JEE Main Online Exam 2020

Question with Solutions

3rd September 2020 | Shift-II

CHEMISTRY

Q.1 The incorrect statement(s) among (a) – (d) regarding acid ram is (are) :

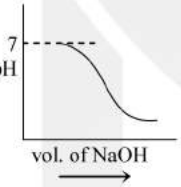
(a) It can corrode water pipes
(b) It can damage structures made up of stone
(c) It cannot cause respiratory ailments in animals
(d) It is not harmful for trees

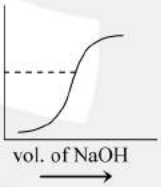
(1) (c) only (2) (c) and (d) (3) (a), (b) and (d) (4) (a), (c) and (d)

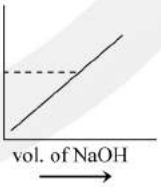
Ans. **[3]**

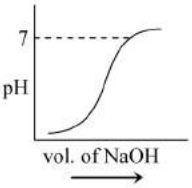
Sol. (1) Acid rain corrodes water pipes resulting in the leaching of heavy of heavy metals such as iron, lead and copper into the drinking water.
(2) Acid rain damages buildings and other structures made of stone or metal.
(3) It causes respiratory aliments in human beings and animals.
(4) It is harmful for agriculture, trees and plants as it wasshes down the nutrients needed for its growth.

Q.2 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?

(1) 

(2) 

(3) 

(4) 

Ans. **[2]**

Sol. Steep rise in pH around the equivalence point for titration of strong acid with strong base.

Q.3 The compound A in the following reactions is :

$$A \xrightarrow[(ii)\ Conc.,\ H_2SO_4/\Delta]{(i)\ CH_3MgBr/H_2O}$$

$$B \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_2} C + D$$

$$C \xrightarrow[(ii)\ \Delta]{(i)\ Conc.\ KOH} C_6H_5COO^{\ominus}K^{+} + C_6H_5CH_2OH$$

$$D \xrightarrow[\Delta]{Ba(OH)_2} H_3C-\overset{CH_3}{\overset{|}{C}}=CH-\overset{O}{\overset{||}{C}}-CH_3$$

(1) $C_6H_5-\overset{O}{\overset{||}{C}}-CH(CH_3)_2$

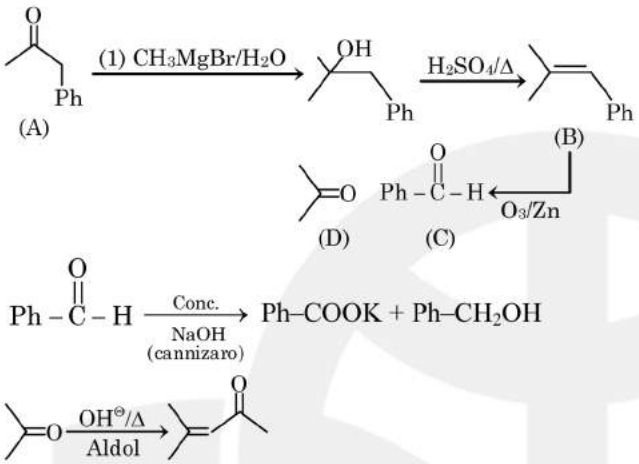
(2) $C_6H_5-CH_2-\overset{O}{\overset{||}{C}}-CH_3$

(3) $C_6H_5-\overset{O}{\overset{||}{C}}-CH_2CH_3$

(4) $C_6H_5-\overset{O}{\overset{||}{C}}-CH_3$

Ans. **[2]**

Sol.



Q.4 Consider the hypothetical situation where the azimuthal quantum number, ℓ takes values 0, 1, 2, ... n + 1. where n is the principal quantum number. Then, the element with atomic number.

