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

JEE (Main) 2021

Questions & Solutions

(Reproduced from memory retention)

Date : 26 February, 2021 (SHIFT-2) Time ; (3.00 pm to 6.00 pm)

Duration : 3 Hours | Max. Marks : 300

SUBJECT : CHEMISTRY

A-10 Road No. 1, IPIA, Kota-324005 (Rajasthan), India

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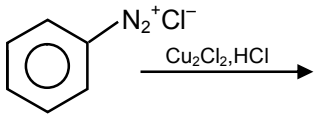
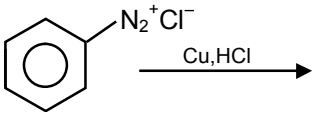
CHEMISTRY

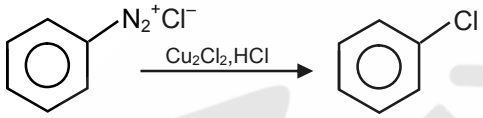
1. Match the coloumn

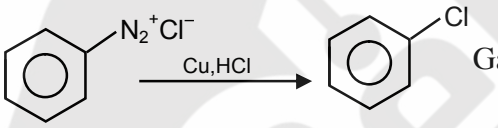
Column–I	**Column–II**
(A) 	(i) Gattermann
(B) 	(ii) Sandmayer
(C) $C_6H_5Cl \xrightarrow{Na/Dry\ ether}$	(iii) Wurtz
(D) $2C_2H_5Cl \xrightarrow{Na/Dry\ ether}$	(iv) Fittig

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

(3) A–i, B–ii, C–iv, D–iii (4) A–ii, B–i, C–iii, D–iv

Ans. **(2)**

Sol. (A)  Sandmayer reaction

(B)  Gattermann reaction

(C)  Fittig reaction

(D) $2C_2H_5Cl \xrightarrow{Na/Dry\ ether} C_2H_5–C_2H_5$ Wurtz reaction

2. Match the coloumn

Column–I	**Column–II**
(A) Sucrose	(i) α-glucose and α-glucose
(B) Lactose	(ii) α-glucose and β-fructose
(C) Maltose	(iii) β-galactose and β-glucose

(1) A–i, B–ii, C–iii (2) A–ii, B–i, C–iii

(3) A–iii, B–i, C–ii (4) A–ii, B–iii, C–i

Ans. **(4)**

Sol. (A) Sucrose – α-glucose and β-fructose

(B) Lactose – β-galactose and β-glucose

(C) Maltose –α-glucose and α-glucose

3. Which of the following give positive test with ceric ammonium nitrate and $CHCl_3$, KOH respectively

(1) Amine & Phenol (2) Phenol & Amine

(3) Alcohol & Amine (4) Amine & Alcohol

Ans. **(3)**

Sol. Alcohols give positive test with ceric ammonium nitrate and primary amines gives carbyl amine test with $CHCl_3$, KOH.

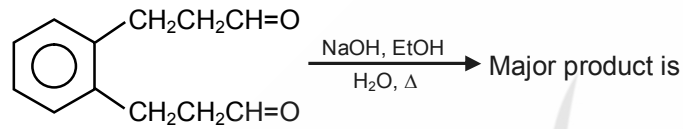
4. Seliwanoff's test and xanthoprotic test is used to distinguish respectively

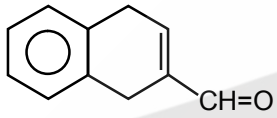
(1) Proteins & ketoses (2) Aldoses & ketoses

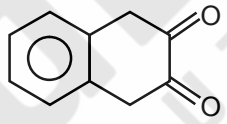
(3) Ketoses & proteins (4) Proteins & Ketones

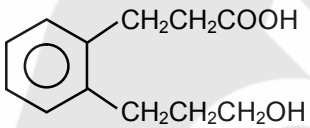
Ans. **(3)**

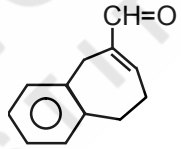
Sol. Seliwanoff's test is used to distinguish between carbohydrates and xanthoprotic test is used to distinguish proteins.

5. 

(1) 

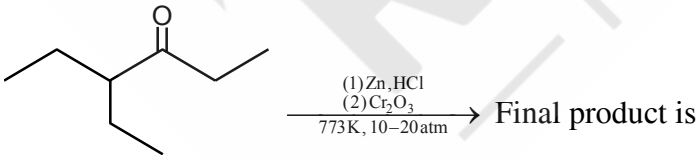
(2) 

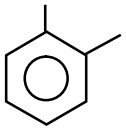
(3) 

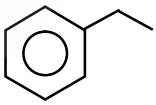
(4) 

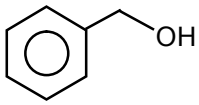
Ans. **(4)**

Sol. It is intramolecular aldol condensation reaction.

