NAMAKKAL DISTRICT

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SECOND MID TERM TEST, NOVEMBER - 2019
STANDARD - XII

Time : 1.30 hrs   CHEMISTRY   Marks: 50

Part - I

Answer all the questions:-.

I. Choose the correct answer:-   10×1=10

1) Conjugate base of $H_2PO_4^-$ is
   a) PO_4^{3-} b) P_2O_5 c) H_3PO_4 d) HPO_4^{2-}

2) Which of the following fluro compounds act as Lewis base
   a) BF_3 b) PF_3 c) CF_4 d) SiF_4

3) Dissociation constant of NH_4OH is $1.8×10^{-5}$ find hydrolysis constant of NH_4Cl is
   a) $1.8×10^{-19}$ b) $5.55×10^{-10}$ c) $5.5×10^{-5}$ d) $180×10^{-5}$

4) Find P^H of 10^{-7} M HCl.
   a) 7   b) 7.70   c) 6.70   d) 6

5) The number of electrons present in 9650 coulomb is
   a) $6.22×10^{23}$ b) $6.022×10^{24}$ c) $6.022×10^{22}$ d) $6.022×10^{-34}$

6) Among the following cells
   I) Leclanche cell   II) Nickel-Cadmium cell
   III) Lead Storage battery   IV) Mercury cell primary cells are
   a) 1 and IV   b) I and II   c) III and IV   d) II and III

7) Assertion: Pure iron when heated in dry air is converted with a layer of rust.
   Reason:-   Rust has the composition Fe_3O_4.
   a) Both Assertion and reason are true. Reason is the correct explanation of assertion.
   b) Both assertion and reason are true. Reason is not the correct explanation of assertion
   c) Assertion-true, Reason-false.
   d) Both assertion and reason are wrong.

8) Carbolic acid is nothing but
   a) Phenol   b) Picric acid
   c) benzoic acid   d) Phenyl acetic acid

9) Williamson synthesis of preparing dimethyl ether is a/an
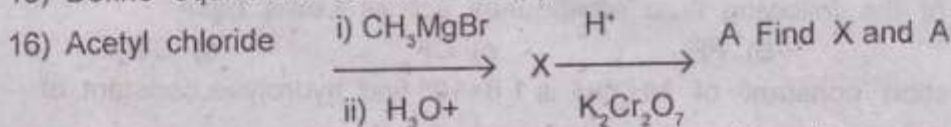   a) SN^1 b) SN^2 c) E_1 d) E_2

N   2   XII - Chemistry

10) Oxidation of glycerol by LTA will yield
   a) HCHO   b) HCOOH   c) both 'a' and 'b'   d) neither 'a' nor 'b'

Part - II

Answer any 5 questions. (question no.13 is compulsory)   5×2=10

11) Define solubility product.
12) What is common ion effect?
13) What is buffer index?
14) State Kohlrausch law.
15) Define equivalent conductance (Λ)
16) Acetyl chloride $\xrightarrow[\text{ii) } H_3O^+]{\text{i) } CH_3MgBr}$ X $\xrightarrow[K_2Cr_2O_7]{H^+}$ A Find X and A
17) How would you obtain phenolphthalein from phenol.

Part - III

Answer any 5 questions (qu.No.19 is compulsory)   5×3=15

18) Differentiate Lewis acid and Lewis base.
19) Calculate P^H of 0.1M CH_3COOH solution Ka for acetic acid is $1.8×10^{-5}$
20) Define Faraday's Laws.
21) Conductivity decreases while the dilution of the solution increased. Why?
22) Write notes on sacrificial protection.
23) Write a note on Kolbes reaction.
24) How is acrolein formed?

Part - IV

Answer all the questions:-   3×5=15

25) Derive Nernst equation.   [or]
   Explain Lithium - ion battery.
26) i) What is buffer solution?
   ii) Find P^H of the buffer solution that containing 0.18 mol lit⁻¹ acetic acid and 0.20 mol lit⁻¹ sodium acetate. Ka value of acetic acid is $1.8×10^{-5}$.

