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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech S1 (Special Improvement) Examinations January 2021 (2019 scheme)

Course Code: CYT100

Course Name: ENGINEERING CHEMISTRY

(2019-Scheme)

Max. Marks: 100 Duration: 3 Hours

PART A

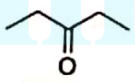
Answer all questions, each carries 3 marks. Marks

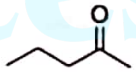
1 Compare electrolytic and electrochemical cells. (3)

2 Write the cell reactions, cell representation and calculate the standard EMF of the cell formed by silver and aluminium electrodes. $E^0_{Ag+/Ag}$= 0.8V, $E^0_{Al3+/Al}$= -1.66V (3)

3 What is the requirement for a molecule to be IR active? Write two examples for IR active and inactive molecules. (3)

4 Predict number of signals for the following and justify your answer. (3)

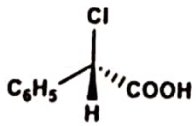
a) 

b) 

5 TGA will not give information regarding phase changes .Give reason. (3)

6 Mention any three applications of SEM. (3)

7 Assign the ***R-S*** configuration for the following molecule and also write its Fischer projection formula. (3)



8 What are co-polymers? Give one example each for addition and condensation co-polymers. (3)

9 What is the chemistry behind the removal of temporary hardness by boiling? (3)

10 What are the factors that affect DO level in water? (3)

PART B

Answer one full question from each module, each question carries 14 marks

Module-I

11 a) Which are the different types of electrodes? Give examples for each type. Also write the equation for the electrode potential of each type. (7)

b) Illustrate the applications of electrochemical series with suitable examples. (7)

12 a) What is the principle in potentiometric titration? Explain the end point determination of a redox reaction by potentiometric titration. (7)

b) Describe the methods of cathodic protection. (7)

Module-II

13 a) Draw the expected NMR spectrum of methyl propanoate and point out how it differs from ethyl acetate (10)

b) Write the mathematical representation of the law governing absorption of light by molecules of a solution. Also calculate the concentration of a solution if it shows a transmittance of 20% when taken in a cell of 2.5 cm thickness (Molar absorption coefficient is 12000 dm^2 mol^{-1}). (4)

14 a) How can you differentiate NMR spectrum of CH_3CH_2Cl and CH_3CHCl_2 using the concept of spin-spin splitting? (8)

b) Comment on the various electronic transitions that are possible in the following molecules (i) C_2H_6 (ii) CH_3CH_2OH and (iii) 1,3 butadiene. (6)

Module-III

15 a) Explain the principle and instrumentation of DTA with a neat diagram. Interpret the DTA thermogram of $CaC_2O_4.H_2O$. (10)

b) Discuss the classification of nanomaterials based on materials. (4)

16 a) Describe the principle, instrumentation, procedure and applications of GC. (10)

b) Explain hydrothermal method of synthesis of nanomaterials. (4)

Module-IV

17 a) What is optical isomerism? What are the conditions for a molecule to be optically active? What are enantiomers and diastereoisomers? Give two examples for each. Mention two properties each of enantiomers and diastereoisomers. (8)

b) What is polypyrrole? How is it synthesised? Mention two properties and two applications of polypyrrole. (6)

18 a) Draw and explain the conformational isomerism in *(cis)* and *(trans)* 1,2-dimethyl cyclohexane. Which conformer is more stable in each case? Give reason. (10)

b) Write the structure of Kevlar and explain why it is used in cryogenic applications? (4)

Module-V

19 a) Explain aerobic and anaerobic methods for the waste water treatment. (10)

b) A water sample contains 16.2 mg/L $Ca(HCO_3)_2$, 7.3 mg/L $Mg(HCO_3)_2$, 9.5 mg/L $MgCl_2$ and 13.6 mg/L $CaSO_4$. Calculate the temporary and permanent hardness of water and what will happen if 10.6 mg/L $NaHCO_3$ is added? (4)

20 a) Explain the complexometric titration method for the estimation of hardness of water. Write necessary calculation steps. (10)

b) Write any four disadvantages of hard water. (4)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.TECH, S1, Jan. 2021 Examination

CYT100 (ENGINEERING CHEMISTRY)

PART A

① Electrochemical cells

→ chemical energy is converted to electrical energy

→ oxidation at anode and reduction at cathode

→ anode and cathode in different containers connected by salt bridge.

→ Energy conversion is spontaneous ($\Delta G < 0$)

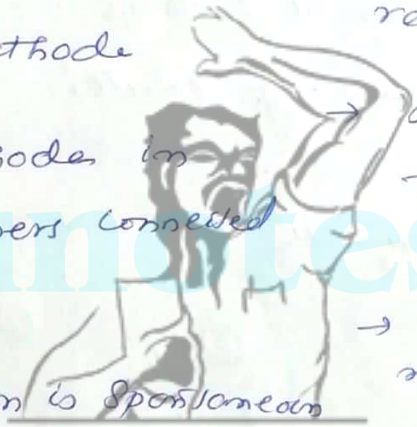
Electrolytic cells

→ Electrical energy is converted into chemical energy

→ oxidation at cathode and reduction at anode

→ anode and cathode in the same container

→ non spontaneous redox reaction



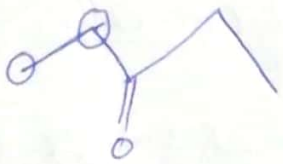
② $E^\circ_{Ag^+/Ag} > E^\circ_{Al^{3+}/Al} \Rightarrow$ $Al_{(s)} + Ag^+ \longrightarrow Ag + Al^{3+}$

