JEE Main September 2020

Question Paper With Text Solution

3 September| Shift-2

CHEMISTRY

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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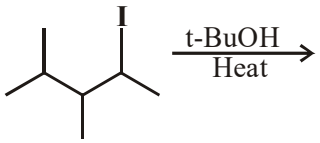
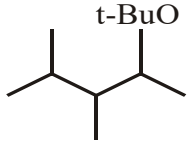
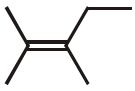
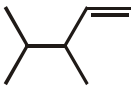
JEE MAIN SEP 2020 | 3 SEP SHIFT-2

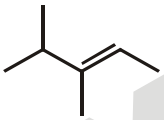
1. The major product in the following reaction is :



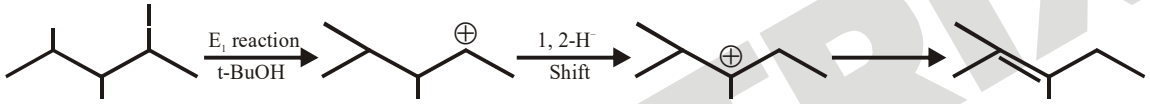
(1) 

(2) 

(3) 

(4) 

Ans. **(2)**

Sol. 

2. 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. **(2) (Answer given by NTA is 3)**

Sol. For n = 1 value of l = 0, 1, 2

For n = 2 value of l = 0, 1, 2, 3

So, according to n + l rule the filling order of subshells will be:

1s 1p 2s 1d 2p 3s 2d 3p 4s ……..

(1) 1st noble gas will have configuration $1s^2\ 1p^6$ so atomic number will be 8.

(2) 1st alkali metal will have electronic configuration $\Rightarrow 1s^1\ 1p^6\ 2s^1 \Rightarrow (Z = 1)$

(3) Electronic configuration of C (Z = 6) $\Rightarrow 1s^2\ 1p^4$

(4) Z = 13, Electronic configuration = $1s^2\ 1p^6\ 2s^2\ 1d^3$

So it will not have half-filled electronic configuration.

3. A mixture of one mole each of H_2, He and O_2 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) 22 atm (2) 14 atm (3) 6 atm (4)38 atm

Ans. **(3)**

Sol. $\boxed{P_{gas} = \frac{n_{gas}RT}{V}}$

as T & V constant So

$P \alpha n$

$P_{H_2} = P_{O_2} = P_{He} = 2$ atm

So, $P_{Total} = P_{H_2} = P_{O_2} = P_{He} = 6$ atm

4. The incorrect statement is :

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

(2) Manganate and permanganate ions are paramagnetic

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

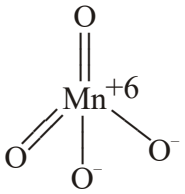
(4) Manganate and permanganate ions are tetrahedral

Ans. **(2)**

Sol.

Manganate

MnO_4^{2-}

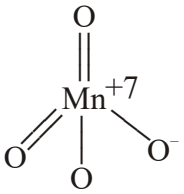


Paramagnetic, green in colour,

Tetrahedral & contains pπ-dπ bond

Permanganate

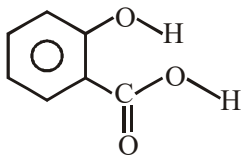
$MnO_4^{\ominus}$

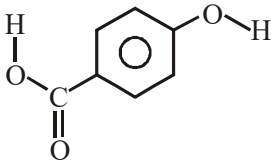


Diamagnetic, purple in colour,

Tetrahedral & contains pπ-dπ bond

5. 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) (b) and (c) are true

(3) (a) and (c) are true

(4) Only (a) is true

Ans. **(1)**

Sol. Due to inter molecular H-Bonding in B, than A, B is more crystalline and having more boiling point than A.

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

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

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

Ans. **(1)**

Sol. $[Ru(en)_3]Cl_2 \Rightarrow Ru^{2+} = 4d^6 = t_{2g}{}^6, e_g{}^0$ (Low spin complex)

$[Fe(H_2O)_6]^{2+} \Rightarrow Fe^{2+} = 3d^6 = t_{2g}{}^4, e_g{}^2$ (High spin complex)

So, correct answer is (1).

7. Complex A has a composition of $H_{12}O_6Cl_3Cr$. 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) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$

(2) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

(3) $[Cr(H_2O)_4Cl]Cl_2 \cdot 2H_2O$

(4) $[Cr(H_2O)_6]Cl_3$

Ans. **(3)**

Sol. Conc. H_2SO_4 acts as dehydrating agent.