                          [or]

   i) Define P^H
   ii) Derive an equation for Ostwald dilution law?
27) Write notes on i) Dow's process   ii) Reimer Tiemann Reaction
   iii) Coupling reaction.   [or]
   i) Write notes on Williamson's ether synthesis.
   ii) What are the uses of diethyl ether.

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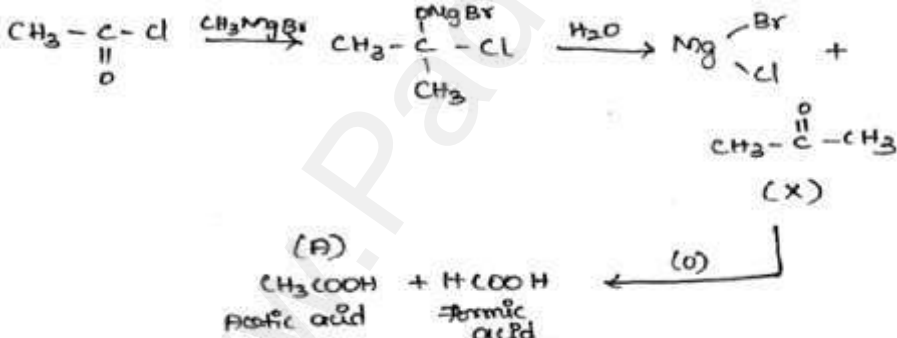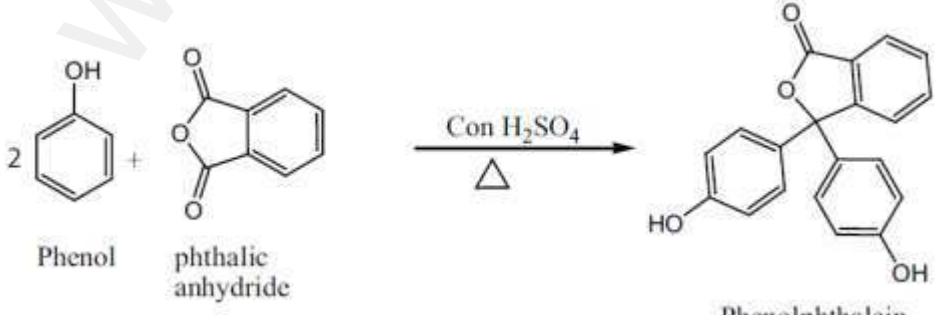## SECOND MID TERM TEST, NOVEMBER - *2019*

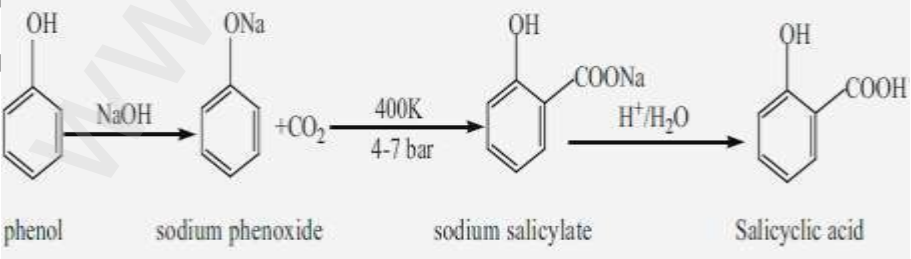**STD: XII**   *06.11.2019*

SUBJECT: CHEMISTRY   **MARKS : *50***

TENTATIVE ANSWER KEY

Q.NO	SECTION-I	MARKS
1	c)H_3PO_4	1
2	b)PF_3	1
3	b)5.55×10^{-10}	1
4	a)7	1
5	c)6.022×10^{22}	1
6	a) I and IV	1
7	d)Both assertion and reason are wrong	1
8	a)Phenol	1
9	b)SN^2	1
10	c)Both 'a'and 'b'	1

