(Memory Based)
JEE MAIN – 2020
September Session
03-09-2020 (Shift-II)
(CHEMISTRY)

01.   An equimolar mixture of $O_2(g), H_2(g)$ and $He(g)$ has been taken in a container of volume V at

        temperature T, in which partial pressure of $H_2(g)$ is 2 atm. The total pressure in the container is

        1) 6 atm   2) 18atm   3) 24 atm   4) 30 atm

Key: 1

Sol: $X_{H_2} = \dfrac{1}{3}$

        $P_{H_2} = X_{H_2}.P_{gas}$

        $2 = \dfrac{1}{3}P_{gas}$

        $P_{gas} = 6\,atm$

02.   What is the molarity and $\%\left(\dfrac{wt}{wt}\right)$ of 5.6 volume H_2O_2 solution. [Given molar mass of $H_2O_4 = 34$

        gram/mole density of solution = 1 gm/ml].

        1) 0.5 and 1.7   2) 0.5 and 0.85   3) 1.0 and 1.7   4) 1.0 and 0.85

Key: 1

Sol: $M = \dfrac{Volume\,strength}{11.2}$

        $= 0.5$

        $M = \dfrac{\%\left(\dfrac{wt}{wt}\right) \times 10 \times d}{Molecular\,weight\,of\,solute}$

        $0.5 = \dfrac{\%\left(\dfrac{wt}{wt}\right) \times 10 \times 1}{34}$

        $\%\left(\dfrac{wt}{wt}\right) = 1.7$

03.   The incorrect statement about manganate and permanganate ions is?

        1) Manganate is in green colour

        2) Both manganate and permanganate ions have tetrahedral geometry

        3) Both manganate & permanganate ions are paramagnetic nature

        4) In both compounds Mn from $d\pi$-$p\pi$ bond with oxygen.

Key: 3

Sol:
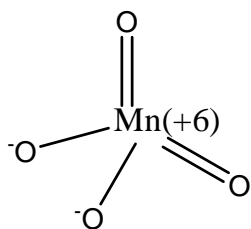
Manganate
Mn^{+6} contain one unpaired
electron so paramagnetic
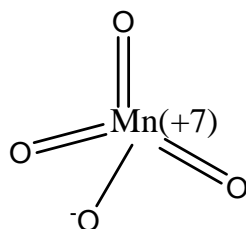
Permanganate
Mn^{+7} has no unpaired electron
so diamagnetic

Hybridization in both compounds is d^3s hence shape is tetrahedral Both contain $d\pi - p\pi$

04.   Among the following statements identify the correct set of statements

a) Size of Be is smaller than Mg

b) Ionization energy of Be is greater than Al

c) Both Be and Al form covalent compounds readily

d) Both Be and Al does not react with nitrogen

1) b, c, d   2) a, c, d   3) a, b, c   4) a, b, d

Key: 3

Sol.   * In general group IIA elements having more IP than group IIIA

* Due to more polarization power of Be and Al can form covalent compounds

* Both Be and Al react with nitrogen to form nitride

$$3Be+N_2 \xrightarrow{\Delta} Be_3N_2$$

$$6Al+3N_2 \xrightarrow{\Delta} 6AlN$$
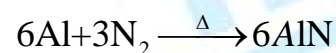
05.   In 10^{-2} molar HCl solution $10^{-2}M$ NaOH solution has been added gradually. Identify the correct
graph for this titration.