Molar mass of given complex = 266.5 g/mol.

On treating with conc. H_2SO_4 the mass

lost by the complex = $\frac{13.5}{100}$ (266.5) $\approx$ 36g

= 2 moles of H_2O

Formula of the complex = $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

8. The incorrect statement(s) among (a) –(d) regarding acid rain 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) (a) , (c) and (d) (2) (c) only (3) (a), (b) and (d) (4) (c) and (d)

Ans. (4)

Sol. (C) It causes breathing problem in human being and animals

(D) It is harmful for trees and plants

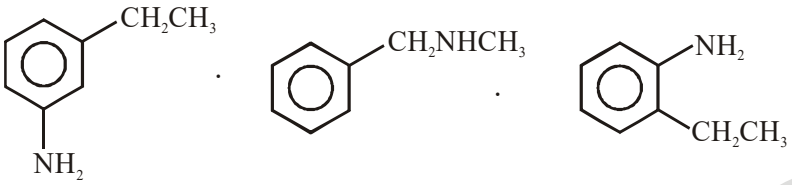
9. Three isomers A, B and C (mol.formula $C_8H_{11}N$) give the following results:

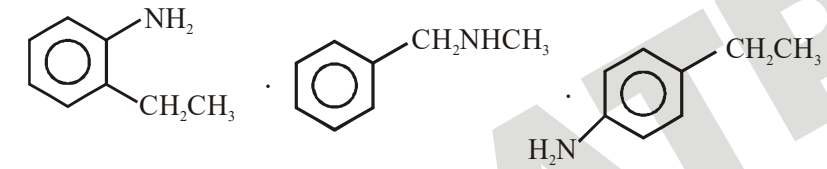
$$\text{A and C} \xrightarrow{\text{Diazotization}} \text{P + Q} \xrightarrow[\text{(ii)oxidation}\ (KMnO_4+H^+)]{\text{(i)Hydrolysis}} \begin{matrix}\text{R (product of A)} \\ + \\ \text{S (product of C)}\end{matrix}$$

R has lower boiling point than S

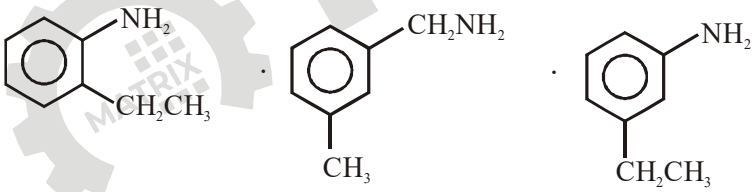
$$\text{B} \xrightarrow{C_6H_5SO_2Cl} \text{alkali-insoluble product}$$

A, B and C, respectively are :

(1) 

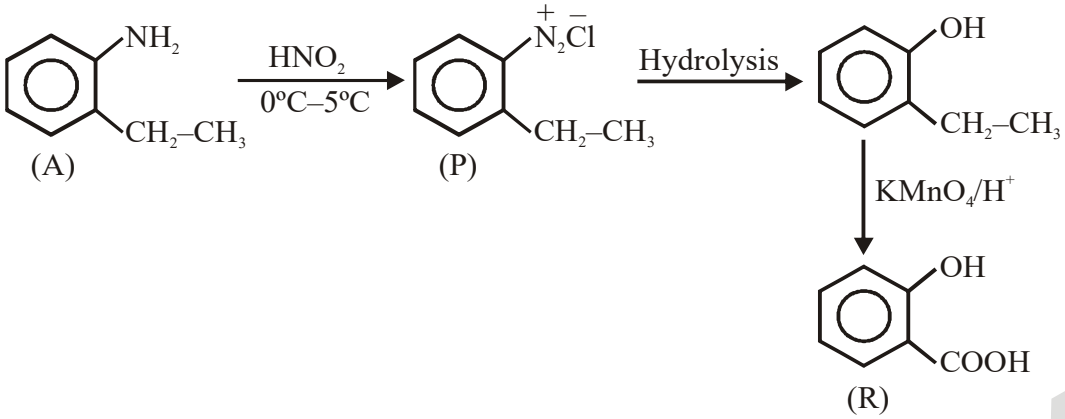
(2) 