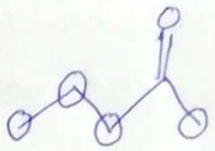
$Al_{(s)} | Al^{3+} || Ag^+ | Ag_{(s)}$

$E^\circ = E^\circ_c - E^\circ_a = 0.8 - (-1.66) = 2.46\ V$

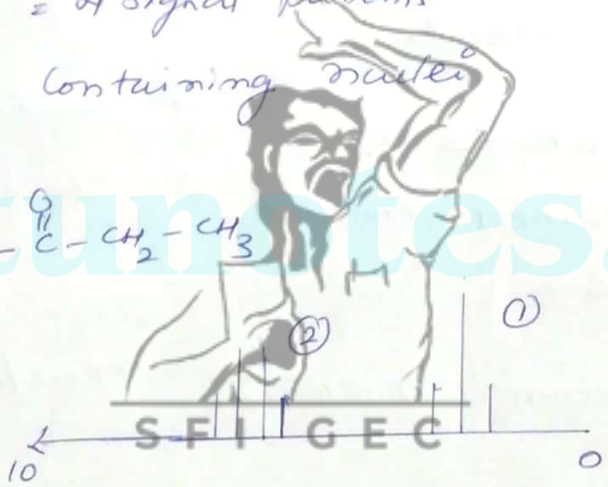
③ A molecule can only absorb IR radiation when the absorption cause a change in its electric dipole.
A polar bond is usually IR-active

IR active :- CO, NO IR inactive :- N_2, H_2, O_2

④ (a)  = 2 Signal pattern (Symmetric molecule)
(2 unique proton containing nuclei)

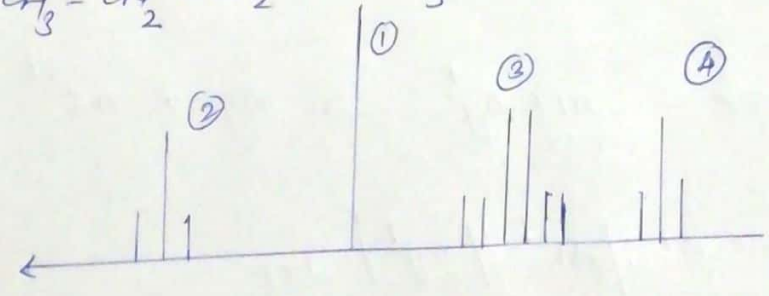
(b)  = 4 Signal patterns as there are 4 proton containing nuclei

(a) $\overset{①}{CH_3}-\overset{②}{CH_2}-\overset{}{\underset{\|}{C}}-CH_2-CH_3$



7 Split Signals

(b) $\overset{④}{CH_3}-\overset{③}{CH_2}-\overset{②}{CH_2}-\overset{}{\underset{\|}{C}}-\overset{①}{CH_3}$

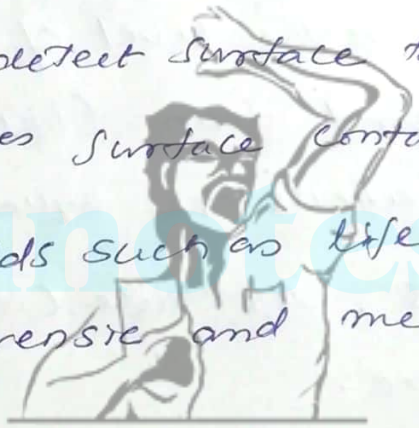


13 Split Signals.

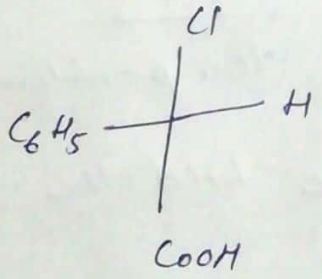
(5) Thermogravimetric Analysis (TGA) measure the weight change with respect to temperature. TGA usually doesn't provide any kind of information about Phase change such as changing of a solid to liquid. This is because the process of phase change doesn't involve with heat change. Hence TGA fails to show this process.

(6) Applications of Scanning Electron microscope

* It helps in the characterisation of solid materials
* Analyse and detect ~~surface~~ fractures in to ~~micro~~ structures surface contaminations.
* used in fields such as life science, nano-science, gemology, forensic and medical science.



(7)



S configuration

(8) Co-polymers are the polymers derived from ~~one~~ more than one species of monomer.

① poly vinyl chloride → addition polymer.

