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JEE MAIN 2021

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

QUESTIONS & SOLUTIONS

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17 March, 2021 SHIFT-2

03:00 pm to 06:00 pm

Duration : 3 Hours Max. Marks : 300

SUBJECT - CHEMISTRY

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CHEMISTRY

1. Match the followings-

(A) Artificial sweetner	(i) Sodium benzoate
(B) Antiseptic	(ii) Bithional
(C) Preservative	(iii) Sodium stearate
(D) Glyceryl ester of stearic acid	(iv) Sucralose

(1) (A) → (iv), (B) → (ii), (C) → (i), (D) → (iii)

(2) (A) → (iii), (B) → (i), (C) → (ii), (D) → (iv)

(3) (A) → (i), (B) → (iii), (C) → (i), (D) → (iii)

(4) (A) → (i), (B) → (iii), (C) → (iii), (D) → (i)

Ans. **(1)**

2. Kjeldahl method is applicable for

(1) $PhN_2^{\oplus}$ (2) $Ph–NO_2$ (3) $Ph–CH_2–NH_2$ (4) 

Ans. **(3)**

3. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{?} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

$C_6H_{12}O_6 \xrightarrow{?} 2C_2H_5OH + 2CO_2$

Which of the following enzymes are used in above reactions respectively?

(1) Amylase and Zymase (2) Invertase and Zymase

(3) Zymase and Invertase (4) Amylase and Invertase

Ans. **(2)**

4. Fructose is an example of

(1) Pyranose (2) Aldohexose (3) Ketohexose (4) Pentose

Ans. **(3)**

5. **Statement-1 :** 2–Methylbutane is oxidised by $KMnO_4$ to give 2–Methyl butan–2–ol.

Statement-2 : An alkane is easily oxidised by $KMnO_4$.

(1) Both Statement-1 and Statement-2 are correct

(2) Both Statement-1 and Statement-2 are false

(3) Statement-1 is correct and Statement-2 is false

(4) Statement-1 is false and Statement-2 is correct

Ans. **(3)**

6. 1º, 2º and 3º amines can be distinguish by-

(1) Chloroform and KOH

(2) CS_2 with $HgCl_2$

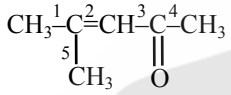
(3) Tosyl chloride

(4) $HCl + ZnCl_2$

Ans. **(3)**

7. How many carbon–carbon σ bonds are present in mesityl oxide ?

Ans. **(5)**

Sol. 

8. 

(A) (B)

Correct statement about A & B is -

(1) A is more stable and formed with faster rate.

(2) B is more stable and formed with faster rate.

(3) A is less stable and formed with slow rate.

(4) B is less stable and formed with faster rate.

Ans. **(1)**

9. $FeCl_3$ is reacted with oxalic acid in presence of KOH. Find secondary valency of iron in product

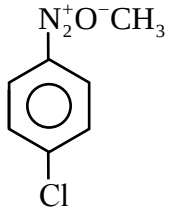
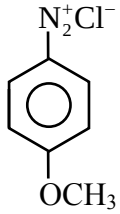
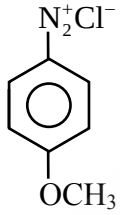
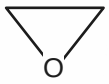
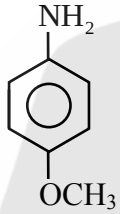
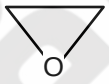
Ans. **(6)**

Sol. $FeCl_3 + H_2C_2O_4 \xrightarrow{OH^-} [Fe(C_2O_4)_3]^{3-} + H_2O$

Secondary valency = 6

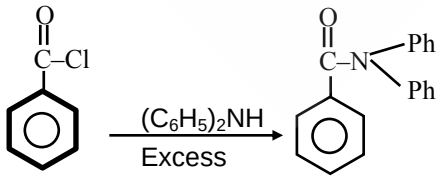
10. [A] + $C_7H_7N_2ClO$ + $CH_3–CH_2–OH$ ⟶ Anisole + B + C + N_2

Identify A, B and C

	A	B	C
(1)		CH_3CHO	HCl
(2)		CH_3CHO	HCl
(3)			HCl
(4)			HCl

Ans. **(2)**

11. 140.5 g Benzoylchloride is reacted with excess of diphenylamine to give 210 g of N,N-diphenyl benzamide. Calculate percentage yield of the product.



