium

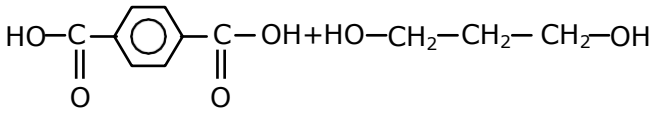
Sol. 3

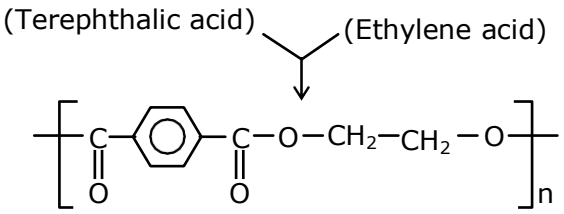
Calamine $\Rightarrow ZnCO_3$

Malachite $\Rightarrow Cu(OH)_2 \cdot CuCO_3$

Q.20 Monomer units of Dacron polymer are :
(1) ethylene glycol and phthalic acid
(2) ethylene glycol and terephthalic acid
(3) glycerol and phthalic acid
(4) glycerol and terephtalic acid

Sol. 2





Dacron

Section B

Q.1 If 80 g of copper sulphate $CuSO_4.5H_2O$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is $x\times10^{-3}$ mol L^{-1}. The value of x is_____
[Atomic masses Cu: 63.54 u, S : 32u, O: 16 u, H:1 u]

Sol. 64

$$\text{Moles of } CuSO_4\cdot5H_2O = \frac{80}{249.54}$$

$$\text{Molarity} = \frac{\frac{80}{249.54}}{5} = 64.117\times10^{-3}$$

Nearest integer, x = 64

Q.2 The molar solubility of $Zn(OH)_2$ in 0.1 M NaOH solution is $x \times 10^{-18}$ M. The value of x is _____(Nearest integer)
(Given: The solubility product of $Zn(OH)_2$ is 2×10^{-20})

Sol. 2

$Zn(OH)_2(s) \rightleftharpoons Zn^{+2}(aq) + 2OH^-(aq)$

S (0.1+2s) $\simeq$ 0.1

$K_{sp} = S(0.1)^2$
$2\times10^{-20} = s \times 10^{-2} \Rightarrow s = 2\times10^{-18}$
$= x \times10^{-18}$
x = 2

Q.3 If the conductivity of mercury at 0°C is 1.07×10^6 Sm^{-1} and the resistance of a cell containing mercury is 0.243 Ω , then the cell constant of the is $x \times 10^4$ m^{-1}. The value of x is _____. (Nearest integer)

Sol. 26

$k = 1.07 \times 10_6\, Sm_{-1}$, R = 0.243 Ω

$$G = \frac{1}{R} = \frac{1}{0.243}\Omega^{-1}$$

$K = G \times G^*$

$G^* = \frac{k}{G} = \frac{1.07 \times 10^6}{\frac{1}{0.243}} \simeq 26 \times 10^4 \text{ m}^{-1}$

Q.4 The sum of oxidation states of two silver ions in $[Ag(NH_3)_2]$ $[Ag(CN)_2]$ complex is

Sol. **2**

$[Ag(NH_3)_2]^+$ $[Ag(CN)_2]^-$

+1 +1

Q.5 The spin-only magnetic moment value of B_2^+ species is _____$\times 10^{-2}$ BM.

(Nearest integer) [Given : $\sqrt{3} = 1.73$]

Sol. **173**

$B_2^+ \Rightarrow \sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2py}^1 \simeq \pi_{2pz}^0$

$\Rightarrow 9e^-$

$\mu = \sqrt{1(1+2)} = \sqrt{3}$ BM

= 1.73 BM

= 1.73 $\times 10^{-2}$ BM

Q.6 For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when ΔS = −176.0 JK $^{-1}$ and ΔH = −57.8 kJ mol^{-1}, the magnitude of ΔG at 298 K for the reaction is _____ kJ mol^{-1}. (Nearest integer)

Sol. **5**

$\Delta G = \Delta H - T\Delta S$

$\Delta G = 57.8 - \frac{298(-176)}{1000}$

ΔG = −5.352kJ/mole

|Nearest integer value| =5

Q.7 The number of atoms in 8 g of sodium is x × 10^{23}. The value of x is _____ (Nearest integer)
[Given : N_A = 6.02 × 10^{23} mol^{-1}]
Atomic mass of Na = 23.0 u

Sol. **2**

No. of atoms $= \frac{8}{23} 6.02 \times 10^{23} = 2.09 \times 10^{23}$

$\simeq 2 \times 10^{23}$

= x $\times 10^{23}$

X = 2

Q.8 A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is $x\times10^2$. The value of x is _____ . (Nearest integer)
[Given : h = 6.63 $\times10^{-34}$Js and c = 3.0 $\times10^8$ ms^{-1}]

Sol. 2

Total energy per sec. = 50 J

$$50 = \frac{n\times6.63\times10^{-34}\times3\times10^8}{795\times10^{-9}}$$

n = 1998.49 $\times10^{17}$ [n = no. of photons per second]

= 1.998 $\times$ 10^{20}

$\simeq$ 2×10^{20}

= x $\times$ 10^{20}

x = 2

Q.9 An empty LPG cylinder weighs 14.8 kg. When full, it weighs 29.0 kg and shows a pressure of 3.47 atm. In the course of use at ambient temperature, the mass of the cylinder is reduced to 23.0 kg. The final pressure inside the cylinder is _____ atm. (Nearest integer)
(Assume LPG to be an ideal gas)

Sol. 2

Initial mass of gas = 29 –14.8 = 14.2 Kg

mass of gas used = 29 –23 = 6 Kg

gas left = 14.2 – 6 = 8.2 Kg

(1) $3.47\times V=\left(\frac{14.2\times10^3}{M}\right)\times R\times T$

(2) $p\times V=\left(\frac{8.2\times10^3}{M}\right)\times R\times T$

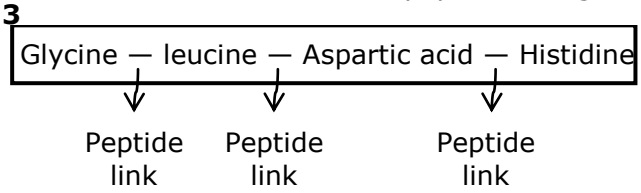
Divide:

$$\frac{(1)}{(2)}\Rightarrow\frac{3.74}{P}=\frac{14.2}{8.2}$$

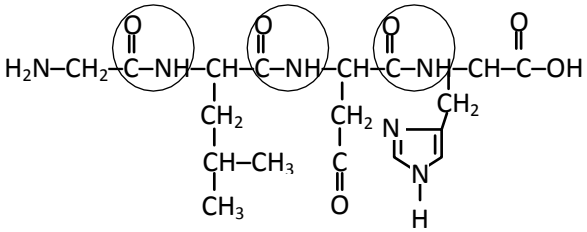
P=2.003

Q.10 A peptide synthesized by the reactions of one molecule each of Glycine, Leucine, Aspartic acid and Histidine will have _____ peptide linkages.

Sol. 3



Total (3) peptide linkages are present



3 peptide linkage

Sol. (3)