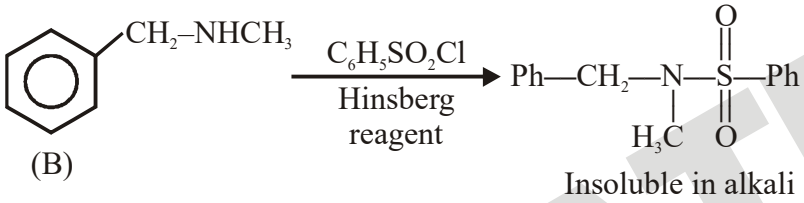
(3) 

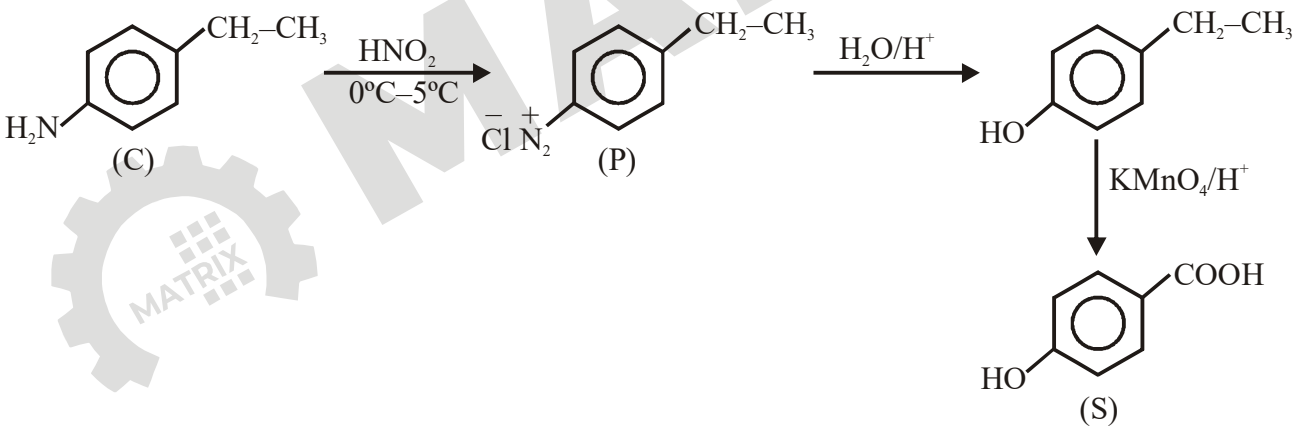
(4) 

Ans. (2)

Sol.







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

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

(II) Be has higher ionization enthalpy than 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 (IV) (2) (I), (II) and (III) (3) (II), (III) and (IV) (4) (I), (III), and (IV)

Ans. **(1)**

Sol. Charge / radius ratio of Be and Al is same because of diagonal relationship. Remaining statements are correct.

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

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

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

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

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

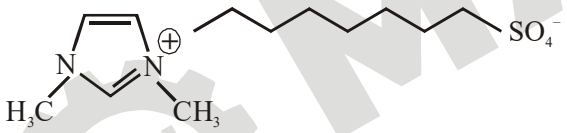
Ans. **(4)**

Sol. For a given reaction, $\text{rate} = -\frac{1}{2}\frac{dn_A}{dt} = -\frac{1}{3}\frac{dn_B}{dt} = -\frac{2}{3}\frac{dn_C}{dt}$

$$\text{rate} = \frac{dn_A}{dt} = -\frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$$

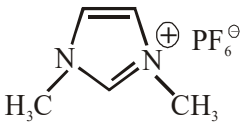
12. An ionic micelle is formed on the addition of :

(1) Sodium stearate to pure toluene

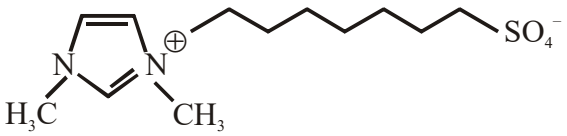
(2) 

(3) liquid diethyl ether to aqueous NaCl solution

excess water to liquid

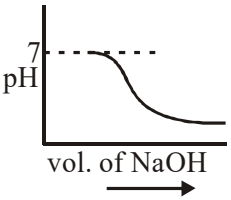
(4) 

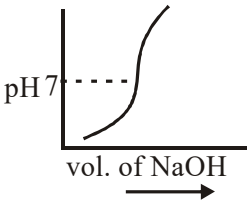
Ans. **(2)**

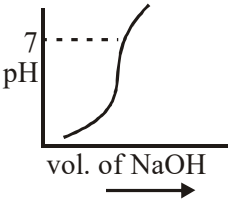
Sol. 