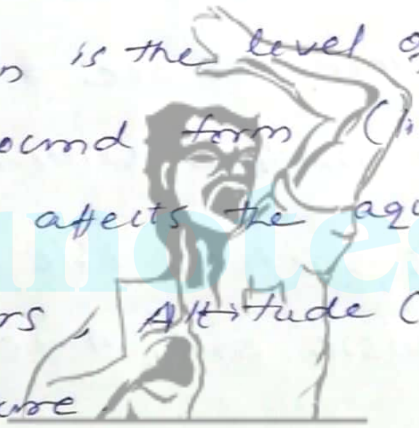
② PET (polyethylene terephtalate) → condensation polymer

9 Temperory hardness is caused due to the bicarbonate salts of ca and mg and some other heavy metals. By boiling such hard water, these bicarbonates are converted into insoluble carbonate and hydroxide salts of the corresponding metals. These can be filtered out by suitable methods.

$$Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3 + H_2O + CO_{2(g)}$$

$$Mg(HCO_3)_2 \xrightarrow{\Delta} Mg(OH)_2 + 2CO_2(g)$$

10 Dissolved oxygen is the level of oxygen that is not in a compound form (like H_2O) in a liquid like water. It affects the aquatic life. It changes and is 24 hours, Altitude (atmospheric pressure) and temperature



dissolving of a gas $\propto$ pressure $\propto \frac{1}{\text{temperature}}$.

Hence water at lower altitude hold the maximum DO naturally

PART B

(11) (a) metal-metal ion electrode :- Electrodes where a metal is dipped in its metal salt solution

eg: $Cu/CuSO_4 \parallel Zn/ZnSO_4$

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{nF} \log \frac{[product]}{[reactant]}$$

(ii) gas Electrode: Electrodes where a gas is in contact with an inert metal (Pt) dipped in an ionic solution of gas molecules eg: Chlorine electrode ($Pt/Cl_2/Cl^-$), Hydrogen electrode ($Pt/H_2/H^+$)

$$E_{SHE} = \frac{2.303RT}{F} \log [H^+]$$

(iii) metal/insoluble metal salt/common ion eletrode:- These are the electrodes where a metal will be in contact with its insoluble salt eg: Calomel eletrode

($Hg/HgCl_2 \parallel Cl_2/Cl^-$)

$$E_{cell} = E^\circ_{cell} - \frac{2.303RT}{F} \log (Cl^-)$$

(iv) Ion selective electrodes :- These are the electrodes which are sensitive to particular ionic species and will develop a potential when a membrane is in contact with an ionic solution eg: glass electrode

$$E_g = E^\circ_g + 0.0591 \log [H^+]$$

v) redox electrode :- An electrode like platinum is in contact with a redox system. Eg: platinum electrode dipped in a mixture of ferric chloride and ferrous chloride solution ($Pt/Fe^{2+}/Fe^{3+}$)

(b)

(i) Prediction of H_2 liberation: metals having -ve emf will replace H from acid as hydrogen undergo reduction.

(ii) knowing oxidation and reduction:- more the reduction potential, the more easily the substance is reduced Eg: Zn reduces Cu as Cu is more electropositive than Zn.

(iii) Displacement reaction: A metal higher in the series will replace the metal from its solution which is lower in the series

$$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$$

(iv) feasibility prediction:- If net emf is positive, the reaction is feasible in the given direction.

(v) emf calculation:- $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$.

Eg: $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Cu^{2+}/Cu}$.

$= 0.80 - 0.34 = 0.46V$

(vi) A non metal having higher reduction potential can displace a non-metal having lower reduction potential : eg: passing flourine gas through sodium chloride solution - generates chlorine gas and sodium flouride

(12) (a) potentiometric titration makes use of the measurement of change in electrode potential upon the addition of the titrant against the volume of titrant added. In this method, a cell is constructed in which atleast one of the electrodes is reversible, with respect to one of the ions taking part in the titration

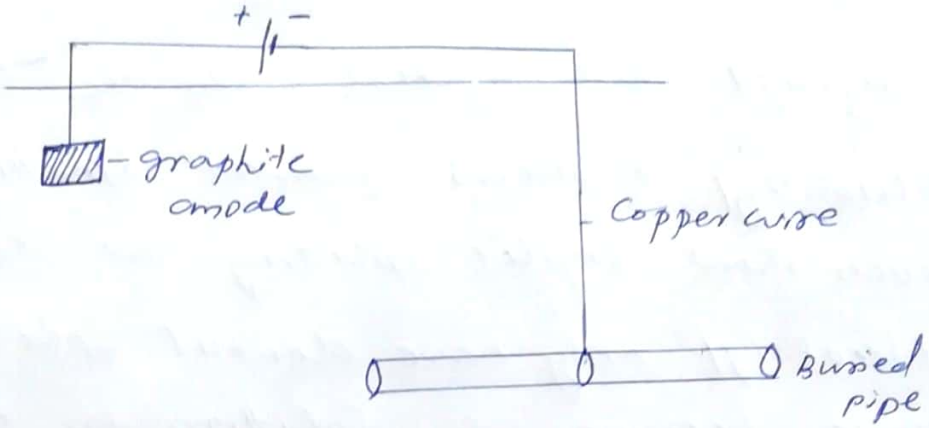
In oxidation reduction potentiometric titration the potential difference between the electrodes can be measured with a digital voltmeter. Standard ceric ammonium sulphate solution is taken in the burette and added to acidified ferrous sulphate solution in the beaker in 1ml installments and the emf is noted in the voltmeter. The titration is repeated when Ce^{4+} solution is added from a burette to Fe^{2+} solution in a beaker, the concentration of Fe^{3+} increase due to oxidation of Fe^{2+}. As a result the potential of indicator electrode increases. When the end point is reached no more Fe^{2+} is available for oxidation

The potential increases sharply near end point. The emf is the point where $\frac{\Delta E}{\Delta V}$ is maximum.

