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

JEE (Main) 2021

Questions & solutions

(Reproduced from memory retention)

Date : 24 February, 2021 (SHIFT-2) Time ; (3.00 pm to 6.00 pm)

Duration : 3 Hours | Max. Marks : 300

SUBJECT : CHEMISTRY

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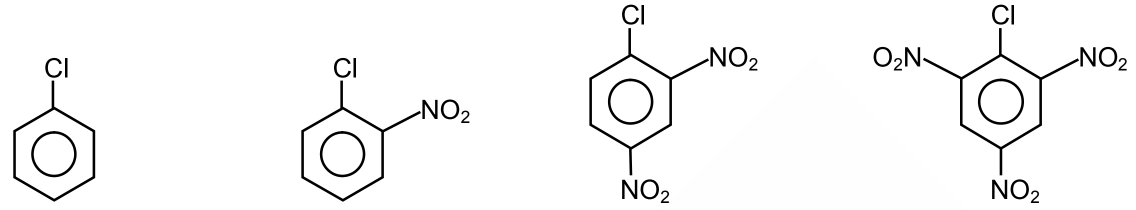
CHEMISTRY

1. Compare the rate of aromatic nucleophilic substitution reaction of the following compounds



(I) (II) (III) (IV)

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

Ans. **(4)**

Sol. **R**ate of aromatic nucleophilic substitution reaction depends upon type of halogens and electronic effect of the group present on the ring. Electron withdrawing groups (–I, –M) increases rate of reaction increases.

2. What is S in Buna-S ?

(1) Sulphure (2) Styrene (3) Rubber (4) Strength

Ans. **(2)**

Sol. Buna-S is the co-polymer of buta-1,3-diene and styrene

3. Which of the following set of the reagent is used to convert nitrobenzene to 1,3–Dibromobenzene?

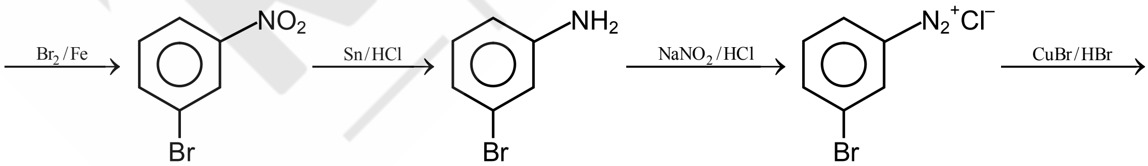
(1) $Br_2/Fe \longrightarrow Sn/HCl \longrightarrow NaNO_2/HCl \longrightarrow CuBr/HBr$

(2)

(3)

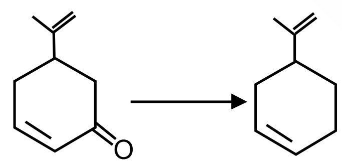
(4)

Ans. **(1)**

Sol. $PhNO_2$ 

1,3–Dibromobenzene

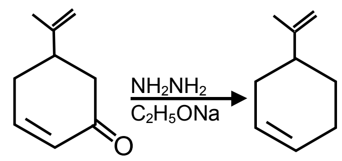
4. The reagent used to convert the following is ?



(1) $NH_2–NH_2/C_2H_5O^-Na^{\oplus}$ (2) Red P/Cl_2

(3) Ni/H_2 (4) $NaBH_4$

Ans. **(1)**

Sol.  it is wolff-Kishner reduction of carbonyl compounds.

5. Match the following

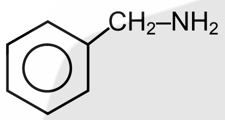
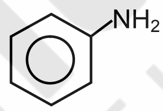
Column – I	**Column – II**
(a) Valium	(p) Pernicious anaemia
(b) Morphine	(q) Analgesic
(c) Norethindrone	(r) Tranquilizer
(d) Vitamin B-12	(s) Antifertility

Ans. $a \rightarrow r$; $b \rightarrow q$; $c \rightarrow s$; $d \rightarrow p$

6. **Statement –I** : BOD is the parameter that can be helpful for survival of aquatic life.
Statement – II : Optimum value of BOD is 6.5 ppm.
(1) Statement I is true ,Statement II is false
(2) Statement I is false ,Statement II is true
(3) Statement I , II both are true
(4) Statement I , II both are false

Ans. (1)

7. How many of the following amines can be prepared by Gabriel phthalimide synthesis ?

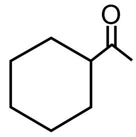
(i)  (ii) 

(iii) $CH_3–NH_2$ (iv) $CH_3–CH_2–NH_2$

Ans. **(3)**

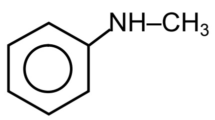
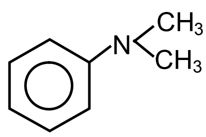
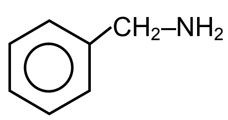
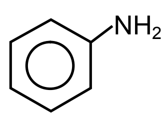
Sol. Only aliphatic amines can be prepared by Gabriel phthalimide synthesis.