Ans. **(77)**

Sol. Moles of $Ph-\overset{\overset{O}{\|}}{C}-Cl = \frac{140.5}{140.5} = 1$ mol.

Moles of $Ph-\overset{\overset{O}{\|}}{C}-N(Ph)_2$ that should be obtained by mol-mol analysis = 1 mol

Theoretical mass of product = 1×273g

Observed mass of product = 210 g

Percentage yield of product = $\frac{W_{experimental}}{W_{theoretical}} \times 100 = \frac{210}{273} \times 100 = 76.9\%$

Ans. 77

12. Element with atomic number 24 is expected to show following common oxidation states -

(1) +1 to +6 (2) +1 & + 3 to +6

(3) +3 to +6 (4) +2 to +6

Ans. (4)

13. Match the column-

(A) $[Cu(NH_3)_4][CuCl_4]$	(P) Solvate isomerism
(B) $[Co(H_2O)_6]Cl_3$	(Q) Coordination isomerism
(C) $[Co(NH_3)_3Cl_3]$	(R) Optical isomerism
(D) Cis-$[Co(en)_2Cl_2]^+$	(S) Geometrical isomerism

(1) A $\rightarrow$ Q, B $\rightarrow$ P, C $\rightarrow$ S, D $\rightarrow$ R

(2) A $\rightarrow$ P, B $\rightarrow$ Q, C $\rightarrow$ S, D $\rightarrow$ R

(3) A $\rightarrow$ P, B $\rightarrow$ Q, C $\rightarrow$ R, D $\rightarrow$ S

(4) A $\rightarrow$ S, B $\rightarrow$ R, C $\rightarrow$ P, D $\rightarrow$ Q

Ans. (1)

14. Match the following ores with their chemical formula :

(A) Bauxite	(P) $Al_2O_3.xH_2O$
(B) Haematite	(Q) Fe_2O_3
(C) Magnetite	(R) Fe_3O_4
(D) Malachite	(S) $CuCO_3.Cu(OH)_2$

(1) A $\rightarrow$P ; B $\rightarrow$Q ; C $\rightarrow$R ; D $\rightarrow$S (2) A $\rightarrow$S ; B $\rightarrow$R ; C $\rightarrow$Q ; D $\rightarrow$P

(3) A $\rightarrow$R ; B $\rightarrow$P ; C $\rightarrow$S ; D $\rightarrow$Q (4) A $\rightarrow$P ; B $\rightarrow$Q ; C $\rightarrow$S ; D $\rightarrow$R

Ans. (1)

15. For the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$K_P = 600.1$ atm & $K_C = 20.4$ mol/L at TK.

Determine T if R = 0.083 L atm/K-mol

Ans. **(354)**

Sol. $K_P = K_C(RT)^1$

$600.1 = 20.4\ (0.083T)$

$T \approx 354$ K

16. 1 molal aqueous $K_4[Fe(CN)_6]$ having $\alpha = 0.4$ has same boiling point as 18.1% by weight solution of non electrolyte A. Find molar mass of A.

Ans. **(85)**

Sol. Since B.P. is same $\Rightarrow$ elevation in B.P. is also same for both solution

$(\Delta T_B)_{K_4[Fe(CN)_6]} = (\Delta T_B)_A$

$\Rightarrow (ik_bm)_{K_4[Fe(CN)_6]} = (ik_bm)_A$

$= (1 + 4\alpha) \times 1 = 1 \times \dfrac{(18.1)/M \times 1000}{(100-18.1)}$

$\Rightarrow 2.6 = \dfrac{(18.1)}{M} \times \dfrac{1000}{(81.9)} \Rightarrow M = 85$

17. Linear species is:

(1) N_3^- (2) NO_2 (3) Cl_2O (4) O_3

Ans. **(1)**

Sol. $\overset{-}{N}=\overset{+}{N}=\overset{-}{N}$

sp

(Linear)

18. In which of the following process entropy of system is decreasing?

(A) Freezing of water at 0ºC (B) Freezing of water at –10ºC

(C) Adsorption of H_2 on Pb (D) Dissolution of NaCl in H_2O

(E) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(1) A, B, C, E (2) A, B, C, D (3) A, B, C, D, E (4) A, B

Ans. **(1)**

Sol. (D) $NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq)$ $\Delta S > 0$

Remaining (A), (B), (C) and (E) have negative entropy

19. $2A + B_2 \rightarrow 2AB$ is an elementary reaction. If volume of container is reduced to $\frac{1}{3}$rd. Determine ratio of rate final to initial.

