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PAPER-1 (B.E./B. TECH.)

JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 03 September, 2020 (SHIFT-2) | TIME : (03.00 p.m. to 06.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT : CHEMISTRY

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PART : CHEMISTRY

SECTION – 1 : (Maximum Marks : 80)

Straight Objective Type (सीधे वस्तुनिष्ठ प्रकार)

This section contains **20 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

इस खण्ड में **20 बहु–विकल्पी प्रश्न** हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमें से **सिर्फ एक सही** है।

1. The incorrect statement(s) among (a) – (b) 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) (b) (c) and (d) (c) (a), (b) and (d) (d) (c) only

Ans. **(2)**

Sol. (B) It is harmful for trees and plants

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

2. 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) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

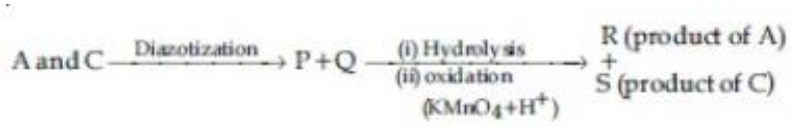
(3) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$ (4) $\frac{dn_A}{dt} = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

Ans. **(3)**

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

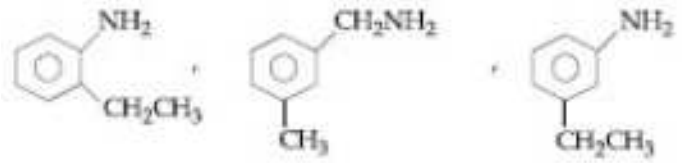
$$\text{rate} = \frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$$

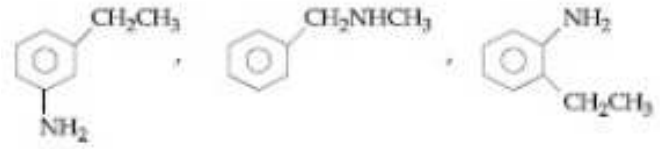
3. Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results:

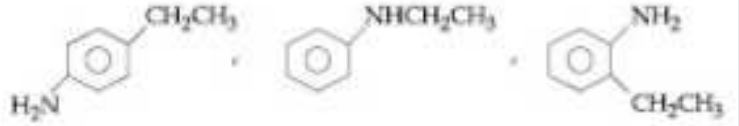


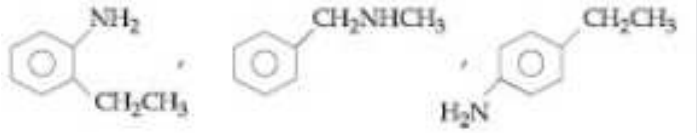
R has lower boiling point than S

B $\xrightarrow{C_6H_5SO_2Cl}$ alkali-insoluble product A, b and C, respectively are:

(1) 

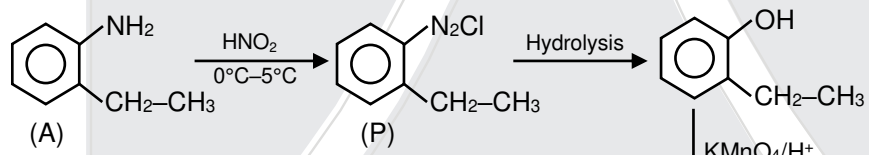
(2) 

(3) 

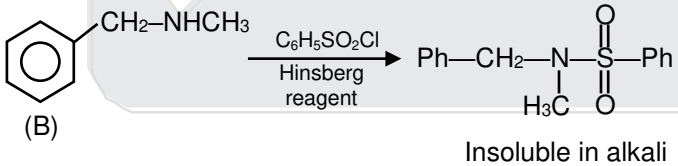
(4) 

Ans. **(4)**

Sol.