(1) 6 has a 2p-valence subshell
(2) 8 is the first noble gas
(3) 13 has a half-filled valence subshell
(4) 9 is the first alkali metal

Ans. **[3]**

Sol. $\ell = 0$ to $(n + 1)$

n = 1
l = 0, 1, 2

n = 2
l = 0, 1, 2, 3

$(n + l) \Rightarrow \frac{1s}{1}\ \frac{1p}{2}\ \frac{1d}{3}$ $\quad \frac{2s}{2}\ \frac{2p}{3}\ \frac{2d}{4}\ \frac{2f}{5}$

n = 3

$\ell = 0, 1, 2, 3, 4$

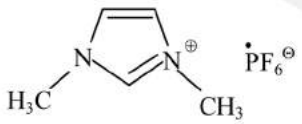
$\frac{3s}{3}\ \frac{3p}{4}\ \frac{3d}{5}\ \frac{3f}{6}\ \frac{3g}{7}$

Now, in order to wire electronic configuration, we need to apply $(n + \ell)$ rule

Energy order 1 : $1s < 1p < 2s < 1d < 2p < 3s < 2d$ ...
Option 1) 13 : $1s^2 1p^6 2s^2 1d^3$ is not half filled
Option 2) 9 : $1s^2 1p^6 2s^1$ is the first alkali metal because after losing one electron, it will achieve first noble gas configuration
Option 3) 8 : $1s^2 1p^6$ is the first noble gas because after $1p^6$ e^- will enter 2s hence new period
Option 4) 6 : $1s^2 1p^4$ has 1p valence subshell.

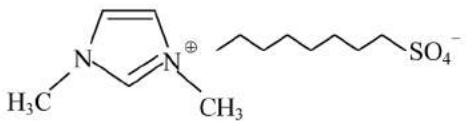
Q.5 An ionic micelle is formed on the addition of :

excess water to liquid

(1) 

excess water to liquid

(2) sodium stearate to pure toluene

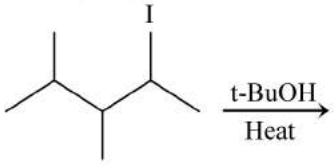
(3) 

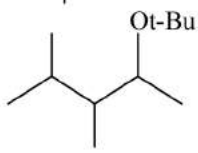
(4) liquid diethyl ether to aqueous NaCl solution

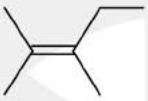
Ans. **[3]**

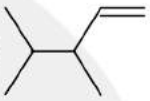
Sol. Correct Ans. is (3)

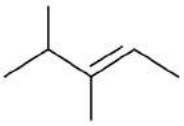
Q.6 The major product in the following reaction is :



(1) 

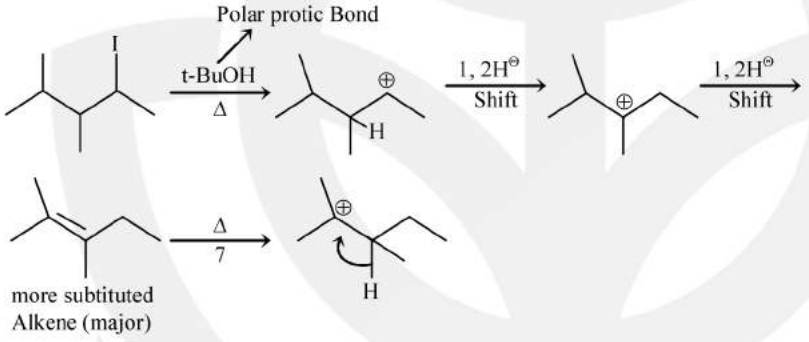
(2) 

(3) 

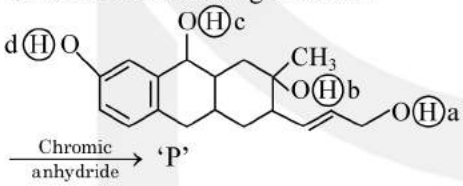
(4) 

Ans. **[2]**

Sol.



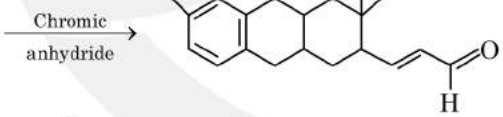
Q.7 Consider the following reaction :



The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these –OH group(s) ?