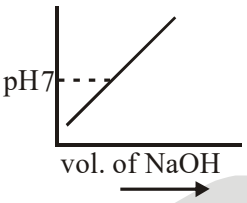
Due to presence of hydrophobic cahin it forms micelle.

13. 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 of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH ?

(1) 

(2) 

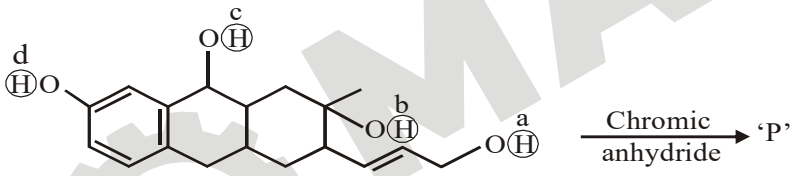
(3) 

(4) 

Ans. **(2)**

Sol. At equivalence point pH is 7 and pH increases with addition of NaOH so correct graph is (2).

14. Consider the following reaction :

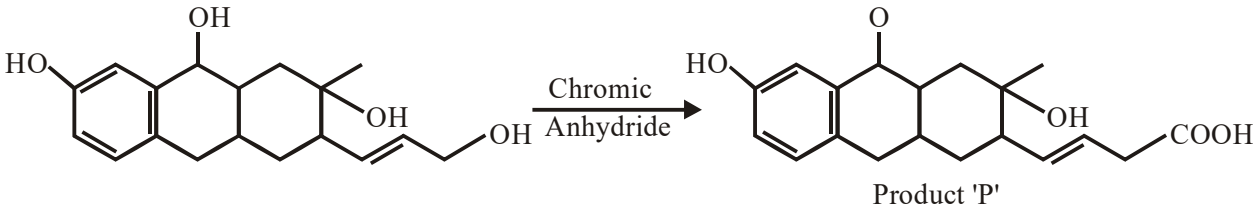


The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these –OH group(s) ?

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

Ans. **(4)**

Sol.



Product 'P'

3º Alcohol gives Red colour with ceric ammonium nitrate

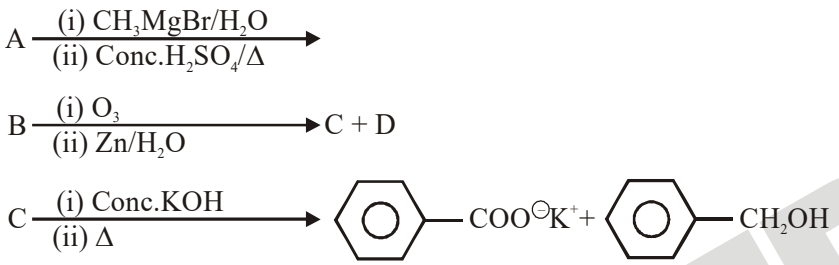
15. The five successive ionzation enthalphies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is :

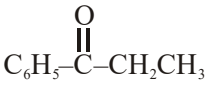
(1) 2 (2) 3 (3)4 (4) 5

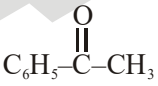
Ans. **(2)**

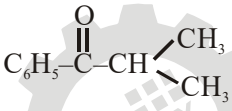
Sol. As difference in 3rd and 4th ionisation energies is high so atom contains 3 valence electrons.

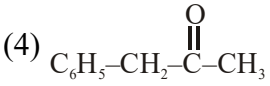
16. The compound A in the following reactions is :



(1) 