Q. NO	SECTION-II	MARKS
11	**Solubility product:** The solubility product of a compound is defined as the product of the molar concentration of the constituent ions, each raised to the power of its stoichiometric co – efficient in a balanced equilibrium equation.	2
12	**Common ion effect:** The dissociation of a weak acid (CH_3COOH) is suppressed in the presence of a salt (CH_3COONa) containing an ion common to the weak electrolyte. It is called the common ion effect.	2

13	**Buffer index:** 1. The buffering ability of a solutiuon can be measured in terms of buffer capacity. 2. It is defined as the number of gram equivalence of acid or base added to one litre of the buffer solution to change its pH by unity. $$\beta = \frac{dB}{d(pH)}$$ Here, dB=number of gram equivalence of acids /base added to one litre of buffer solution d(pH)= the change in the pH after the addition of acid/base	1 1	

	Kohlraush law:	
14	At infinite dilution,the limiting molar conductivity of an electrolyte is equal to the some of the limiting molar conductivities of its constituent ions.	2

	Equivalent conductance:	
15	Equivalent conductance is defined as the conductance of 'V' m^3 of electrolytic solution containing one gram equivalent of electrolyte in a conductivity cell in which the electrodes are one meter apart. $$\Lambda = \frac{\kappa\ (Sm^{-1}) \times 10^{-3}\ (gram\ equivalent)^{-1}\ m^3}{N}$$	2

16		2

	Phenolphthalein from phenol:	
17		2

Q.NO	PART-III	MARKS
18	**Differentiate Lewis Acid and Lewis Base:** 	3

Lewis acids	Lewis bases
Electron deficient molecules such as BF_3, $AlCl_3$, BeF_2 etc..	Molecules with one (or) more lone pairs of electrons. NH_3, H_2O, R-O-H, R-O-R, R – NH_2
All metal ions (or) atoms Examples: Fe^{2+}, Fe^{3+}, Cr^{3+} Cu^{2+} etc...	All anions F^-, Cl^-, CN^-, SCN^-, SO_4^{2-} etc...
Molecules that contain a polar double bond Examples : SO_2, CO_2, SO_3 etc...	Molecules that contain carbon – carbon multiple bond Examples: $CH_2 = CH_2$, $CH \equiv CH$ etc...
Molecules in which the central atom can expand its octet due to the availability of empty d – orbitals Example: SiF_4, SF_4, $FeCl_3$ etc..	All metal oxides CaO, MgO, Na_2O etc...

Q.NO		MARKS
19	**Calculate pH of 0.1M CH_3COOH:** $pH = -\log[H^+]$ For weak acids, $[H^+] = \sqrt{K_a \times C}$ $= \sqrt{1.8 \times 10^{-5} \times 0.1}$ $= 1.34 \times 10^{-3} M$ $pH = -\log\left(1.34 \times 10^{-3}\right)$ $= 3 - \log 1.34$ $= 3 - 0.1271$ $= 2.8729 \simeq 2.87$	3

Q.NO		MARKS
20	**Faraday's Law:** **First Law:** The mass of the substance (m) liberated at an electrode during electrolysis is directly proportional to the quantity of charge (Q) passed through the cell. i.e $m \propto Q$ We know that the charge is related to the current by the equation $m \propto It$ (or) m = Z It	**1½**
	Second Law: When the same quantity of charge is passed through the solutions of different electrolytes, the amount of substances liberated at the respective electrodes are directly proportional to their electrochemical equivalents.	**1½**

21	**Conductivity decreases while the dilution of the solution increases .Why?** Conductivity of an electrolyte solution decreases with dilution because the number of ion per unit volume furnished by an electrolyte decreases with dilution	3