1)
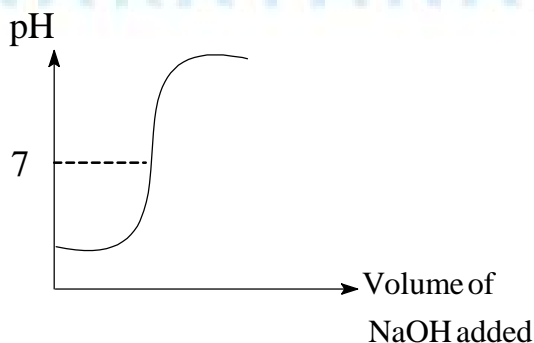
2)
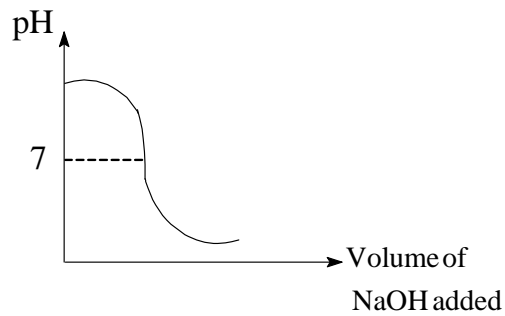
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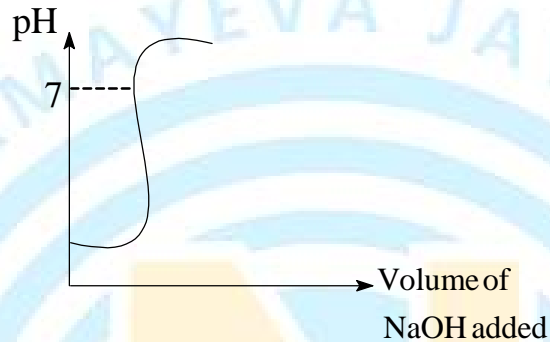
4)
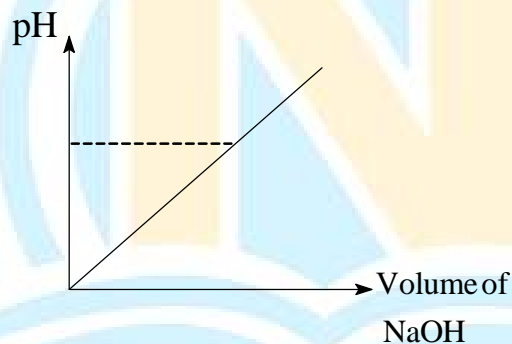
Key: 1

Sol: At equivalent point solution will be neutral and P^H will be 7. After equivalent point if we add more NaOH P^H of the solution increases.

06. For a reaction $2A + 3B + \dfrac{3}{2}C \rightarrow P$ the correct reaction between the rate of reaction of species A, B and C is

1) $-\dfrac{dn_A}{dt} = \dfrac{-dn_B}{dt} = -\dfrac{dn_C}{dt}$

2) $-\dfrac{dn_A}{dt} = -\dfrac{2}{3}\dfrac{dn_B}{dt} = -\dfrac{4}{3}\dfrac{dn_C}{dt}$

3) $2\dfrac{dn_A}{dt} = 3\dfrac{dn_B}{dt} = \dfrac{3}{2}\dfrac{dn_C}{dt}$

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

Key: 2

Sol: $rate = -\dfrac{1}{2}\dfrac{dh_A}{dt} = -\dfrac{1}{3}\dfrac{dh_B}{dt} = -\dfrac{2}{3}\dfrac{dh_C}{dt}$

$rate = -\dfrac{dh_A}{dt} = -\dfrac{2}{3}\dfrac{dh_B}{dt} = -\dfrac{4}{3}\dfrac{dh_C}{dt}$

07. The crystal field configuration of complexes $\left[Ru(en)_3\right]Cl_2$ and $\left[Fe(H_2O)_6\right]^{2+}$ respectively is

1) t_{2g}^4, e_g^2 and t_{2g}^6, e_g^0 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}^6, e_g^0 and t_{2g}^4, e_g^2

Key: 4

Sol: * The both given metals belongs to VIIIB group and having general electronic configuration **ns²(n-1) d⁶**

The oxidation state of both metals is +2 therefore the configuration will be **(n-1) d⁶**

* The complex formed by the **Ru** is having more splitting energy $(\Delta o > P)$ with the result the 6e⁻ are paired up in t₂g orbitals

* On the other hand the complex formed by **Fe** is having less splitting energy $(\Delta o < P)$ so the pairing takesplace only when the **e**g orbitals are filled