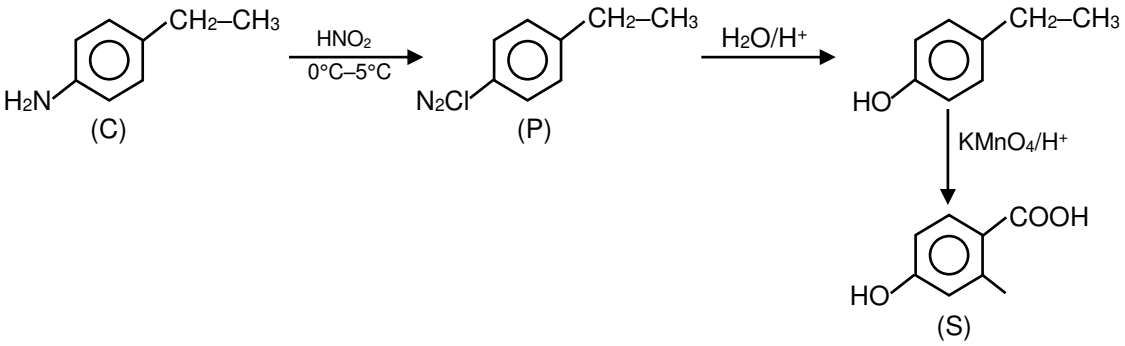


(A) (P) (R)



(B)

Insoluble in alkali



(C) (P) (S)

4. The five successive ionization enthalpies of an element are 800, 2427, 3658, 35024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is:

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

Ans. **(2)**

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

5. The increasing order of the reactivity of the following compounds in nucleophile addition reaction is:

Propanal, Benzaldehyde, Propanone, Butanone

(1) Benzaldehyde > Butanone < Propanone < Propanal

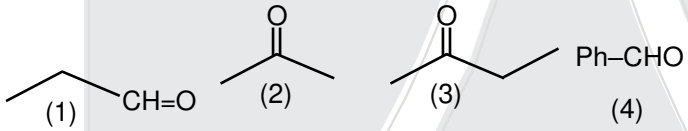
(2) Butanone < Propanone < Benzaldehyde < Propanal

(3) Benzaldehyde < Propanal < Propanone < Butanone

(4) Propanal < Propanone < Butanone < Benzaldehyde

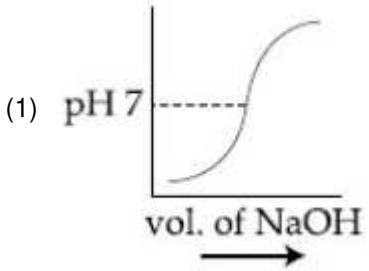
Ans. (2)

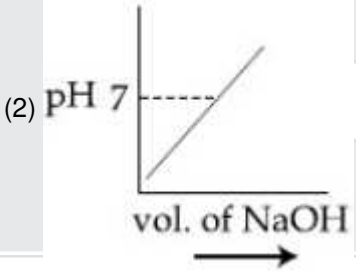
Sol. Rate of NAR $\alpha - I - M$ on substate

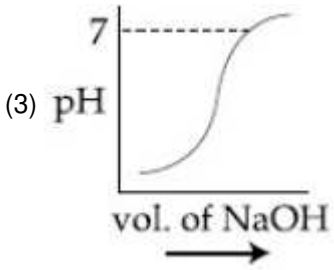


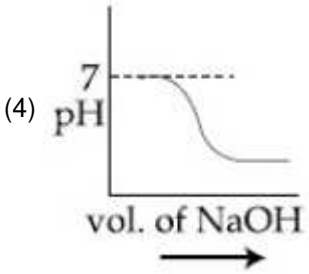
1 > 4 > 2 > 3

6. 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?





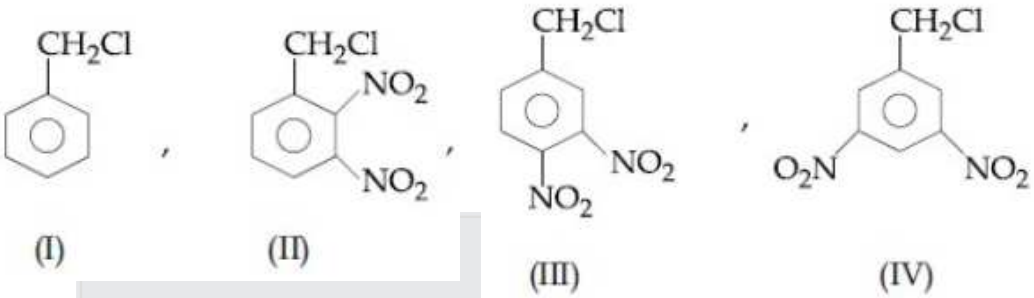




Ans. **(1)**

Sol. At equivalence point pH is 7 and pH increases with addition of NaOH so correct graph is (1).