22	**Sacrificial Protection:**
	• Protection of metals form corrosion
	• This can be achieved by the following methods.
	    i. Coating metal surface by paint.
	    ii. Galvanizing - by coating with another metal such as zinc. zinc is stronger oxidising agent than iron and hence it can be more easily corroded than iron. i.e., instead of iron, the zinc is oxidised.
	    iii. Cathodic protection - In this technique, unlike galvanising the entire surface of the metal to be protected need not be covered with a protecting metal instead, metals such as .Mg or zinc which is corroded more easily than iron can be used as a sacrificial anode and the iron material acts as a cathode. So iron is protected, but Mg or Zn is corroded.
	• **Passivation -** The metal is treated with strong oxidising agents such as concentrated HNO_3. As a result, a protective oxide layer is formed on the surface of metal.
	• **Alloy formation -** The oxidising tendency of iron can be reduced by forming its alloy with other more anodic metals. Example, stainless steel - an alloy of Fe and Cr .
		1
		
		1
		
		1

23	**Kolbe's (or) Kolbe's Schmitt reaction:** In this reaction, phenol is first converted into sodium phenoxide which is more reactive than phenol towards electrophilic substitution reaction with CO_2 . Treatment of sodium phenoxide with CO_2 at 400K, 4-7 bar pressure followed by acid hydrolysis gives salicylic acid. 	3

	Acrolein formed:	
24.	When glycerol is heated with dehydrating agents such as Con H_2SO_4, $KHSO_4$ etc….,it undergoes dehydration to form acrolein. $CH_2 - OH$ $\mid$ $CH - OH$ $\xrightarrow[\Delta]{KHSO_4}$ $CH_2 = CH - CHO$ $\mid$ $CH_2 - OH$ Propan - 1,2,3 - triol Prop - 2- enal (acrolein)	3

| **Q.NO**	**PART -IV**	**MARKS**
25	**Nernst Equation:** • Nernst equation is the one which relates the cell potential and the concentration of the species involved in an electrochemical reaction. • Let us consider an electrochemical cell for which the overall redox reaction is, $xA + yB \leftrightarrows lC + mD$ • The reaction quotient Q for the above reaction is given below $$Q = \frac{[C]^l\,[D]^m}{[A]^x\,[B]^y} \quad ----------(1)$$ • We have already learnt that, $$\Delta G = \Delta G° + RT\,lnQ \quad -----------(2)$$ The Gibbs free energy can be related to the cell emf as follows $$\Delta G = -\,nFE_{cell} \quad ; \quad \Delta G° = -\,nFE°_{cell}$$ Substitute these values and Q from(1) in the equation (2) $$(2) \rightarrow \quad -nFE_{cell} = -nFE°_{cell} + RT\,ln\frac{[C]^l[D]^m}{[A]^x\,[B]^y} \quad ----------(3)$$ equation (3) by (-nF) $$E_{cell} = E°_{cell} - \frac{RT}{nF}ln\frac{[C]^l[D]^m}{[A]^x\,[B]^y}$$ $$(or)\; E_{cell} = E°_{cell} - \frac{2.303RT}{nF}\,log\,\frac{[C]^l[D]^m}{[A]^x\,[B]^y}$$ The above equation(4) is called the Nernst equation. At $25°C$ (298K), the above equation (4) becomes, $$E_{cell} = E°_{cell} - \frac{2.303 \times 8.314 \times 298}{n(96500)}\,log\frac{[C]^l[D]^m}{[A]^x\,[B]^y}$$ $$E_{cell} = E°_{cell} - \frac{0.0591}{n}\,log\,\frac{[C]^l[D]^m}{[A]^x\,[B]^y}$$	1/2 1 1/2 1/2 1 1/2 1

(OR)

Lithium-ion battery:

Anode   : Porus graphite
Cathode : transition metal oxide such as CoO_2
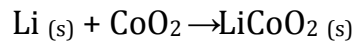Electrolyte : Lithium salt in an organic solvent

At the anode oxidation occurs

$$Li_{(s)} \rightarrow Li^+_{(aq)} + e^-$$
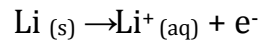
At the cathode reduction occurs

$$Li^+ + CoO_{(s)} + e^- \rightarrow Li\,CoO_{2\,(s)}$$
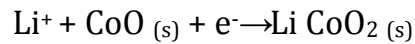
Overall reactions

$$Li_{(s)} + CoO_2 \rightarrow LiCoO_{2\,(s)}$$

   i.   Both electrodes allow Li_+ ions to move in and out of their structures. During discharge, the Li_+ ions produced at the anode moves towards cathode through the non – aqueous electrolyte.
   ii. When a potential greater than the emf produced by the cell is applied across the electrode, the cell reaction is reversed and now the Li_+ ions move from cathode to anode where they become embedded on the porous electrode. This is known as intercalation.