6. 

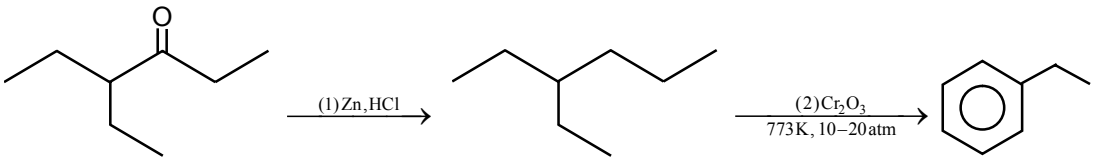
(1) 

(2) 

(3) 

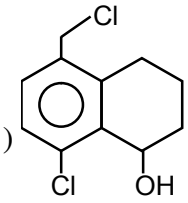
(4)

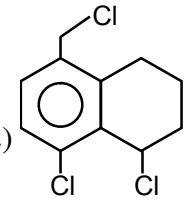
Ans. **(2)**

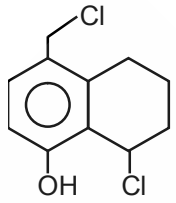
Sol. 

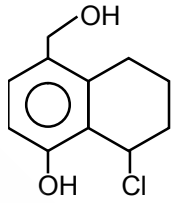
In first step ketonic group is reduced by Clemenssen reduction, in second step aromatisation takes place.

7. 

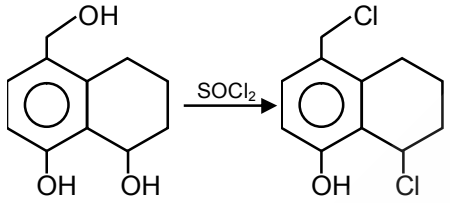
(1) 

(2) 

(3) 

(4) 

Ans. **(3)**

Sol. 

Phenolic OH group does not give substitution reaction as lone pair of oxygen is delocalised with benzene and double bond character in C–O bond.

8. What will be the correct basic strength (K_b) order for the following amines ?

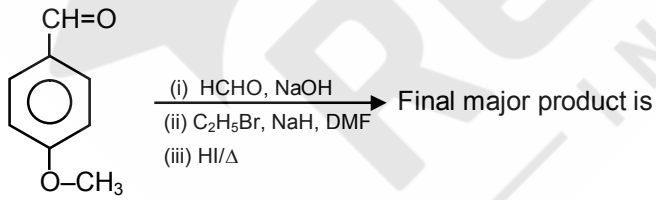
(i) Phenyl methanamine (ii) N,N–Dimethylaniline

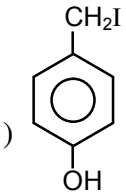
(iii) N–methylaniline (iv) Benzenamine

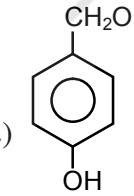
(1) i > ii > iii > iv (2) ii > iii > i > iv (3) i > iii > ii > iv (4) ii > iv > iii > i

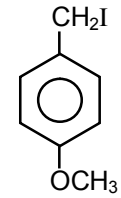
Ans. **(1)**

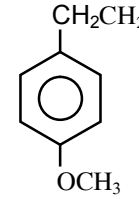
Sol. In phenyl methanamine lone pair of nitrogen is localised so it is most basic among the given amines. Benzenamine is least basic because lone pair of nitrogen is delocalised.

9. 

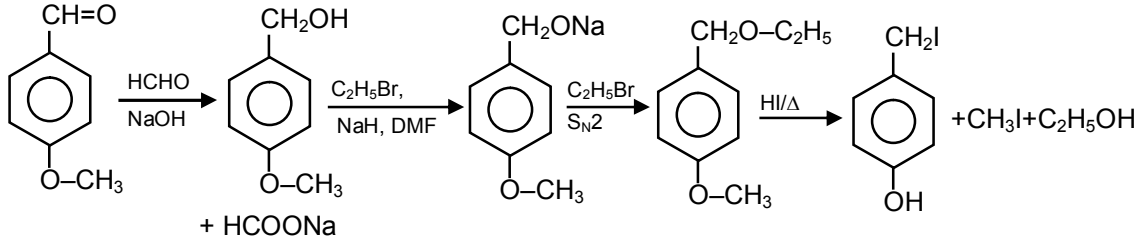
(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. 

10. Which of the following oxides are acidic ?

(1) CaO, B_2O_3 (2) BaO, SiO_2 (3) ZnO, B_2O_3 (4) ZnO, CaO

Ans. **(2)**

Sol.