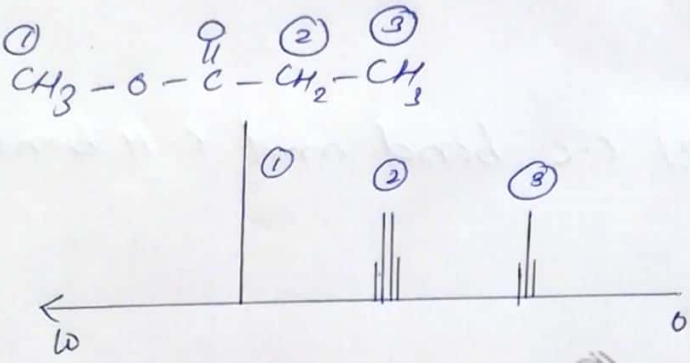
(b) There are two types of cathodic protection

(i) Sacrificial anodic protection: The metallic structure (to be protected) is connected by a wire to a more anodic material. So that all the corrosion is concentrated at the more active metal. The more active metal itself get corroded slowly while the parent structure is protected.

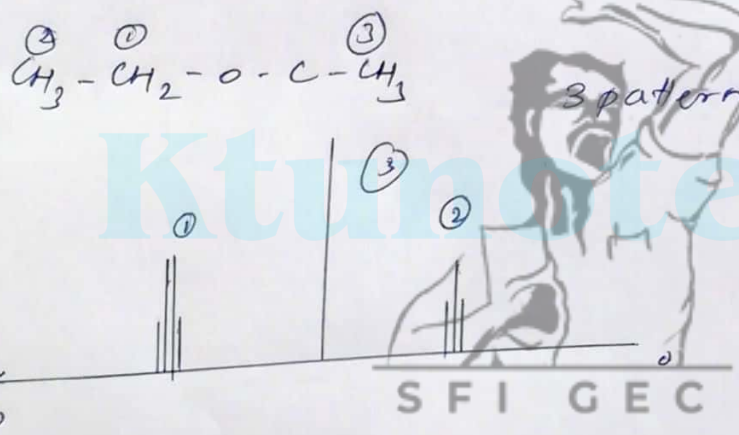
(ii) Impressed current cathodic protection:- The object to made protected is cathode and is connected to negative terminal of DC source. The +ve terminal of the source is connected to the other electrode made of graphite or platinum. The impressed current approaches and opposes the galvanic current and protection from corrosion



(13) (a)



3 signal pattern.



In methyl proponate the signal has more chemical shift- than quartet but in ethyl acetate quartet has more chemical shift than singlet

(b) $\log(I_0/I) = \varepsilon c l$

$\log(\frac{1}{T}) = \varepsilon c l$

$-\log 0.2 = 12000 \times 10^2 \text{ cm}^2 \text{ mol} \times c \times 2.5$

$c = 2.32 \times 10^{-7} \text{ mol}$

(14) (a) $\overset{2}{CH_3}\overset{1}{CH_2}Cl$ and $\overset{1}{CH_3}\overset{2}{CH}Cl_2$. In the first carbon of 1 Chloroethyl it shows quartet Splitting and second carbon show triplet splitting but second carbon of dichloroethyl only have doublet Splotting. And the distance between the Splitting is highest in the case of dichloroethyl.