Uses :
Used in cellular phones, laptop computer digital camera etc…
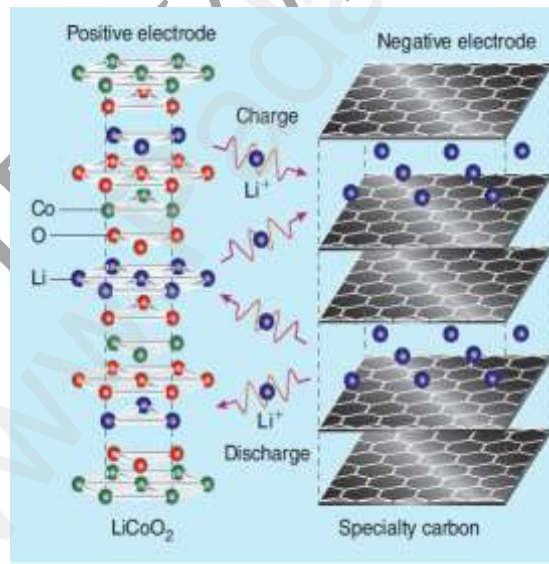
i**) Buffer solution:**

Buffer is a solution which consists of a mixture of a weak acid and its conjugate base (or) a weak base and its conjugate acid. This buffer solution resists drastic changes in its pH upon addition of a small quantities of acids (or) bases, and this ability is called buffer action. The buffer containing carbonic acid (H_2CO_3) and its conjugate base HCO_3^- is present in our blood.

26

ii)Find pH of the buffer solution :

$$pH = pK_a + \log \frac{[salt]}{[acid]}$$

Given that $K_a = 1.8 \times 10^{-5}$

$$\therefore \quad pK_a = -\log(1.8 \times 10^{-5}) = 5 - \log 1.8$$
$$= 5 - 0.26$$
$$= 4.74$$

$$\therefore pH = 4.74 + \log \frac{0.20}{0.18}$$
$$= 4.74 + \log \frac{10}{9}$$
$$= 4.74 + \log 10 - \log 9$$
$$= 4.74 + 1 - 0.95$$
$$= 5.74 - 0.95$$
$$= 4.79$$

(OR)

i)$_P$H:

pH of a solution is defined as the negative logarithm of base 10 of the molar concentration of the hydronium ions present in the solution.

$$pH = -\log_{10}[H_3O^+].$$

ii)Ostwald dilution law:

Ostwald's dilution law relates the dissociation constant of the weak acid (K_a) with its degree of dissociation (α) and the concentration (C). Degree of dissociation (α) is the fraction of the total number of moles of a substance that dissociates at equilibrium

$$\alpha = \frac{\text{Number of moles dissociated}}{\text{total number of moles}}$$

We shall derive an expression for ostwald's law by considering a weak acid, i.e. acetic acid($CH_3 COOH$) . The dissociation of acetic acid can be represented as

The dissociation constant of acetic acid is,

$$k_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$$
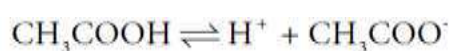
$$CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$$

	CH$_3$COOH	H$^+$	CH$_3$COO$^-$
Initial number of moles	1	-	-
Degree of dissociation of CH COOH	α	-	-
Number of moles at equilibrium	1-α	α	α
Equilibrium concentration	(1-α)C	αC	αC