$\left[Ru(en)_3\right]Cl_2 \Rightarrow Ru^{2+} = 4d^6 = t_{2g}^6, e_g^0$

$\left[Fe(H_2O)_6\right]^{2+} \Rightarrow Fe^{2+} = 3d^6 = t_{2g}^4, e_g^2$
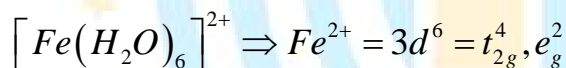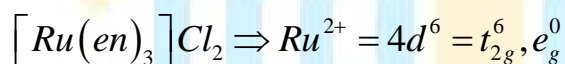
So, correct answer is (4)

08. What is the valency of an atom if its successive ionization energies respectively are 800, 900, 925, 25356, 32456 kJ/mole?

1) 3   2) 4   3) 5   4) 6

Key: 1

Sol: As we observe the values of given IE's the sudden huge jump observed after 3rd value. It clearly indicates the removal of 4th electron is very difficult due to inert gas configuration of M^{+3}

09. For a hypothetical case let value of l is defind as 0,1,2,3..... (n+1) for principle quantum number n

1) Atomic number of 1st noble gas is 8

2) Atomic number of 1st alkali metal is 9

3) Carbon has electron in $2pz$

4) Element with atomic number 13 has half filled d-subshell

Key: 4

Sol: For n = 1   value of $l = 0, 1, 2$

                      Electronic configuration $= 1s^2 1p^6 1d^{10}$

   1) 1st noble gas atomic number 18

   2) 1st alkali metal electronic configuration $\Rightarrow 1s^2 1p^6 1d^{10} 2s^1 \Rightarrow (Z = 19)$

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

   4) Z = 13, Electronic configuration $= 1s^2 1p^6 1d^5$

   So it has half filled electronic configuration

10.   Write down nucleophilic substitution $(S_N 2)$ order for following.
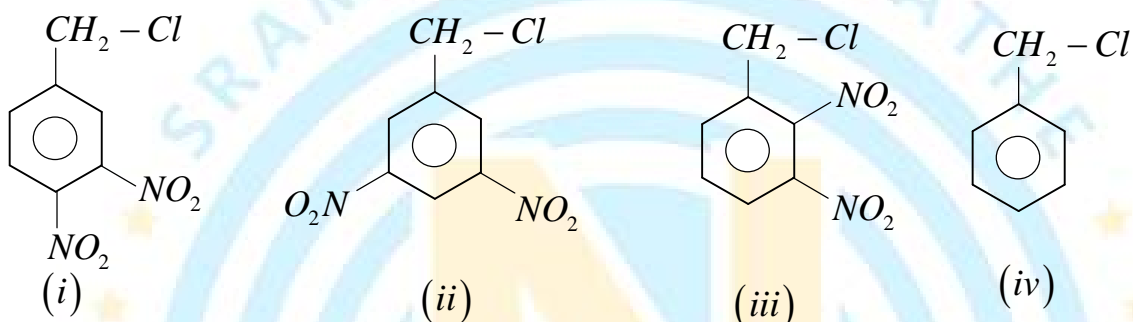
   1) $i > iii > ii > iv$ 2) $iv > iii > ii > i$ 3) $i > ii > iii > iv$ 4) $iii > i > ii > iv$

Key: 1

Sol: * In S_N^2 reaction the Nucleophile simultaneously interact with $\sigma*$ orbitals of carbon bearing leaving group. The presence of the π-bonds and with drawing group will decrease the energy of $\sigma*$ orbitals which facilitates more interaction with $\sigma*$ orbitals. Consequently the rate of SN^2 reaction enhances

   * In the given molecules (i) molecule reacts at faster rate because of combination of -I and -M effects and the (iv) molecule reacts with slow rate then the other molecule

   * Among $(ii) \& (iii)$ although the NO_2 (ortho) is going out of the plane but exhibit strong -I effect

11.   Identify structure of A in following reaction sequence.

1)

2)

3)

4)

Key.   (4)

Sol.