(1) (b) only (2) (c) and (d) (3) (d) only (4) (b) and (d)

Ans. **[1]**

Sol. Compound 

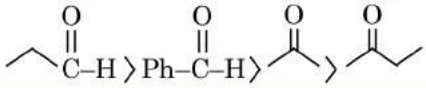
due to pressure of b.

Q.8 The increasing order of the reactivity of the following compounds in nucleophilic addition reaction is :
Propanal, Benzaldehyde, Propanone, Butanone

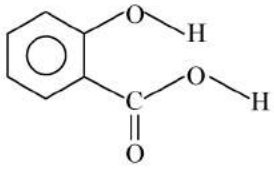
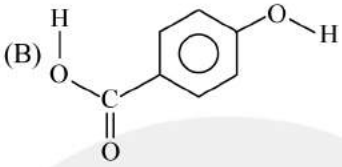
(1) Butanone < Propanone < Benzaldehyde < Propanal
(2) Propanal < Propanone < Butanone < Benzaldehyde
(3) Benaldehyde < Propanal < Propanone < Butanone
(4) Benzaldehyde < Butanone < Propanone < Propanal

Ans. **[1]**

Sol. Reactivity order of various carbonyl compounds → Aldehdes > Ketones



Q.9 Consider the following molecules and statements related to them :

(A)  (B) 

(a) (B) is more likely to be crystalline than (A)

(b) (B) has higher boiling point than (A)

(c) (B) dissolves more readily than (A) in water

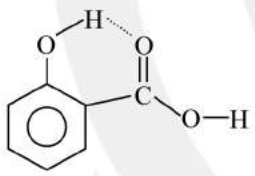
Identify the correct option from below :

(1) (a) and (b) are true (2) (a) and (c) are true

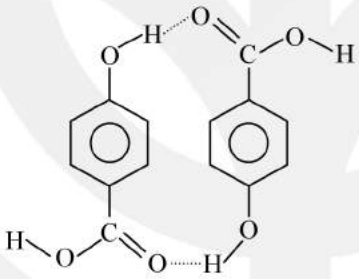
(3) Only (a) is true (4) (b) and (c) are true

Ans. **[4]**

Sol.



O-salicylic acid
intra molecular
H-bonding



p-salicylic acid
inter molecular
H-bonding

(a) B will be more crystalline due to more inter molecular interactions hence more efficient packing.

(b) B will have higher boiling point due to higher intermolecular interactions.

(c) B will be more soluble in water than A as B will have more extent of H-bonding in water

So all three statements are correct

{Solubility date $\Rightarrow$ O-salicylic acid = 2g/L ; P-salicylic acid = 5g/L}

Q.10 A mixture of one mole each of H_2, He andO_2 each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is -

(1) 14 atm (2) 22 atm (3) 38 atm (4) 6 atm

Ans. **[4]**

Sol. According to Dalton's law of partial pressure $p_i = x_i \times P_T$

p_i = partial pressure of the i^{th} component

x_i = mole fraction of the i^{th} component

p_T = total pressure of mixture

$$\Rightarrow \quad 2 \text{ atm} = \left(\frac{n_{H_2}}{n_{H_2} + n_{H_e} + n_{O_2}} \right) \times p_T$$

$$\Rightarrow \quad p_T = 2 \text{ atm} \times \frac{3}{1} = 6 \text{ atm}$$

Q.11 The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are :