8. Which of the following compound cannot be prepared by the reaction of alkyne with $HgSO_4$/dil.H_2SO_4?

(1) CH_3CHO (2) CH_3CH_2CHO (3) $CH_3COCH_2CH_3$ (4) 

Ans. (2)

9. Diazonium salt of which of the following will give coloured dye on reaction with β-Napthol in NaOH

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

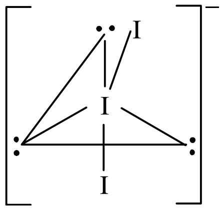
Ans. (4)

Sol. Only aromatic Primary amines will gives Dye test.

10. The correct bond angle & shape of I_3^- is

(1) Linear & 180°
(2) Trigonal pyramidal & 120°
(3) V-shape & 120°
(4) T-shape & 109° 28′

Ans. **(1)**

Sol.  sp^3d hybridisation

Linear shape $\angle$I–I–I = 180°

11. Correct statements

(a) K.E. $\propto \frac{z^2}{n^2}$

(b) (nv) $\propto z^2$

(c) Frequency $\propto \frac{z^3}{n^3}$

(d) Electrostatic force $\propto \frac{z^3}{n^4}$

(1) a & d are correct
(2) a & b are correct
(3) b & c are correct
(4) b & d are correct

Ans. **(1)**

12. Which of the following is incorrect?

(1) Cr_2O_3 is Amphoteric
(2) RuO_4 is oxidising agent
(3) $VOSO_4$ is reducing agent
(4) Ruby appears due to presence of Co^{3+}

Ans. **(4)**

13. Which of the following order of melting point is correct

(1) LiF > LiC1 , NaCl > MgO
(2) LiF < LiCl , NaCl > MgO
(3) LiF > LiCl , NaCl < MgO
(4) LiF < LiCl , NaCl > MgO

Ans. **(3)**

Sol. Lattice energy $\propto |Z^+||Z^-|$

$$\propto \frac{1}{r^+ + r^-}$$

	LiF	LiCl	
Size	$F^- < Cl^-$		[charge are same]
Lattice energy	$\boxed{LiF > LiCl}$		

$NaCl \longrightarrow Na^{\oplus} + Cl^{-}$ $\quad |Z^{+}||Z^{-}| = 1 \times |1| = 1$

$MgO \longrightarrow Mg^{+2} + O^{-2}$ $\quad |2||-2| = 4$

Lattice energy $\boxed{MgO > NaCl}$

Charge dominate over size

14. Spin only magnetic moment of the following complexes

$[FeCl_4]^{2-}, [CO(ox)_3]^{3-}, MnO_4^{2-}$

(1) 4.9, 0, 1.76 BM (2) 5.9, 1.73 BM

(3) 1.73, 2.83, 0 BM (4) 2.83, 6.9, 0 BM

Ans. **(1)**

Sol. $[FeCl_4]^{2-}$ Contain Fe^{+2} in tetrahedral complex. Its configuration is $e_g^{2,1}\ t_{2g}^{1,1,1}$ it have 4 unpaired electron in $[Co(ox)_3]^{3-}$ Co^{+3} have configuration $t_{2y}^{2,2,2}eg^{0,0}$ MnO_4^{2-} have Mn in +6 oxidation state and configuration of Mn is $e_g^{1,0}\ t_{2g}^{0,0,0}$

15. α–sulphur, β–Sulphur, $S_2 \rightarrow$ find how many are paramagnetic

Ans. **(1)**

Sol. In S_2, like O_2 two unpaired electron are present, α & β- sulphur have S_8 ring which are diamagnetic

16. Which of the following can be used for clotting of blood efficiently?

(1) $NaHCO_3$ (2) $FeCl_3$ (3) $FeSO_4$ (4) $Mg(HCO_3)_2$

Ans. **(2)**

Sol. Blood is a negative charged Sol. Therefore according hardy-Schulz rule Fe^{+3} cation have highest coagulation power . Therefore $FeCl_3$ can be used for clotting of blood efficiently.

17. $3C_2H_2 \rightleftharpoons C_6H_6(\ell)$

given that

G_m° (C_2H_2) =2.4×10^5J

G_m° (C_6H_6) = -1.4×10^5J

Find $\log_{10}$ k at 25°C

Ans. **(150.72)**

Sol. $\Delta G^\circ = \left(G_M^\circ\right)_{C_6H_6} - 3\left(G_M^\circ\right)_{C_2H_2}$

$= -1.4 \times 10^5 - 3 \times 2.4 \times 10^5$

$= -8.6 \times 10^5$ Joule

$-2.303RT \log_{10} k = -8.6 \times 10^5$

$-2.303 \times 8.314 \times 298 \log_{10} k = -8.6 \times 10^5$

$\log_{10} k = 150.72$

18. 1.86 gm of aniline is converted into acetanilide with 90% efficiency. Mass of acetanilide formed is [X] × 10^{-2} gm

Ans. 243×10^{-2}

Sol. $Ph-NH_2 \xrightarrow{Ac_2O \text{ or } CH_3COCl,\ Pyridine} Ph-NH-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$

(C_6H_7N) Acetanilide (C_8H_9NO)

1.86 g

Molar mass = 93 Molar mass = 135

* 93 g aniline produces 135 g acetanilide

1.86 g aniline produces $\frac{135 \times 1.86}{93} = 2.70$ g

* At 90% efficiency of reaction it produces = $\frac{2.70 \times 90}{100} = 2.43$ g

Ans. 243×10^{-2}

19. Freezing point of C_6H_6 (ℓ) is 5.5°C. If 10g of C_4H_{10} is mixed with 200g of C_6H_6 (ℓ). Calculate freezing point of solution $k_f = 5.12$°C/m.