(A)   (i) CH_3MgBr (B) $Conc.H_2SO_4$
       (ii) H_3O^+ $\triangle$

(C) O_3 (D)   (E)
       Zn/H_2O $+ CH_3-\overset{\text{O}}{\underset{\|}{C}}-CH_3$
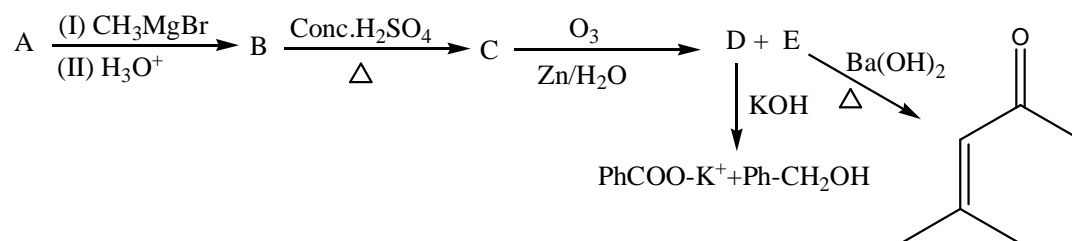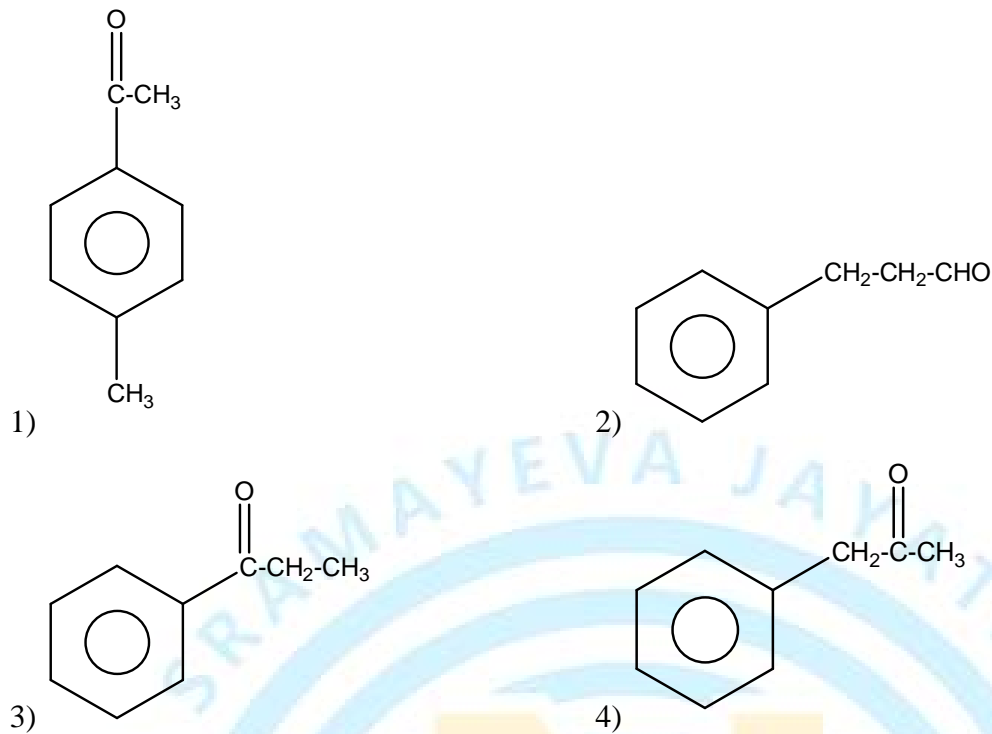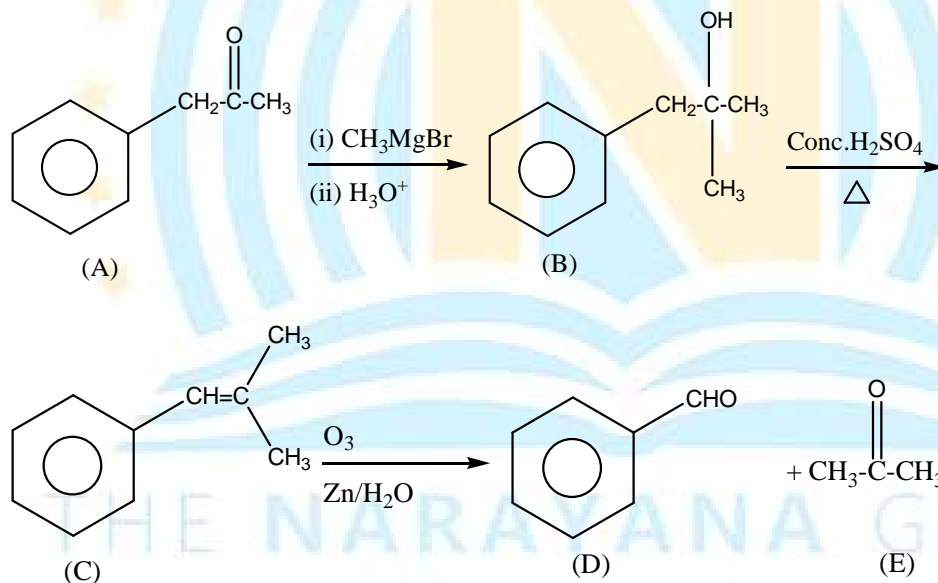
* The molecule (D) undergoes Cannizzaro reaction because of absence of α−hydrogen atoms