(b) CH_3-CH_3 $\sigma \longrightarrow \sigma^*$ of C-C bond and C-H bond

CH_3-CH_2-OH

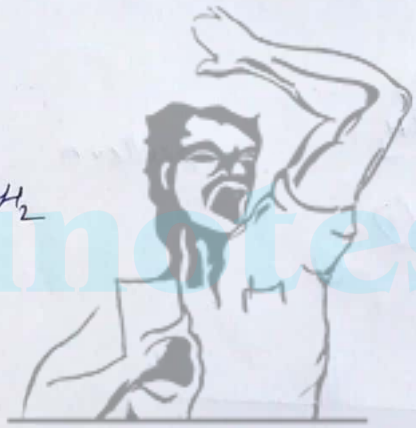
$\sigma \longrightarrow \sigma^*$

$\pi \longrightarrow \sigma^*$

$CH_3=CH-CH=CH_2$

$\sigma \longrightarrow \sigma^*$

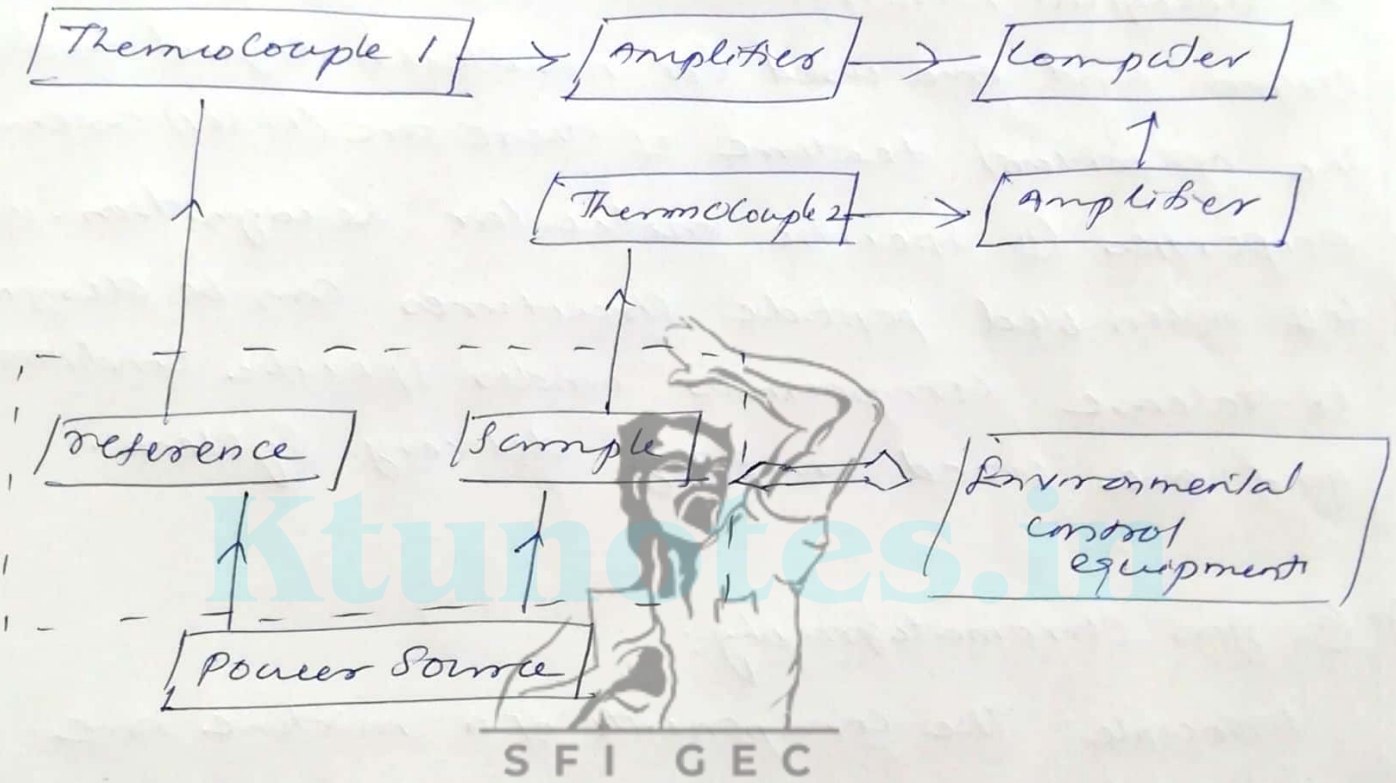
$\pi \longrightarrow \pi^*$



(15) DTA : Differential thermal analysis is a thermoanalytic techniques. In DTA., the material under study and an inert reference material are heated under identical conditions at a constant rate. The difference in temperature ΔT between the sample and reference is then plotted against temperature of sample (T_S). Gives DTA. curve of differential thermogram. Heat changes in the sample either exothermic or endothermic, can be detected relative to the

inert reference. Exothermic changes are represented by upward peak and endothermic represented by downward peak. Thus a DTA curve provides data on the transformations that have occured, without the mass, but involving heat change

Instrumentation



(b) (i) carbon based nanomaterials: These materials contain pure carbon as nanocomponent.

(ii) metal based nanomaterial:- metal based nanomaterial are materials made of metallic nanoparticles like gold, silver, oxides etc. for eg. titanium oxide (TiO_2)

(iii) nanocomposites:- composite nanomaterials contain a mixture of simple nanoparticles or compounds such as nanosized clays, within a bulk material. The nanoparticles give better physical, mechanical

and chemical properties. to the bulk.

(iv) nano polymers / dendrimers :- Dendrimers are nano sized polymers built from branched units. These are tree like molecules with defined cavities. They can be functionalised at the surface and can hide molecules in their cavities.

(v) Biological nanomaterials: These are of biological origin and are used for nanobiological applications. The important feature of these are (i) Self assembly properties (ii) Specific molecular recognitions. Various self assembled peptide structures can be designed to release compounds under specific conditions and are used in drug delivery systems.

(16) @ gas chromatography:

Principle: The components of a mixture are separated depending upon the extent of adsorption or partition on the stationary phase and the role of which component is carried by the mobile phase.

mobile phase: gas (carrier gas) like nitrogen, argon

Stationary phase : solid or liquid.

Instrumentation

Carrier gas : The carrier gas is allowed to flow through the system carrying the sample in the vapour state through the column eg : He, N_2

Instrumentation.

1) Carrier Gas :- It flows through the column carrying the sample in the vapour state through the column carrier gas must be chemically suitable for detector of sample, best column performance.

2) Sample injection system :- Heated injection part with ensuring rapid vapourisation but not thermal degradation. Solid sample are given as solution.

3) Columns :- Different components in the vapourised samples are seperated from each other by vertical difference in programmable furnace is made of stainless steel. Cu, Ni a glass.