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

Ans. (2)

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

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

Ans. **(3) [NTA answer is given (4)]**

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 $\Rightarrow 1s^1 \Rightarrow (Z = 1)$

(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.

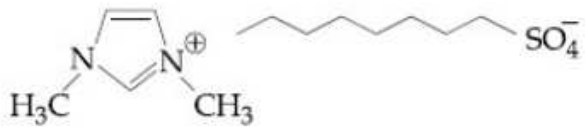
9. An ionic micelle is formed on the addition of:

excess water to liquid

(1) 

(2) liquid diethyl ether to aqueous NaCl solution

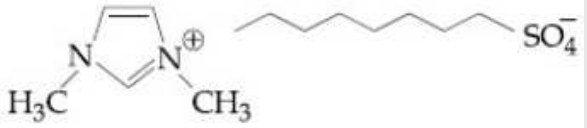
excess water to liquid

(3) 

(4) Sodium stearate to pure toluene

Ans. **(3)**

Sol. excess water to liquid



Due to presence of hydrophobic cahin it forms micelle.

10. 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 $t_{2g}^4 e_g^2$ (3) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$ (4) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$

Ans. **(1)**

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

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

So, correct answer is (1).

11. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/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 0.5 (2) 0.85 and 0.5 (3) 1.7 and 0.25 (4) 0.85 and 0.25

Ans. **(1)**

Sol. For H_2O_2

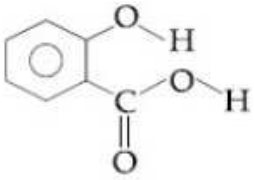
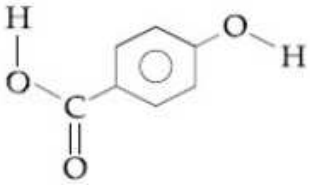
$$\text{Molarity} = \frac{\text{Volume strength}}{11.2} = \frac{5.6}{11.2} = 0.5\ \text{M}$$

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

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

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

12. 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) dissoloves more readily than (A) in water

Identify the correct option from below:

(1) only (a) is true (2) (a) and (b) are true (3) (b) and (c) are true (4) (a) and (c) are true

Ans. **(2)**

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

13. The incorrect statement is:

(1) Manganate and permanganate ions are tetrahedral

(2) Manganate and permanganate ions are paramagnetic

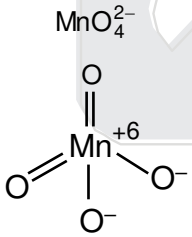
(3) In manganate and permanganate ion, the π-bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese

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

Ans. **(2)**

Sol.

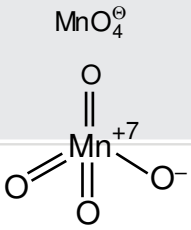
Manganate



Paramagnetic, green in colour,

Tetrahedral & contains pπ-dπ bond

Permanganate



Diamagnetic, purple in colour,

Tetrahedral & contains pπ-dπ bond

14. 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 formulas of A is:

[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]

(1) $[Cr(H_2O_6]Cl_3$ (2) $[Cr(H_2O)_4Cl_2]Cl\cdot 2H_2O$

(3) $[Cr(H_2O)_3Cl_3]\cdot 3H_2O$ (4) $[Cr(H_2O)_5Cl]Cl_2\cdot H_2O$

Ans. **(2)**

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 = $[Cr(H_2O)_4Cl_2]Cl\cdot 2H_2O$