* The molecule (E) undergoes Aldol condensation reaction because of presence of α−hydrogen atoms

12.   Match the columns

Columns-I   Columns-II

A) Chloramphenicol   i) Antacid

B) Ranitidine   ii) Antihistamine

C) Phenelzine (nardil)   iii) Antibiotic

D) Morphine   iv) Analgesic

v) Antidepressent

1) A-i   B-ii   C-iv   D-v   2) A-ii   B-iv   C-v   D-i

3) A-iii B-i   C-v   D-iv   4) A-iii B-ii C-i   D-v

Key.   (3)

Sol.

Ranitidine $\longrightarrow$ Antacid

Phenelzine(Nardil) $\longrightarrow$ Antidepressant drugs

Chloramphenicol $\longrightarrow$ Antibiotics

Morphine $\longrightarrow$ Analgesics

13.

$$\xrightarrow[\triangle]{\text{t-BuO}^-\text{k}}$$
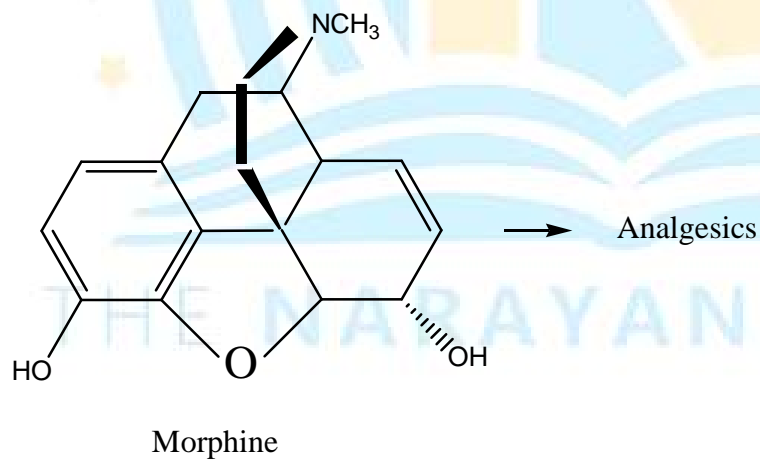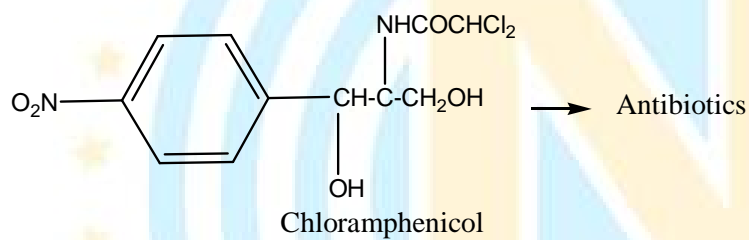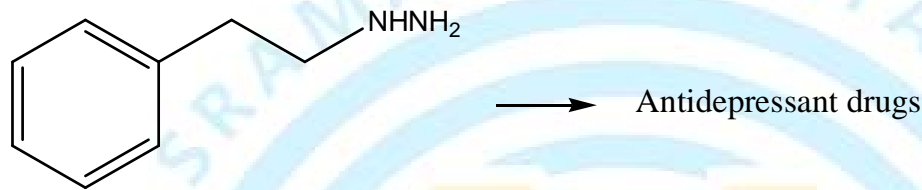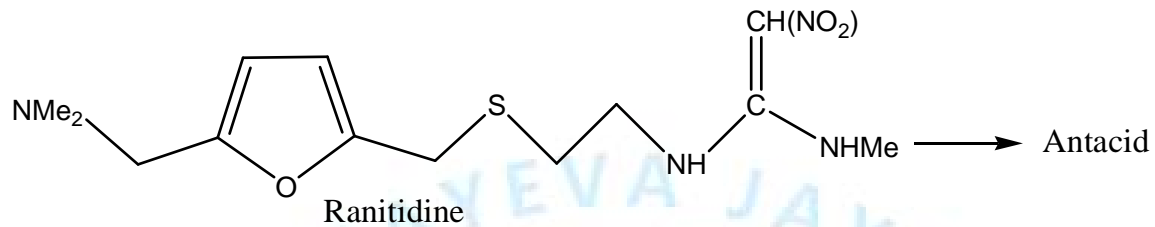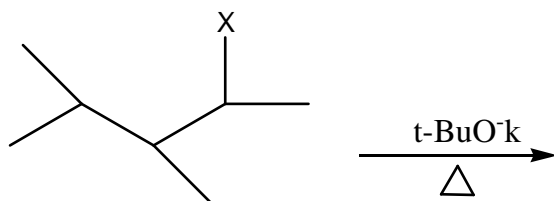
Find product of above reaction.

1)   2)   3)   4)
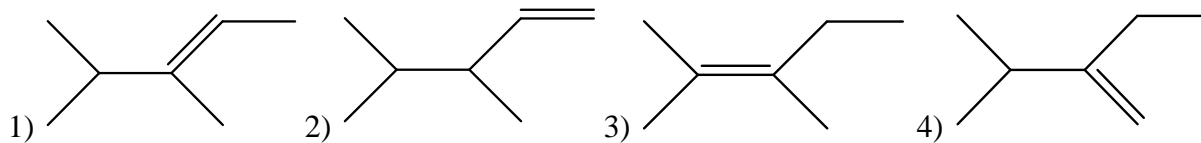
Key.   (2)

Sol.   The substrate is 2° substrate, so it can undergo either E_1 and E_2 reactions on heating. However the presence of the strong base renders more towards E_2 spectrum. Further more the presence of bulky base $\left(t-BuO^-\right)$ accumulates the formation of Anti-Zaitsev's product (Hoffman's product)

Major product

14.

(A)