4) Detector :- Physical properties can be detected on the basis of response to organic inorganic compounds or electrical conductive gases.

PROCEDURE

Sample injected to the sample part vapourised and carried by carrying gas to heated chromatographic column components get distributed into two phase on the basis vand

partition or adsorption. Different components emerge at different times helps in identification.

APPLICATION

* Test purity of organic compounds
* Study extent of air pollution.
* Banned drugs can be detected.

b) Hydrothermal synthesis :- Heating a solution inside a steel bomb to a temperature between 100 to 1000°C. High pressure ranging from 1 atm to 1000 atm is generated. This can be used to form nanostructures. like thin film, single crystals etc.....

Eg:- $MgCl_2 + H_2O \rightarrow MgO + HCl$
↳ Nano particles.

(17) (a) MRI is a medical imaging technique used in radiology to visualise internal structure of body. MRI makes use of nuclear magnetic resonance to image nuclei of atom inside body.

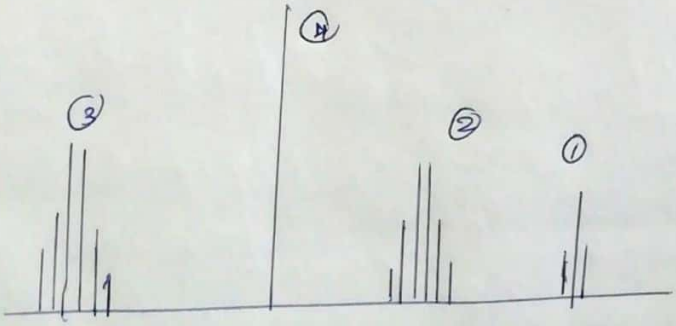
Application: Diffusion of MRI is used for diagnosis of neurological disorder and help in understanding of nervous system.

* It is also used to measure the levels of different metabolites in body.

* MRI angiography generates pictures of arteries.

(b) .) Detection of impurities
.) Structure elucidation of organic compounds
.) quantitative analysis
.) molecular weight determination
.) Cis and trans isomerism

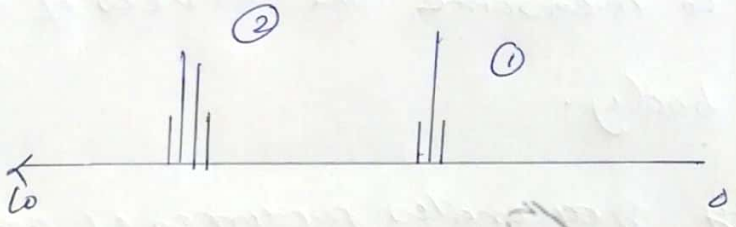
(18) (a) $CH_3 - CH_2 - CH_2 - O - CH_3$



methoxy propane shows 4 Spin-Spin Splitting but ethoxyethane show only 2splitting

In first one there is singlet, triplet and sextet

$CH_3 - CH_2 - O - CH_2 - CH_3$



Here only quartet and triplets.

(b) $n \rightarrow \pi^*$, $\pi \rightarrow \pi^*$ transitions.

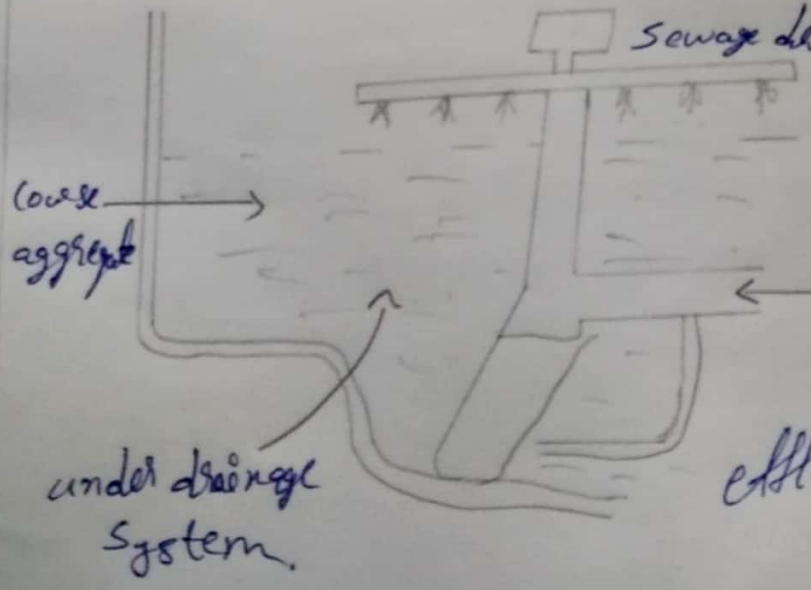
$\pi \rightarrow \pi^*$ electronic transition takes place in red coloured dye of tomato

Q.19) a) Explain Aerobic and anaerobic waste water management.

b) A water sample contain 16.2 mg/l $Ca(HCO_3)_2$, 7.3 mg/l $Mg(HCO_3)_2$, 9.5 mg/l $MgCl_2$ and 13.6 mg/l $CaSO_4$. Calculate temporary and permanent hardness of water and what will happen if 10.6 mg/l $NaHCO_3$ is added ?.