Oxide	Nature
CaO	Basic
B_2O_3	Acidic
SiO_2	Acidic
ZnO	Amphoteric

11. Which amongs the following will give positive 2,4-DNP-test?

(1)Aldehyde (2) Ester (3) Alcohol (4) Ether

Ans. **(1)**

12. Arrange in order of increasing electron gain enthalpy

O, S, Se, Te

(1) O < Te < Se < S (2) O < S < Se < Te (3) O > S > Se >Te (4) S < Te < Se < O

Ans. **(1)**

Sol. Electron gain enthalpy decreases down the group but for oxygen it is minimum in its group.

13. Assertion : $T\ell I_3$ is isomorphous with CsI_3 & oxidation number of $T\ell = 1$

Reason : $T\ell$ has 14 f electrons

(1) Assertion is true, Reason is true and Reason is correct explanation for Assertion.

(2) Assertion is true, Reason is true and Reason is not correct explanation for Assertion.

(3) Assertion is true, Reason is false.

(4) Assertion is false, Reason is true.

Ans. **(2)**

14. Which of the following emits low energy β-particles?

(1) ${}_1^1H$ (2) ${}_1^2H$ (3) H^+ (4) ${}_1^3H$

Ans. **(4)**

Sol. Fact Based

${}_1H^3$ (tritium) is radio active

Its $\frac{n}{p}=\frac{2}{1}$(Higher), Hence

It emits β particle

15. $FeCl_3$ + Hot water $\longrightarrow$ Colloid

What is the charge on the particles of colloid formed?

(1) Positive (2) Negative (3) No charge (4) Can not be predicted

Ans. **(1)**

Sol. $FeCl_3 \xrightarrow{\text{Hydrolysis}} Fe(OH)_3 \downarrow \xrightarrow[\text{Adsorption}]{Fe^{3+}} \underset{\text{Colloidal particle}}{Fe(OH)_3 / Fe^{3+}}$

16.

Processes	**Compounds**
(A) Deacon's	(p) NaOH
(B) VanArkel	(q) Cl_2
(C) Solvay	(r) Ti
(D) Castner kellner	(s) Na_2CO_3

(1) A → q, B → r, C → s, D → p

(2) A → r, B → q, C → s, D → p

(3) A → q, B → s, C → r, D → p

(4) A → p, B → r, C → s, D → q

Ans. **(1)**

Sol. Theory based

17.

Species	**Bond order**
(1) Ne_2	(p) 1
(2) N_2	(q) 3
(3) O_2	(r) 2
(4) F_2	(s) 0

(1) 1 → s, 2 → q, 3 → r, 4 → p

(2)1 → p, 2 → q, 3 → r, 4 → s

(3) 1 → r, 2 → p, 3 → s, 4 → q

(4) 1 → s, 2 → q, 3 → p, 4 → r

Ans. **(1)**

Sol.

Species	Bond order
Ne_2	0
N_2	3
O_2	2
F_2	1

18. Which of the following statement is incorrect regarding calgon process for treatment of hard water?

(1) It contains the 2nd most abundant element in the earth crust

(2) It does not precipitate Ca^{2+}

(3) Calgon is polymeric and water soluble

(4) It is also called Graham's salt

Ans. **(1)**

Sol. Calgon → $Na_2[Na_4(PO_3)_6] \xrightarrow{\text{Water Soluble}} 2Na^+ [Na_4(PO_3)_6]^{2-} \xrightarrow{Ca^{2+}} 2Na^+ \underset{\text{Soluble}}{\left[Na_2Ca(PO_3)_6\right]^{2-}}$

19. Match the column

Ore	**Metal**
(i) Siderite	(p) Cu
(ii) Calamine	(q) Fe
(iii) Malachite	(r) Zn
(iv) Cryolite	(s) Al

(1) (i) → q, (ii) → r, (iii) → p, (iv) → s

(2) (i) → r, (ii) → q, (iii) → p, (iv) → s

(3) (i) → s, (ii) → q, (iii) → p, (iv) → r

(4) (i) → p, (ii) → q, (iii) → r, (iv) → s

Ans. (1)

Sol. Theory based

20. $Zn(s)\,|\underset{0.1M}{Zn^{2+}}\,\|\,\underset{0.01M}{Ag^{+}}\,|\,Ag$

$E^{\circ}_{Zn^{+2}/Zn} = -0.76V$ $\qquad$ $E = x \times 10^{-2}$

$E^{\circ}_{Ag^{+}/Ag} = 0.8V$ $\qquad$ Determine 'x'

Ans. 147

Sol. $E^{\circ}_{Cell} = \left[E^{\circ}_{Ag^{+}/Ag}\right]_{cathode} - \left[E^{\circ}_{Zn^{2+}/Zn}\right]_{anode}$

$= 0.8 + 0.76 = 1.56$ V

Anode : $Zn(s) \longrightarrow Zn^{+2}(aq) + 2e^{-}$ (oxidation)