Ans. (1.09°C)

Sol. $\Delta T_f = k_f \times m$

$= 5.12 \times \frac{10}{58} \times \frac{1000}{200} = 4.41°C$

$\Delta T_F = (T_F)_{Solvent} - \left(T_{F_1}\right)_{Solution}$

$4.41°C = 5.5 - \left(T_{F_1}\right)_{Solution}$

$\left(T_{F_1}\right)_{Solution} = 5.5 - 4.41 = 1.09°C$

20. De-broglie's wavelength of a proton and an α-particle is same. Calculate ratio of their velocities

Ans. (4)

Sol. $\lambda_p = \lambda_\alpha$

$$\frac{h}{m_p v_p} = \frac{h}{m_\alpha v_\alpha}$$

$$\frac{v_p}{v_\alpha} = \frac{m_\alpha}{m_p} \qquad \because m_\alpha = 4\, m_p$$

$$\frac{v_p}{v_\alpha} = \frac{4m_p}{m_p} = 4$$

Ans. 4

21. If $[H^+]$ changed from 1M to 10^{-4} M

Find change in electrode potential $E^\circ_{MnO_4^-/Mn^{+2}}, \left(\frac{RT}{F} = 0.059\right)$

[Assume $[MnO_4^-] = [Mn^{+2}] = 1M$]

Ans. 0.3776 V

Sol. $5e^- + 8H^+ + \underset{1M}{MnO_4^-} \longrightarrow \underset{1M}{Mn^{+2}} + 4H_2O$

$$E_1 = E^o - \frac{0.59}{5} \log_{10}\left[\frac{1}{[H^+]^8} \times \frac{[Mn^{+2}]}{[MnO_4^-]}\right]$$

$$= E^o - \frac{0.059}{5}\log_{10}\left[\frac{1}{(1)^8}\right] = E^o$$

$$E_2 = E^o - \frac{0.059}{5}\log_{10}\left[\frac{1}{(10^{-4})^8} \times \frac{[Mn^{+2}]}{[MnO_4^-]}\right]$$

$$= E^o - \frac{0.059}{5}\log_{10}\left[10^{32}\right]$$

$$= E^o - \frac{0.059}{5} \times 32$$

$$E_1 - E_2 = E^o - E^o + \frac{0.059}{5} \times 32$$

$$= 0.3776 \text{ V}$$

22. V ml of a hydrocarbon C_xH_y requires 6V ml of oxygen for complete combustion & forms 4V ml of CO_2. Determine y

Ans. **8**

Sol. $C_xH_y + \left(x+\frac{y}{4}\right)O_2 \longrightarrow X\ CO_2\ \left(\frac{y}{2}\right)H_2O\ (\ell)$

Volume-Volume V 6V 4V

Analysis

$$\frac{V_{C_xH_y}}{1} = \frac{V_{CO_2}}{x}$$

$$\frac{v}{1} = \frac{4v}{x} \qquad x = 4$$

$$\frac{v_{C_xH_y}}{1} = \frac{V_{O_2}}{x+\frac{y}{4}}$$

$$\frac{V}{1} - \frac{6V}{x+\frac{y}{4}}$$

$$x + \frac{y}{4} = 6$$

$$4 + \frac{y}{4} = 6$$

$$\frac{y}{4} = 2$$

y = 8

Formula C_4H_8

23. Sucrose $\xrightarrow{\text{I order}}$ Glucose + Fructose

$t_{1/2}$ = 3.33 hour

f = fraction remaining of sucrose at 9 hour.

Find out value of $100 \times \log\left(\frac{1}{f}\right)$ $[\log_{10} 2 = 0.3]$

Ans. (81)

Sol. $f = \frac{1}{2^n}$ $\quad n = \frac{\text{time given}}{t_{1/2}} = \frac{9\text{ hr}}{3.33\text{ hr}} = 2.7$

$= \frac{1}{2^{2.7}}$

$\log\frac{1}{f} = \log 2^{2.7} = 2.7 \times 0.3 = 0.81$

$100 \times \log_{10}\left(\frac{1}{f}\right) = 100 \times 0.81 = 81$

Ans. 81

24. Determine volume occupied by 4.75g acetylene gas at 740 mmHg pressure & 50ºC temperature R = 0.0826 Latm/mol k (in L)

Ans. (5)

Sol. $V = \frac{nRT}{P} = \frac{\left(\frac{4.75}{26}\right) \times 0.0826 \times 323}{\left(\frac{740}{760}\right)} \approx 5L$