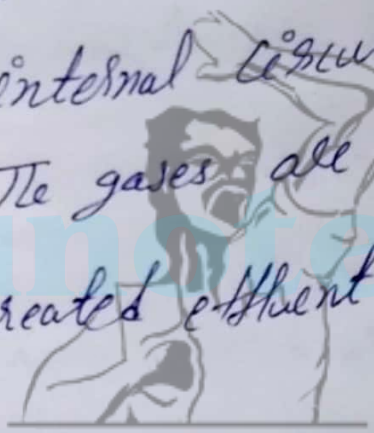
Ans.) a) **Aerobic Method**

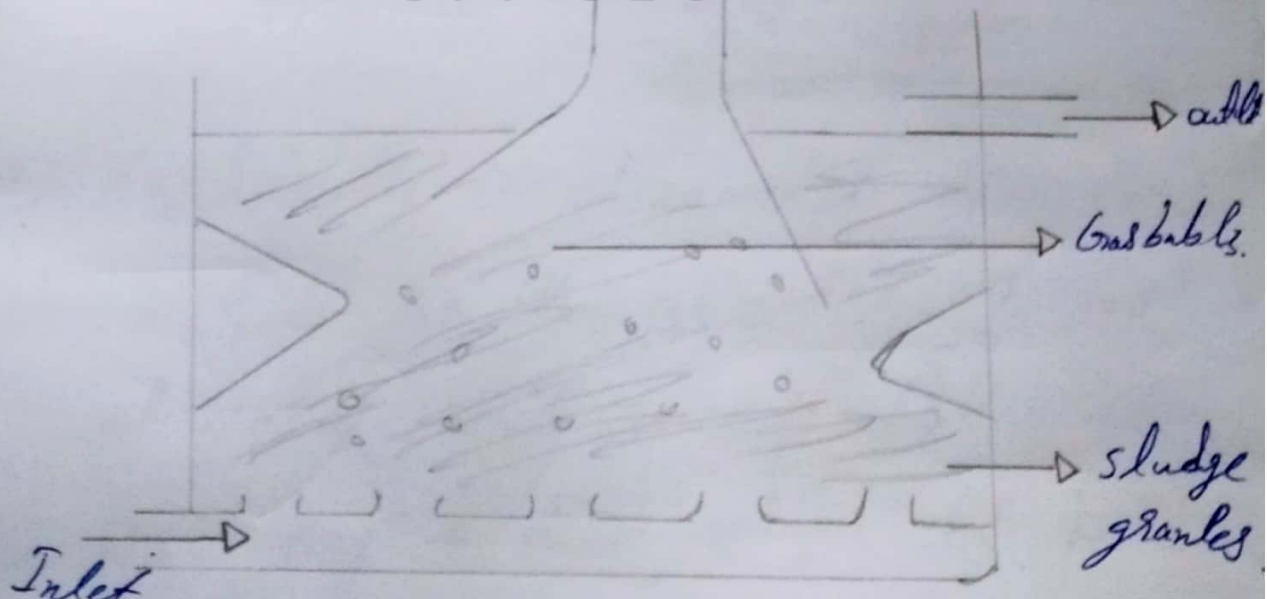
Sewage trickles over a filter using rotating distributor. The filter is 2m deep & filled with broken bricks. Aerobic micro organism starts consuming organic matter in the sewage. More or less clear effluent is collected using under the drive system.



Upflow Anaerobic Sludge Bed Reactor (UASB)

Effluent is feel from under the reactor and moves upward through a sludge blanket (composed by biologically formed granules). As waste comes in contact with bacterial in granules methane like gases are formed under anaerobic conditions. The gases facilitates internal circulations & maintains of granules. The gases are collected as biogas & treated effluent comes out at top outlet.





b) Temporary hardness = $\frac{10 \times 100}{10} + \frac{7.2 \times 100}{20}$

$10 + 5 = 15 ppm$

permanant hardness = $9.5 \times \frac{100}{95} + 13.6 \times \frac{100}{136}$

$10 + 10 = 20 ppm$

Addition of $NaHCO_3$.

Temporary hardness = $15 + 10.6 \times \frac{50}{84} = 15 + 6.31$

$= 21.31 ppm$

Permenant hardness = $20 + 10.6 \times \frac{50}{84}$

$= 26.31 ppm$

Q20) a) Explain the complexometric titration methods for the estimation of hardness of water. Write necessary calculation steps.

b) Write any 4 dissadvantages of hard...

Ans) * In this complexometric titration EDTA is used as titrant. EBT is used as the indicator. The titration conducted at pH = 10. Standard hard water (0.02N). 1g pure $CaCO_3$ dissolved in diluted HCl and evaporated to dryness residue dissolved in distilled water and made upto 1L in Std. flask.

* Standardisation of EDTA: 20ml Std. hard water pipetted out into a conical flask. 20ml buffer, & 2,3 drops of EBT added. Titrated against EBT in burette till wine red changes to blue. Let volume of EDTA be V_1.

* Estimation of total hardness of unknown sample: 20ml of unknown hard water pipetted at in conical flask 2ml buffer and 2,3 drops of EBT added. Titrated against EDTA solution in burette till wine red changes to blue. Let volume of EDTA be V_2.