Cathode: $2Ag^{+}(aq) + 2e^{-} \longrightarrow 2Ag(s)$ (Reduction)

$$Zn(s) + 2Ag^{+}(aq) \longrightarrow Zn^{+2}(aq) + 2Ag(s)$$

$$E_{cell} = E^{\circ}_{Cell} - \frac{0.0591}{2}\log_{10}\left[\frac{[Zn^{+2}]}{[Ag^{+}]^2}\right]$$

$$= 1.56 - \frac{0.0591}{2}\log_{10}\left[\frac{0.1}{10^{-4}}\right]$$

$$= 1.56 - \frac{0.0591}{2}\times 3$$

$= 1.56 - 0.088 = 1.472$ V

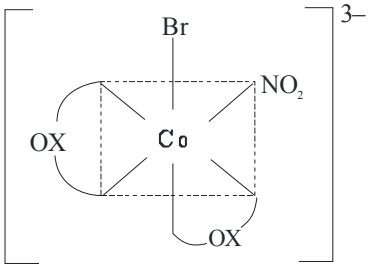
$= 147 \times 10^{-2}$ C

$X = 147$

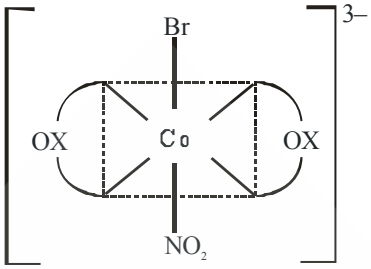
21. For the complex $[Co(OX)_2(Br)(NO_2)]^{3-}$, total number of stereoisomers are

Ans. **3**

Sol.



Cis
optically active
having two stereoisomers d & ℓ



Trans
optically inactive

Therefore total three stereoisomers are possible

22. ΔH_f° of S(g) = 275 kJ/mole

F(g) = 80 kJ/mole

$SF_6(g) = -1100$ kJ/mole

Determine bond energy of S–F bond.

Ans. **309.16 kJ/mole**

Sol. $S(g) + 6F(g) \longrightarrow SF_6(g)$

$\Delta H_R^\circ = \Delta H_f^\circ(SF_6) - \Delta H_f^\circ(S) - 6\Delta H_f^\circ(F)$

$= (-1100) - (275) - 6(80) = -1855$

$\Delta H_R^\circ = -1855 = 0 - 6 \times (\Delta H_{S-F}^\circ)$

$\Rightarrow \Delta H_{S-F}^\circ = \frac{1855}{6} = 309.16 \frac{kJ}{mole}$

23. How much mass of $NaNO_3$ is required to prepare 50ml of aqueous solution to get 70mgNa^+ per ml of solution

Ans. **129.3478gm**

Sol. Mass of Na^+ in 50ml = $70 \times 50 = 3500$ mg

23000mg of Na^+ is present in 85000 mg $NaNO_3$

$\therefore$ 3500 mg Na^+ will be present in $\frac{85000}{23000} \times 35000 = 129347.8$mg

$= 129.3478$ gm.

24. Fraction of molecules crossing activation energy barrier = e^{-x}. Determine 'x'
(E_a = 80.3 kJ/mole, T = 700 K, R = 8.314 J/mole-K)

Ans. **14**

Sol. Fraction (f) = $e^{-\frac{E_a}{RT}}$

$= e^{-\frac{80.3\times10^3}{8.314\times700}}$

$= e^{-13.8}$

$\simeq e^{-14}$

25. Ratio of octahedral voids & number of lattice points in a FCC crystal structure is

Ans. **1**

Sol. Effective number of octahedral void in FCC lattice = 4

Effective number of lattice point in FCC = 4

26. In mildly alkaline medium $KMnO_4$ reacts with thiosulphate ion to yield a species 'A' containing sulphur . What is the oxidation state of S in 'A'.

Ans. **6**

Sol. $MnO_4^- + S_2O_3^{2-} \xrightarrow{OH^-} MnO_2 + SO_4^{2-}$

Oxidation state of 'S' in SO_4^{2-} is 6

27. Calculate the pH of ammonium phosphate solution. Given $pk_a = 4.75$; $pk_b = 5.23$

Ans. **6.76**

Sol. $pH = \frac{1}{2}(pK_w + pK_a - pK_b)$

$= \frac{1}{2}(14 + 4.75 - 5.23)$

= 6.76

28. 12.2 g benzoic acid is added in 100g water. T_f of this solution is –0.93ºC. Consider 'n' number of benzoic acid molecules are associated. Calculate 'n', assuming 100% association.
K_f = 1.86 K kg/mol.

Ans. **2**

Sol. $\Delta T_f = i \times K_f \times m$

$0.93 = i \times 1.86 \times 1 \qquad \therefore i = \frac{1}{2}$

$\therefore \frac{1}{2} = 1 + \left(\frac{1}{n} - 1\right)1 \qquad \therefore n = 2$