(B)
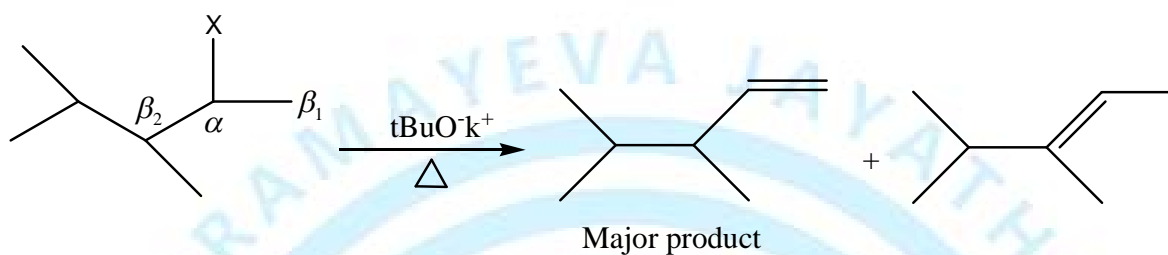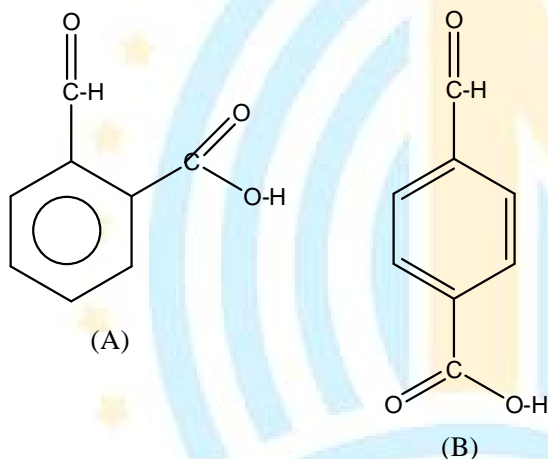
A) B is less water soluble than A

B) B is more crystalline in nature than A

C) B has more boiling point than A

Select correct statement regarding above structures.

1) A, B are correct   2) Only C is correct   3) B, C are correct   4) A, B, C all are correct

Key.   (3)

Sol.   *Among the given molecules A & B the compound A shows chelation (Intramolecular H-bond) with the result solubility and B.P both decrease than compound B

* The Compound B is more Symmetrical than compound A. consequently the compound B has more crystalline in nature than A

15.   Write down decreasing order of Nucleophilic addition reaction of following Propanal, Butanone, Propanone, Benzaldehyde

1)Propanal> Butanone > Propanone > Benzaldehyde

2) Propnone> Butanone > Benzaldehyde >Propanal

3)Propnone>Propanal> Butanone > Benzaldehyde

4) Propanal> Benzaldehyde > Propanone > Butanone

Key. (4)

Sol. * Aldehydes are more reactive than ketones towards Nucleophilic addition reactions

* Among aldehydes, aliphatic aldehydes are more reactive than aromatic aldehydes due to steric hindrance

* Among ketones methyl ketones are more reactive due to less stearic crowding (In propanone two methyl groups are attached to carbonyl carbon)
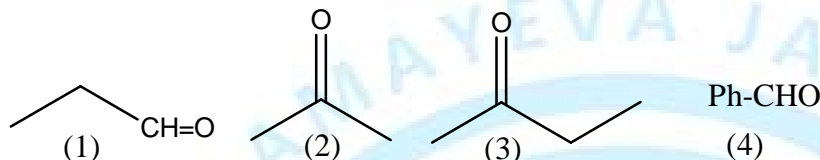

$1 > 4 > 2 > 3$

16. Which of the following statements are incorrect statement (s) for acid rain

(A) It corrodes water pipes

(B) It is not harmful for trees and plats

(C) It does not cause breathing problem in human being and animals

(D) It damages building and other structures made of stone or metal.

1) B&C 2) A&B 3) A & C 4) B & D

Key. 1

Sol. (A/D) Acidic medium will enhance the rusting process (oxidation of metal)

(B/C) The pH balance is necessary for living organism as well as plants

17. A current of 2 amp is passed through a dichromate solution for 5 mint. In this process 0.104 gram Cr^{+3} ions are formed. What is the percentage efficiency of the cell?

[Given $Cr_2O_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$]

Key: 96.50

Sol: $\left(\dfrac{W}{E}\right)_{Cr^{+3}} = \dfrac{i'.t}{96500}$

$\dfrac{0.104}{52/3} = \dfrac{i' \times 5 \times 60}{96500}$

$i' = 1.93\, amp$

$\% efficiency = \dfrac{i'}{i} \times 100$

$= \dfrac{1.93}{2} \times 100$

$= 96.50\%$

18.   What volume of 0.1 N NaOH will neutralize 10ml of 0.1 N phosphonic acid?

Key: 10

Sol: Phosphonic acid $\Rightarrow H_3PO_3$

$$(N \times V)_{Acid} = (N \times V)_{Base}$$

$$0.1 \times 10 = 0.1 \times V_{Base}$$

$$V_{Base} = 10ml$$

19.   0.73 gram of protein A is dissolved in 250 ml of a solution and 1.65 gram of protein B is dissolved in 1 litre solution. Solution of protein A and protein B are isotonic. Find out the ratio of molecular mass of protein A and protein B?