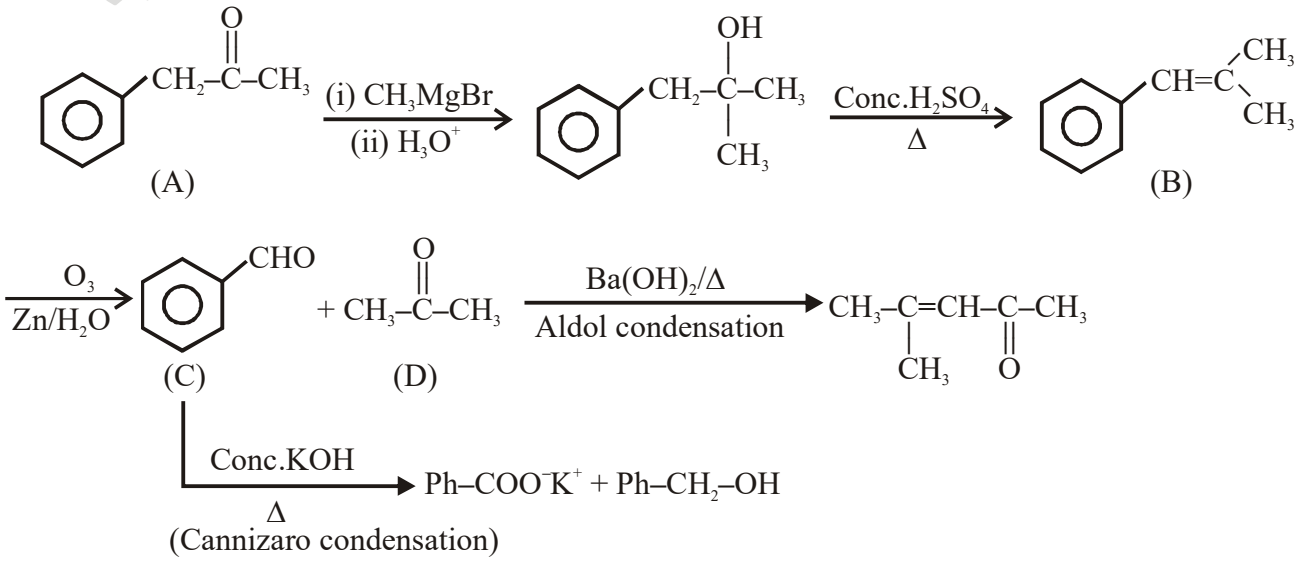
(2) 

(3) 

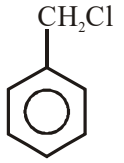
(4) 

Ans. **(4)**

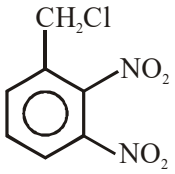
Sol.



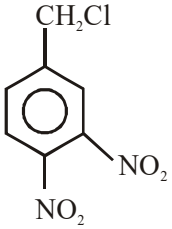
17. The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N2) is:



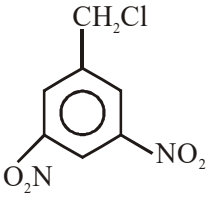
(I)



(II)



(III)



(IV)

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

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

Ans. **(4)**

Sol. S_N2 reaction depend upon –I, –M effect on substrate. On increase –I, –M, effect rate of S_N2 reaction increase.

18. The strengths of 5.6 volume hydrogen peroxide (of density1g/mL) in terms of mass percentage and molarity (M), respectively, are: (Take molar mass of hydrogen peroxide as 34 g/mol)

(1) 1.7 and 0.25 (2) 0.85 and 0.5 (3) 1.7 and 0.5 (4) 0.85 and 0.25

Ans. **(3)**

Sol. For H_2O_2

$$\text{Molarity} = \frac{\text{Volume strength}}{11.2} = \frac{5.6}{11.2} = 0.5\,\text{M}$$

$$\text{Molarity} = \frac{\%(w/w)\times 10\times d}{\text{GMM}}$$

$$0.5 = \frac{\%(w/w)\times 10\times 1}{34}$$

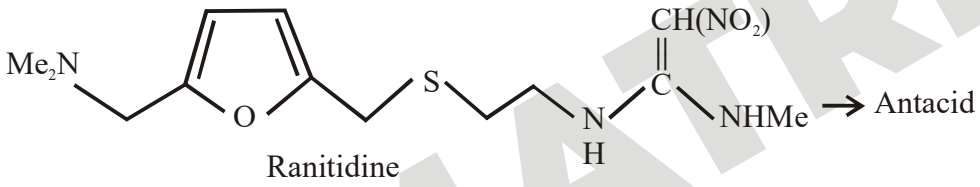
$$\%(w/w) = \frac{0.5\times 34}{10} = 1.7$$

19. Match the following drugs with their therapeutic actions :

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

(1) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)
(2) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e)
(3) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)
(4) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c)

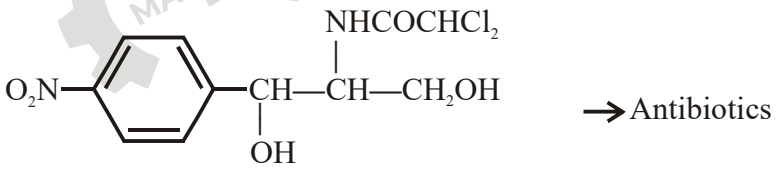
Ans. (4)