(1) $t_{2g}^6\ e_g^0$ and $t_{2g}^4\ e_g^2$

(2) $t_{2g}^6\ e_g^0$ and $t_{2g}^6\ e_g^0$

(3) $t_{2g}^4\ e_g^2$ and $t_{2g}^4\ e_g^2$

(4) $t_{2g}^4\ e_g^2$ and $t_{2g}^6\ e_g^0$

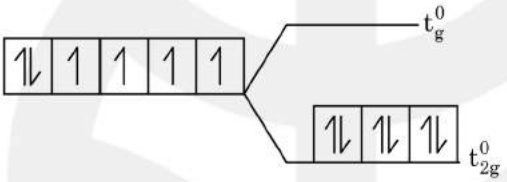
Ans. **[1]**

Sol. $[Ru(en)_3]\ Cl_2$ $R_u \Rightarrow$ 4d series

en $\Rightarrow$ chelating ligand

CN = 6, octahedral splitting hence laye splitting of d-subshell

$R_u^{+2} \Rightarrow [Kr]4d^6 5s^0$

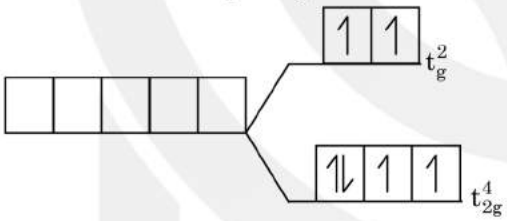


$[Fe(H_2O)_6]Cl_2 \Rightarrow H_2O \Rightarrow$ Weak filled ligand

$Fe^{+2} \Rightarrow [Ar]\ 3d^6 4s^0$

less plitting

CN = 6 octahedral splitting



Q.12 Match the following drugs with their therapeutic actions :

(i) Ranitidine	(a) Antidepressant
(ii) Nardil (Phenelzine)	(b) Antibioitic
(iii) Chloramphenicol	(c) Antihistamine
(iv) Dimetane (Brompheniramine)	(d) Antacid
	(e) Analgesic

(1) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)

(2) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)

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

(4) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e)

Ans. **[3]**

Sol. Raniticline $\rightarrow$ Antacid

Nardl $\rightarrow$ Antidepressant

Chloramphenicol $\rightarrow$ Antibiotic

Dimetane $\rightarrow$ Antihistamine

Q.13 The incorrect statement is :

(1) Manganate and permanganate ions are paramagnetic

(2) Manganate ion is green in colour and permanganate ion is purple in colour

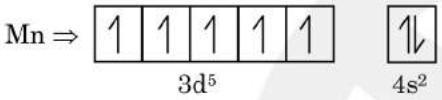
(3) In manganate and permanganate ions, the π-bonding, takes place by overtap of p-orbitals of oxygen and d-orbitals of manganese

(4) Manganate and permanganate ions are tetrahedral

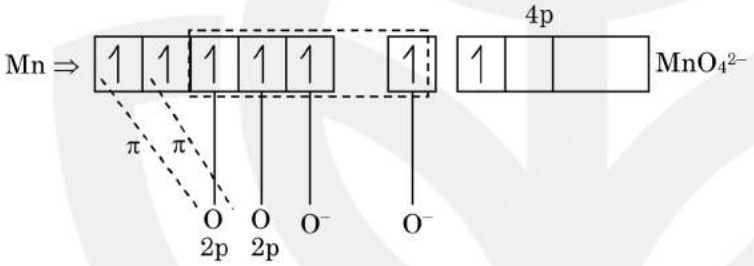
Ans. **[1]**

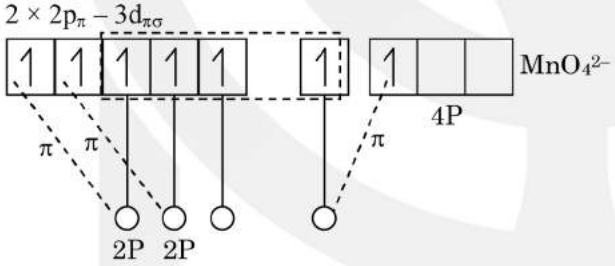
Sol. Option 1) Maganate $\Rightarrow MnO_4^{2-}$,
Permanganate $\Rightarrow MnO_4^-$

hybridisation of Mn $\Rightarrow d^3s$ hybridisation of Mn $\Rightarrow d^3s$



After excitation





$2 \times 2P_\pi - 3d_\pi$
$1 \times 2P_\pi - 4P_\pi$

(2) $MnO_4^{2-} \Rightarrow$ Green
$MnO_4^- \Rightarrow$ purple/violet

(3) Manganate contains 1 unpaired electron hence it is paramagnetic.
where as permanganetic contains no unpaired electrons hence it is diamagnetic.