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

Ans. **(3)**

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

as n, T & V constant So

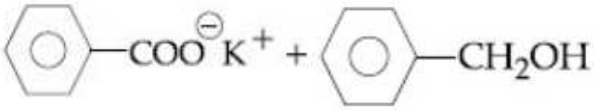
$P_{H_2} = P_{O_2} = P_{He} = 2\,atm$

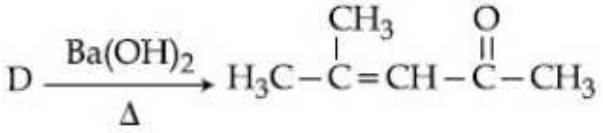
So, $P_{Total} = P_{H_2} + P_{O_2} + P_{He}$ = 6 atm

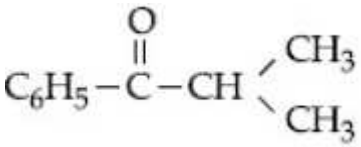
16. The compound A in the following reactions is:

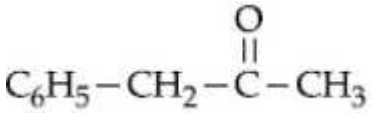
$$A \xrightarrow[(ii)\ Conc.\ H_2SO_4/\Delta]{(i)\ CH_3MgBr/H_2O}$$

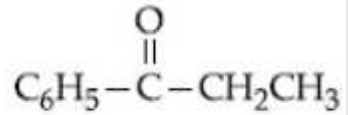
$$B \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} C + D$$

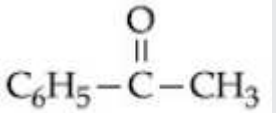
$$C \xrightarrow[(ii)\ \Delta]{(i)\ Conc.KOH} \text{  }$$



(1) 

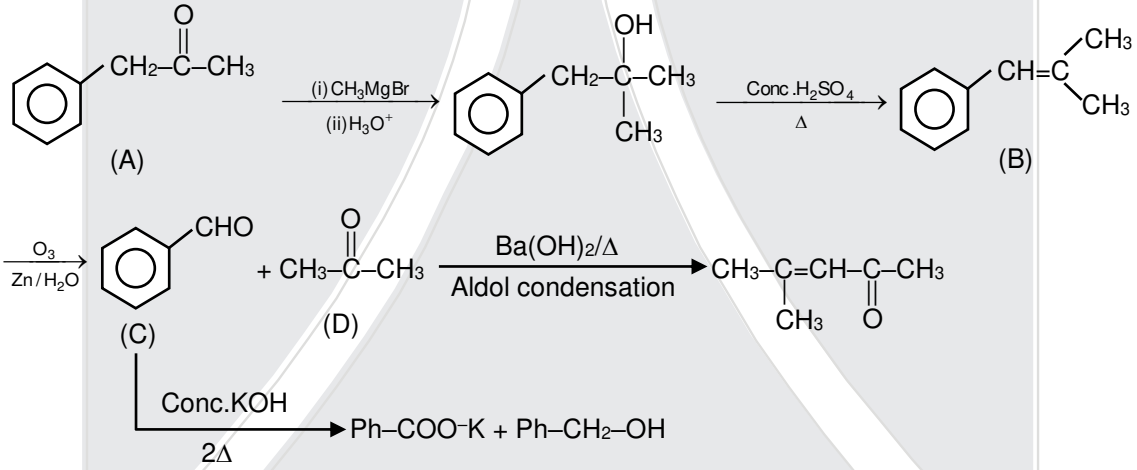
(2) 

(3) 

(4) 

Ans. **(2)**

Sol.



17. Among the statement (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.

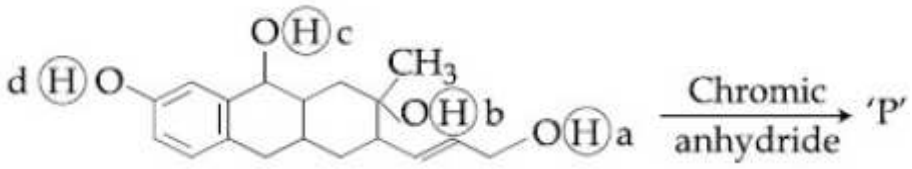
(IV) Both Be and Al form mainly covalent compounds.