Substituting the equilibrium concentration in equation

$$k_a = \frac{(\alpha C)(\alpha C)}{(1-\alpha)C}$$

$$k_a = \frac{\alpha^2 C}{1-\alpha} \ldots\ldots\ldots$$

1

We know that weak acid dissociates only to a very small extent compared to one, α is so small and hence in the denominator (1 - α) =1

$$K_a = \alpha^2 C$$

$$\Rightarrow \alpha^2 = \frac{K_a}{C}$$

$$\alpha = \sqrt{\frac{K_a}{c}} \ldots$$

½

The concentration of H$^+$ (H$_3$O$^+$) can be calculated using the K$_a$ value as below.

$$[H^+] = \alpha C \ldots$$

Equilibrium molar concentration of [H$^+$] is equal to αC

$$\therefore [H^+] = \left(\sqrt{\frac{K_a}{C}}\right) C$$

Similarly, for a weak base

$$K_b = \alpha^2 C \quad \text{and} \quad \alpha = \sqrt{\frac{K_b}{C}}$$

½

$$[OH^-] = \alpha C$$

$$\text{(or)}$$

$$[OH^-] = \sqrt{K_b C} \ldots\ldots\ldots\ldots$$
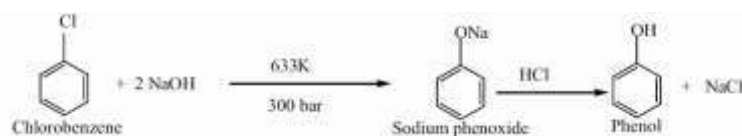
i) **Dows process:**

When Chlorobenzene is hydrolysed with 6-8% NaOH at 300 bar and 633K in a closed vessel, sodium phenoxide is formed which on treatment with dilute HCl gives phenol.
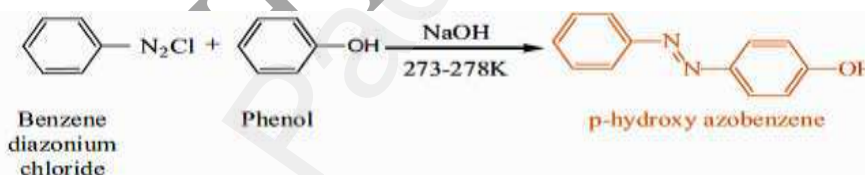

ii)**Reimer Tiemann Reaction:**

On treating phenol with CHCl$_3$ /NaOH, a -CHO group is introduced at ortho position. This reaction proceeds through the formation of substituted benzal chloride intermediate.
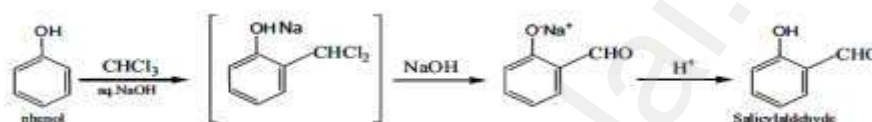
iii)**Coupling reaction:**

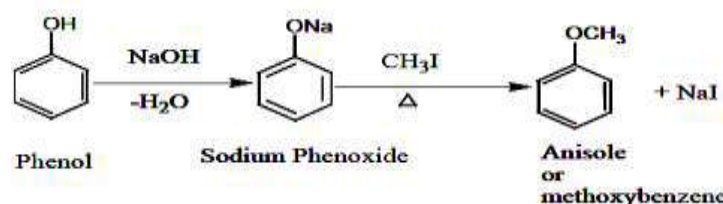Phenol couples with benzene diazonium chloride in an alkaline solution to form p-hydroxy azobenzene(a red orange dye).

(OR)

i)**Williamson's ether synthesis:**
An alkaline solution of phenol react with alkyl halide to form phenyl ethers. The alkyl halide undergoes nucleophilic substitution by the phenoxide ion in the presence of alkali.

27	1 1/2
	2
	1 1/2
	1
	2

	ii) **Uses of Diethyl ether:**	
	1. Diethyl ether is used as a surgical anesthetic agent in surgery. 2. It is a good solvent for organic reactions and extraction. 3. It is used as a volatile starting fluid for diesel and gasoline engine. 4. It is used as a refrigerant.	2

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