(4) Both have d^3s hybridisation hence both have tetrahedral geometry.

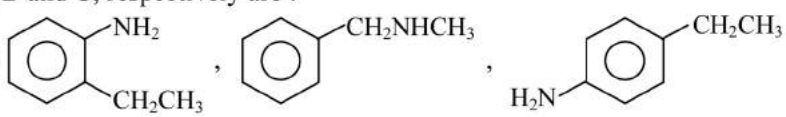
Q.14 Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results :

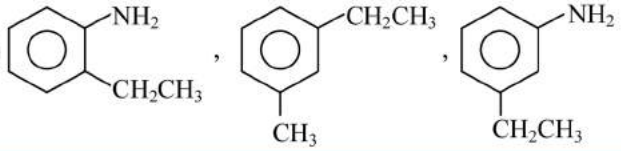
$$\text{A and C} \xrightarrow{\text{Azotization}} \text{P + Q} \xrightarrow[\text{(ii) Oxidation } (kMnO_4+H^+)]{\text{(i) Hydrolysis}} \begin{matrix}\text{R(product of A)} \\ + \\ \text{S(product of C)}\end{matrix}$$

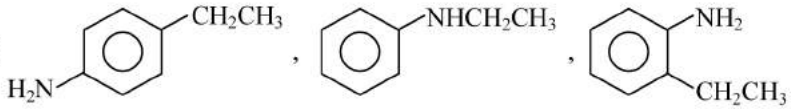
R has lower boiling point than S

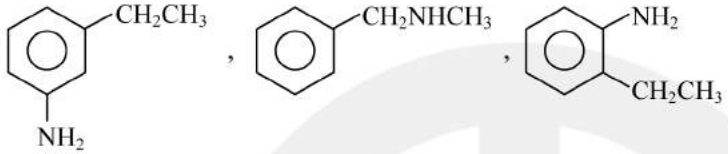
$B \xrightarrow{C_6H_5SO_2Cl}$ alkali-insoluble product

A, B and C, respectively are :

(1) 

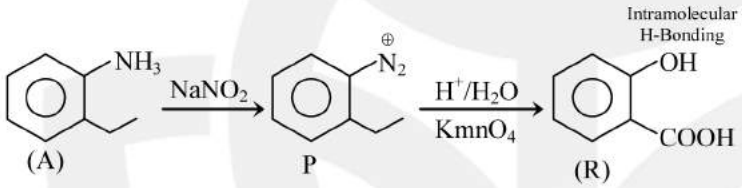
(2) 

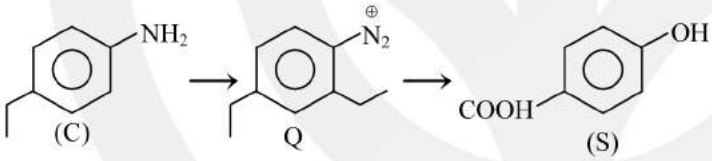
(3) 

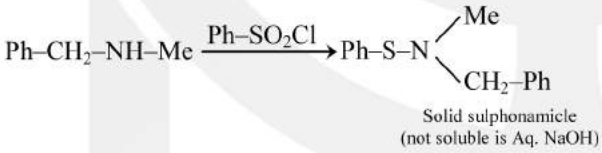
(4) 

Ans. **[1]**

Sol.







Q.15 Among the statements (I – IV), the correct ones are :

(I) Be has smaller atomic radius compared to Mg.

(II) Be has higher ionization enthalpy then Al.

(III) Charge/radius ratio of Be is greater than that of Al.

(IV) Both Be and Al form mainly covalent compounds.