(1) (II), (III) and (IV) (2) (I), (III) and (IV) (3) (I), (II) and (III) (4) (I), (II) and (IV)

Ans. **(4)**

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

18. Consider the following reaction:

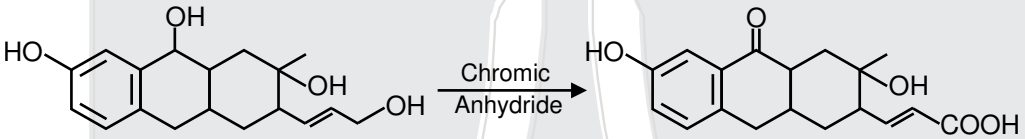


The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these –OH group(s)?

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

Ans. **(1)**

Sol.



Product 'P'

3° Alcohol gives Red colour with ceric ammonium nitrate

19. Match the following drugs with their therapeutic actions:

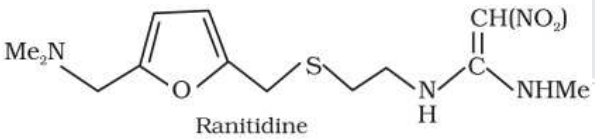
(i) Ranitidine	(a) Antidepressant
(ii) Nardil (Phenelzine)	(b) Antibiotic
(iii) Chloramphenicol	(c) Antihistamine
(iv) Dimetane (Brompheniramine)	(d) Antacid
	(e) Analgesic

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

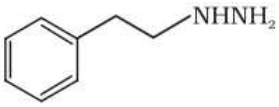
(3) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c); (4) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d);

Ans. **(3)**

Sol.

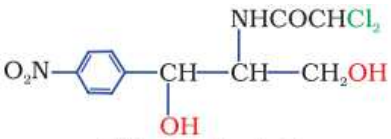


Ranitidine → Antacid



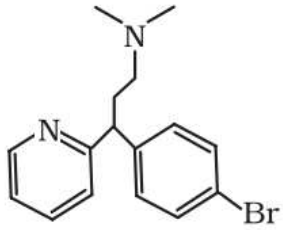
→ Antidepressant drugs

Phenelzine (Nardil)



→ Antibiotics

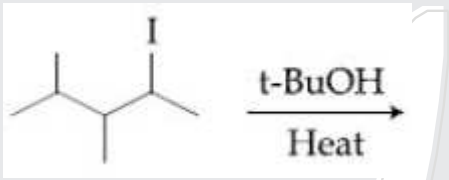
Chloramphenicol

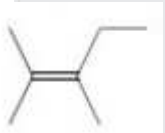


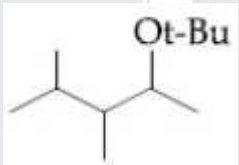
Brompheniramine
(Dimetapp, Dimetane)

→ Antihistamine

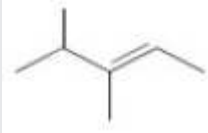
20. The major product in the following reaction is:



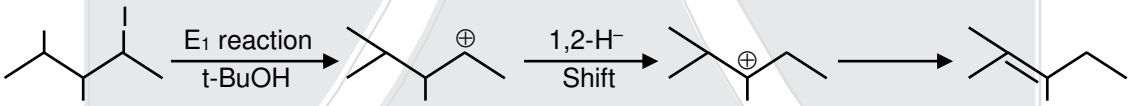
(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. 

SECTION – 2 : (Maximum Marks : 20)

- This section contains **FIVE (05)** questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.
- If the numerical value has more than two decimal places **truncate/round-off** the value upto **TWO** decimal places.
  - Full Marks : **+4** If ONLY the correct option is chosen.
  - Zero Marks : **0** In all other cases

खंड 2 (अधिकतम अंक: 20)