Key: $C_1 = C_2$

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

$$\frac{M_A}{M_B} = 1.77$$

20. 6.022×10^{22} molecules of a compound X has mass 10 gram. 5 gram compound X is present in 2 litre solution. If molarity of the solution is $P \times 10^{-3}$ mole/litre. Find out the value of P?

Key: 25

Sol: $\text{mole} = \dfrac{\text{wt}}{\text{M.wt}}$

$$\text{mole} = \frac{6.022 \times 10^{22}}{6.022 \times 10^{23}} = 0.1$$

$$0.1 = \frac{10}{M.wt}$$

$$M.wt = 100$$

$$molarity = \frac{wt}{M.wt \times V(l)}$$
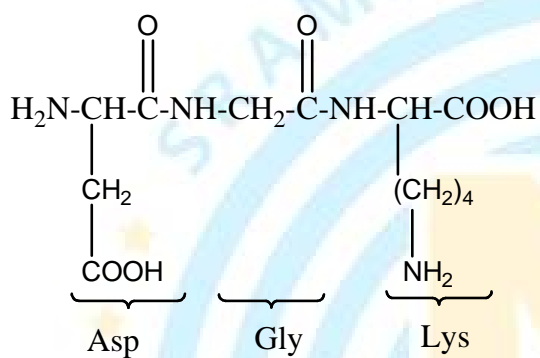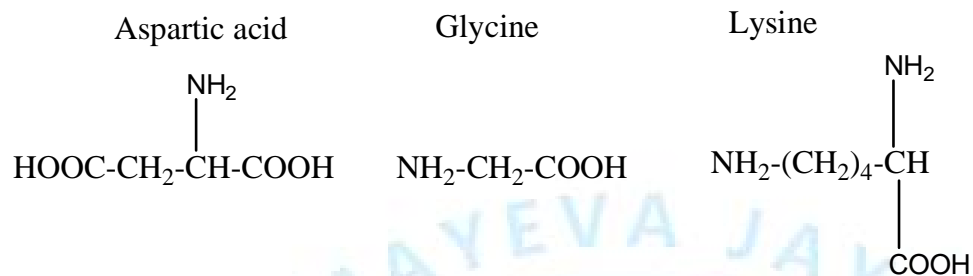
$$= \frac{5}{100 \times 2}$$

$$= 0.025$$

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

So $P = 25$

21.   Calculate total number of $-\overset{\overset{\displaystyle O}{\|}}{C}-$ groups in the given sturecture of tri peptide chain Asp-Gly-Lys

Key.   4

Sol.

Aspartic acid   Glycine   Lysine

$$\underset{\displaystyle HOOC-CH_2-\overset{\displaystyle |}{\underset{\displaystyle NH_2}{CH}}-COOH}{}$$

NH_2-CH_2-COOH

$$NH_2-(CH_2)_4-\overset{\overset{\displaystyle NH_2}{|}}{\underset{\underset{\displaystyle COOH}{|}}{CH}}$$

$$H_2N-\overset{\overset{\displaystyle }{|}}{\underset{\underset{\displaystyle |}{CH_2}}{CH}}-\overset{\overset{\displaystyle O}{\|}}{C}-NH-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-NH-\overset{\underset{\displaystyle }{|}}{\underset{\underset{\underset{\displaystyle NH_2}{|}}{(CH_2)_4}}{CH}}-COOH$$

$$\underbrace{\qquad COOH \qquad}_{Asp} \quad \underbrace{\qquad}_{Gly} \quad \underbrace{\qquad NH_2 \qquad}_{Lys}$$