(1) (I), (II) and (III) (2) (I), (II) and (IV)

(3) (I), (III) and (IV) (4) (II), (III) and (IV)

Ans. **[1]**

Sol. I, A_N ; Be < Mg

II IE : Be ,. Al

III Charge/radius ratio of Be w less than that of Al (IV) be, Al mainly form covalent compounds.

Q.16 The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electron in the element is -

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

Ans. **[1]**

Sol. Let suppose element X ⇒

$$X_{(g)} \xrightarrow[800]{IE_1} X(\overset{+}{g}) \xrightarrow[2427]{IE_2} X(\overset{+2}{g}) \xrightarrow[3658]{IE_3}$$

$$X(\overset{+3}{g}) \xrightarrow[25024]{IE_4} X(\overset{+4}{g}) \xrightarrow[32824]{IE_5} X(\overset{+5}{g})$$

X^{+3} has stable inert gas configuration as there is high jump after IE_3
So valence electrons are 3.

Q.17 Complex A has a composition of $H_{12}O_6Cl_3C_r$. If the complex on treatment with conc. H_2SO_4 loses 13.5 % of its original mass, the correct molecular formula of A is :
[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]
(1) $[Cr(H_2O)_5Cl]\ Cl_2 \cdot H_2O$ (2) $[Cr(H_2O)_6]Cl_3$
(3) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$ (4) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

Ans. **[4]**

Sol. % mass of water

$$= \frac{x \times 18}{(12 + 6\times + 35\times 3 + 52)} \times 100 = 13.5$$

$$\Rightarrow x = \frac{265 \times 13.5}{18 \times 100} \simeq 2$$

Q.18 The strengths of 5.6 volume hydrogen peroxide (of density 1g/mL) in terms of mass percentage and molarity (M), respectively, are : (Take molar mass of hydrogen peroxide as 34 g/mol)
(1) 0.85 and 0.5 (2) 1.7 and 0.25 (3) 1.7 and 0.5 (4) 0.85 and 0.25

Ans. **[3]**

Sol. Volume strength = 11.2 × molarity

$$\Rightarrow \text{molarity} = \frac{5.6}{11.2} = 0.5$$

Assuming 1 litre solution;
mass of solution = 1000 ml × 1 g/ml = 1000 g
mass of solute = moles × molar mass
= 0.5 mol × 34 g/mol
= 17 gm.

$$\Rightarrow \text{mass\%} = \frac{17}{1000} \times 100 = 1.7\ \%$$

Q.19 For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$, which statement is correct?

(1) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$ (2) $\frac{dn_A}{dt} = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$
(3) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$ (4) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$

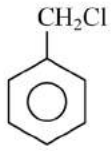
Ans. **[4]**

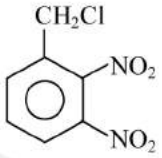
Sol. For $aA + bB \rightarrow cC$;

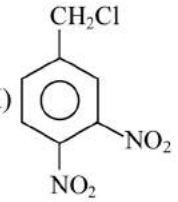
$$\frac{-1}{a}\frac{d[A]}{dt} = \frac{-1}{b}\frac{d[B]}{dt} = \frac{1}{c}\frac{d[C]}{dt}$$

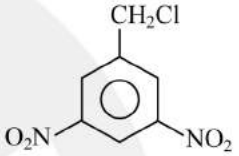
$$\therefore \frac{-1}{2}\frac{d[A]}{dt} = \frac{-1}{3}\frac{d[B]}{dt} = \frac{-2}{3}\frac{d[C]}{dt} = \frac{1}{3}\frac{d[p]}{dt}$$

Q.20 The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N^2) is :

(I) 

(II) 

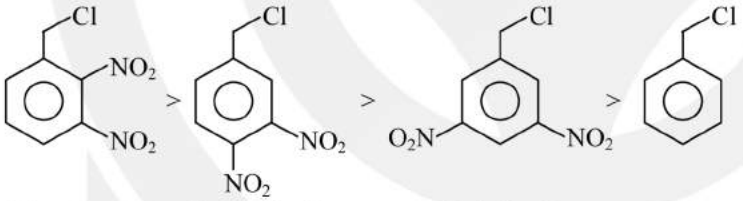
(III) 

(IV) 

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

Ans. **[4]**

Sol.