- इस खंड में **पाँच (05)** प्रश्न है। प्रत्येक प्रश्न का उत्तर संख्यात्मक मान **(NUMERICAL VALUE)** हैं, जो द्वि–अंकीय पूर्णांक तथा दशमलव एकल–अंकन में है।
- यदि संख्यात्मक मान में दो से अधिक दशमलव स्थान है , तो संख्यात्मक मान को दशमलव के दो स्थानों तक **ट्रंकेट/राउंड ऑफ (truncate/round-off)** करें।
- अंकन योजना :
  - पूर्ण अंक : **+4** यदि सिर्फ सही विकल्प ही चुना गया है।
  - शून्य अंक : **0** अन्य सभी परिस्थितियों में।

21. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation $Cr_2O_7^{2-} + 14\ H^+ + 6\ e^- \rightarrow 2Cr^{3+} + 7\ H_2O$

The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in%) is (Take : F = 960000 C, At. mass of chromium = 52)

Ans. **60**

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

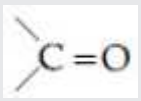
$$\frac{960}{96000} = 0.01F$$

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow \quad 2Cr^{3+} \quad + \quad 7H_2O$$

$$0.01F \qquad \frac{1}{3} \times 0.01\,mole$$

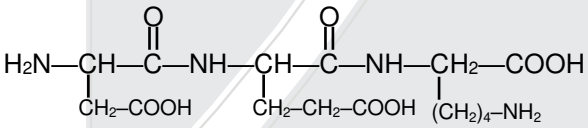
Theoritical mass of $Cr^{3+} = \frac{1}{3} \times \frac{600}{96000} \times 52 = 0.173\,g$

So, efficiency = $\frac{w_{actual}}{w_{Theoritial}} \times 100 = \frac{0.104}{0.173} \times 100 = 60\%$

22. The number of  groups present in a tripeptide Asp – Glu – Lys is

Ans. **5**

Sol. Asp – Glu – Lys pripeptide is:



No. of CO group = 5

23. 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_____ × 10^{-2} (to the nearest integer)

Ans. **177**

Sol. For isotonic solution

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

$C_1 = C_2$

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

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

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. 0.023×10^{22} molecules are present in 10g 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. Number of mole of X = $\frac{6.022\times10^{22}}{6.022\times10^{23}} = \frac{10}{\text{Molar mass of X}}$

So molar mass of X = 100g

Molarity = $\frac{5}{100\times2} = 0.025M$

Ans. = 0.025 M

$M = 25\times10^{-3}$

So P = 25

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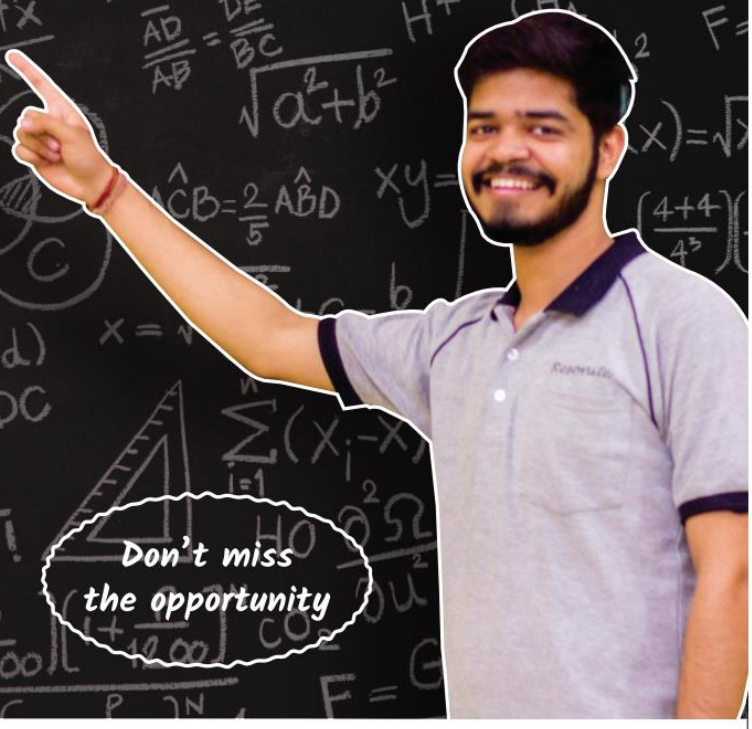

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