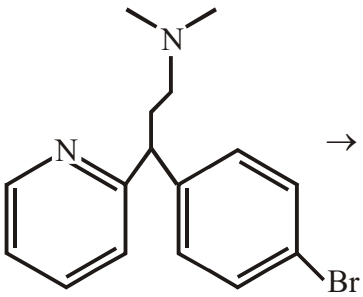
Ranitidine

Antidepressant drugs

Sol. Phenelzine (Nardil)



Chloramphenicol



Brompheniramine
(Dimetapp, Dimetane)

20. The increasing order of the reactivity of the following compounds in nucleophilic addition reaction is:

Propanal, Benzaldehyde, Propanone, Butanone

(1) Butanone < Propanone < Benzaldehyde < Propanal

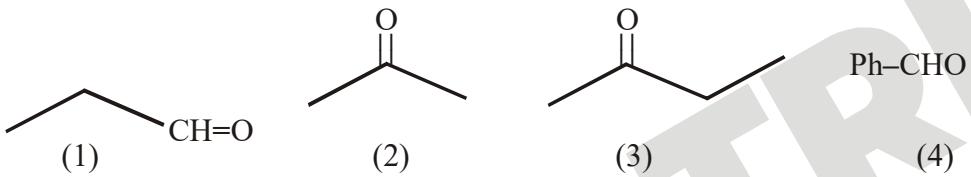
(2) Benzaldehyde < Butanone < Propanone < Propanal

(3) Propanal < Propanone < Butanone < Benzaldehyde

(4) Benzaldehyde < Propanal < Propanone < Butanone

Ans. **(1)**

Sol. Rate of Nucleophilic addition reaction α – I, – M on substate

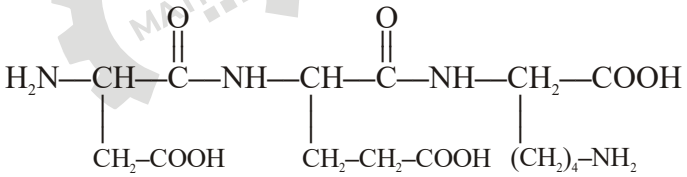


1 > 4 > 2 > 3

21. The number of $\diagdown C = O$ groups present in a tripeptide Asp –Glu –Lys is _____ .

Ans. **5**

Sol. Asp – Glu – Lys tripeptide is :



No. of $\diagdown C = O$ group = 5

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

Ans. 25

Sol. $\text{Number of mole of X} = \dfrac{6.022\times10^{22}}{6.022\times10^{23}} = \dfrac{10}{\text{Molar mass of X}}$

So molar mass of X = 100g

$\text{Molarity} = \dfrac{5}{100\times2} = 0.025\text{M}$

Ans. = 0.025 M

$M = 25\times10^{-3} = P \times 10^{-3}$

So, P = 25

23. 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. Charge (q) = it = 2 × 8 × 60 = 960 C

$\dfrac{960}{96000} = 0.01\text{F}$

$Cr_{27}^{2-} + 14H^+ + 6e^- \longrightarrow \quad 2Cr^{3+} \quad + \quad 7H_2O$

$0.01\text{F} \qquad \dfrac{1}{3}\times0.01 \text{ mole}$

$\text{Theoritical mass of } Cr^{3+} = \dfrac{1}{3}\times\dfrac{600}{96000}\times52 = 0.173\,\text{g}$

$\text{So, efficiency} = \dfrac{w_{\text{actual}}}{w_{\text{Theoritial}}}\times100 = \dfrac{0.104}{0.173}\times100 = 60\%$

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

Ans. **10**

Sol. Phosphinic acid is hypo phosphorous acid (H_3PO_2).

$$NaOH + H_3PO_2 \longrightarrow NaH_2PO_2 + H_2O$$

For neutrization

$$(N_1V_1)_{acid} = (N_2V_2)_{base}$$

$$0.1 \times 10 = 0.1 \times (V_{mL})_{NaOH}$$

$$V_{NaOH} = 10 \text{ mL}$$

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 1.65 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. For isotonic solution

$i_1C_1 = i_2C_2$ {For protein i = 1}

$C_1 = C_2$

$$\Rightarrow \quad \frac{0.73 \times 1000}{M_A \times 250} = \frac{1.65}{M_B \times 1}$$

$$\frac{M_A}{M_B} = \frac{0.73 \times 4}{1.65} = 1.77 = 177 \times 10^{-2}$$