Ans. **(27)**

Sol. For elementary reaction,

Rate of reaction = $K [A]^2 [B_2]$

Initial rate = $K \left(\frac{n_A}{v_0}\right)^2 \left(\frac{n_B}{v_0}\right)$

Final rate = $K \left(\frac{n_A}{\frac{v_0}{3}}\right)^2 \left(\frac{n_B}{\frac{v_0}{3}}\right) = 27\ K \left(\frac{n_A}{v_0}\right)^2 \left(\frac{n_B}{v_0}\right) \Rightarrow \frac{\text{Final Rate}}{\text{Initial Rate}} = \frac{27}{1}$

20. Spin only magnetic moment in ground state of iron is $x \times 10^{-1}$.

($\sqrt{2} = 1.41$, $\sqrt{3} = 1.73$)

Ans. **(49)**

Sol. $Fe - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$

Number of unpaired electron = 4

$N_{spin} = \sqrt{n(n+2)}$

$= \sqrt{4(4+2)}$

$= \sqrt{24}$

$= 4.9$

$= 49 \times 10^{-1}$

21. A conductivity cell when filled with NaCl solution is found to have conductivity 0.14 $\Omega^{-1}m^{-1}$ and R = 4.09 Ω. When HCl solution is filled in same conductivity cell, R is found to be 1.03 Ω. If conductivity of HCl solution is $x \times 10^{-2}$ (in $\Omega^{-1}\ m^{-1}$). Determine 'x'.

Ans. **(56)**

Sol. for NaCl solution

$R = \left(\frac{1}{K}\right)\left(\frac{\ell}{A}\right) \Rightarrow \frac{\ell}{A} = (R)(K) = (4.09)(0.14)\ m^{-1}$

for HCl solution

$R = \left(\frac{1}{K}\right)\left(\frac{\ell}{A}\right) \Rightarrow K = \frac{\left(\ell/A\right)}{R} = \frac{(4.09)(0.14)}{1.03} = 56 \times 10^{-2}$

x = 56

22. Number of atoms in 20 ml of Cl_2 at STP are $x \times 10^{21}$. Find x

$R = 0.083$

$N_A = 6.023 \times 10^{23}$

Ans. **(1)**

Sol. $n = \frac{PV}{RT}$

$= \frac{1 \times 20 \times 10^{-3}}{0.083 \times 273}$

Number of atoms = $\frac{1 \times 20 \times 10^{-3}}{0.083 \times 273} \times 2 \times 6.023 \times 10^{23}$

$= 1.06 \times 10^{21}$

Ans.1

23. If NaCl is doped with 10^{-3} mole percentage of $SrCl_2$, cationic vacancies per mole of NaCl. ($N_A = 6.023 \times 10^{23}$) are 6.022×10^x. Determine x.

Ans. **(18)**

Sol. 100 mole NaCl $\longrightarrow$ 10^{-3} mole $SrCl_2 \longrightarrow 10^{-3}$ N_A Cationic vacancies

$\therefore$ 1 mole NaCl $\longrightarrow$ 10^{-5} N_A Cationic vacancies

$= 10^{-5} \times 6.023 \times 10^{23}$

$= 6.022 \times 10^{18}$ Cationic vacancies

24. During the recovery of NH_3 in solvey process byproduct formed is :

(1) $CaCl_2$ (2) Na_2CO_3 (3) NaCl (4) $Ca(OH)_2$

Ans. **(1)**

25. Highest flocculating power for the coagulation of negatively charged sol is –

(1) Na^+ (2) Be^{2+} (3) PO_4^{3-} (4) SO_4^{2-}

Ans. **(2)**