–I & – R | less –I & –R rate of SN^2 reaction | Only 2 – 1

Q.21 6.023×10^{22} molecules are present in 10 g of substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2L solution is .....$\times 10^{-3}$.

Ans. **[25]**

Sol. $$\text{moles} = \frac{\text{number of molecules}}{6\times10^{23}} = \frac{\text{given mass}}{\text{molar mass}}$$

$$\Rightarrow \text{molar mass} = \frac{10\times6.023\times10^{23}}{6.023\times10^{22}} = 100 \text{ g/mol}$$

$$\Rightarrow \text{molarity} = \frac{\text{moles of solute}}{\text{volume of sol}^n(\ell)} = \frac{(5/100)}{2} = 0.025$$

Q.22 An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$. The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in %) is (Take : F = 96000 C, At. mass of chromium = 52) ..... .

Ans. **[60]**

Sol. $$\text{Moles of } e^{\Theta} = \left(\frac{8\times60\times2}{96000}\right)$$

Using stoichiometry; theoritically

$$\frac{n_{e^{\Theta}} \text{ used}}{6} = \frac{n_{cr^{+3}} \text{ produced}}{2}$$

$\Rightarrow$ $n_{cr^{+3}}$ produced $= \frac{2}{6} \times \frac{8 \times 60 \times 2}{96000}$

$\Rightarrow$ $wt_{cr^{+3}}$ theoritically produced $= \left(\frac{0.02}{6} \times 52\right) g$

$\Rightarrow$ % efficiency $= \frac{0.104g}{\left(\frac{0.02 \times 52}{6}\right) g} \times 100 = 60\ \%$

Q.23 The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is ..... .

Ans. **[10]**

Sol. $H_3PO_2 + NaOH \rightarrow NaH_2PO_2 + H_2O$

$\frac{n_{H_3PO_2}\text{reached}}{1} = \frac{n_{NaOH}\text{reacted}}{1}$

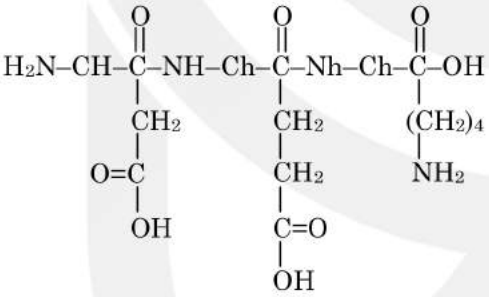
$\Rightarrow \frac{0.1 \times 10}{1} = 0.1 \times V_{NaOH}$

$\Rightarrow V_{NaOH} = 10$ ml.

Q.24 The number of C = O groups present in a tripeptide Aspp — Glu — Lys is ..... .

Ans. **[5]**

Sol. Structure of Tri peptide Asp – Glu – Lys



Q.25 If 250 cm^3 of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.66 g of a protein B. at 298 K, the ratio of the molecular masses of A and B is ..... $\times 10^{-2}$ (to the nearest integer).

Ans. **[177]**

Sol. Let molar mass of protein A = x g/mol

Let molar mass of protein B = y g/mol

π_A = osmotic pressure of protein A $= \frac{\left(\frac{0.73}{x}\right)}{0.25} RT$

π_B = osmotic pressure of protein B $= \frac{\left(\frac{1.65}{y}\right)}{1} RT$

$\pi_A = \pi_B$

$\Rightarrow \left(\frac{0.73}{x \times 0.25}\right) RT = \left(\frac{1.65}{y}\right) RT$

$\Rightarrow \left(\frac{x}{y}\right) = \frac{0.73}{0.25 \times 1.65} = 1.769 \cong 1.77$