* Estimation of permenant hardness :- 250 ml of unknown water is boild to 50 ml. Bicarbonates decompose to carbonates & hydroxides. Then water is filted and made upto 250 ml with distilled water. 20 ml of this titrated against EDTA solution and volume of EDTA be V_3 ml.

Calculations

* No. eq of Hard water = No. of eq of EDTA

20 ml of 0.02N std hard water = V_1 ml N_2 EDTA

* Normality of std Hard water, $N_1 = \frac{W_1}{\text{eq. wt} \times V_{(l)}} \times \frac{1}{50 \text{ ml}}$

Normality (EDTA) :- $N_2 = \frac{20 \times 0.02}{V_1}$ $= 0.02N$

* Estimation of total hardness.

Normality of Hard water, $N_3 = \frac{V_2 \times N_2}{20} = \frac{V_2}{20} \times \frac{20 \times 0.02}{V_1}$

$\frac{V_2 \times 0.02}{V_1}$ //

Total hardness = $N_3 \times 50 \times 10^3$ mg/L.

- Estimation of permenant hardness.

Normality of Hardwater, $N_4 = \frac{V_3 \times N_2}{20} = \frac{V_3}{20} \times \frac{20 \times 0.02}{V_1}$

$= \frac{V_3 \times 0.02}{V_1}$

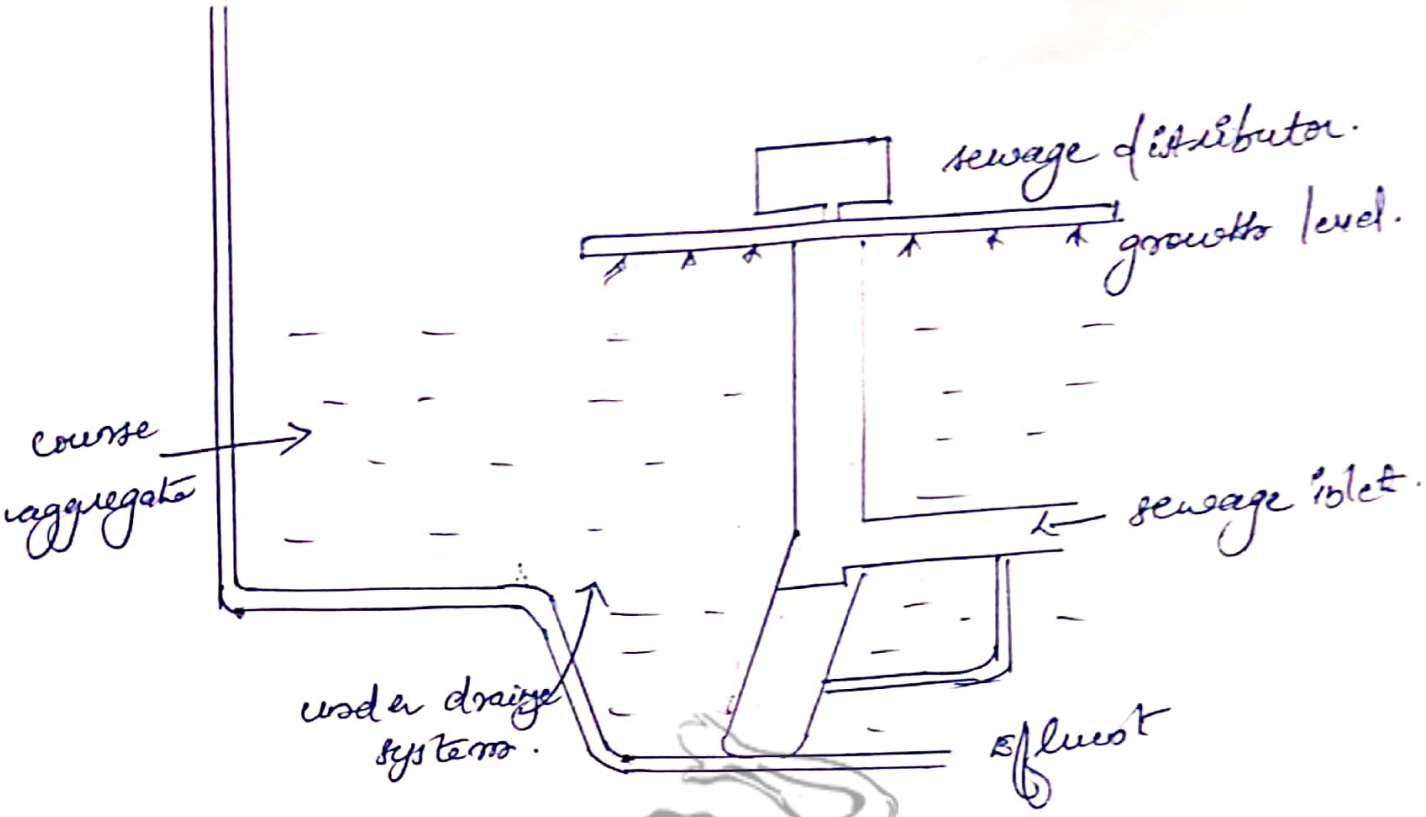
permenant hardness = $N_4 \times 50 \times 10^3$ mg/L.

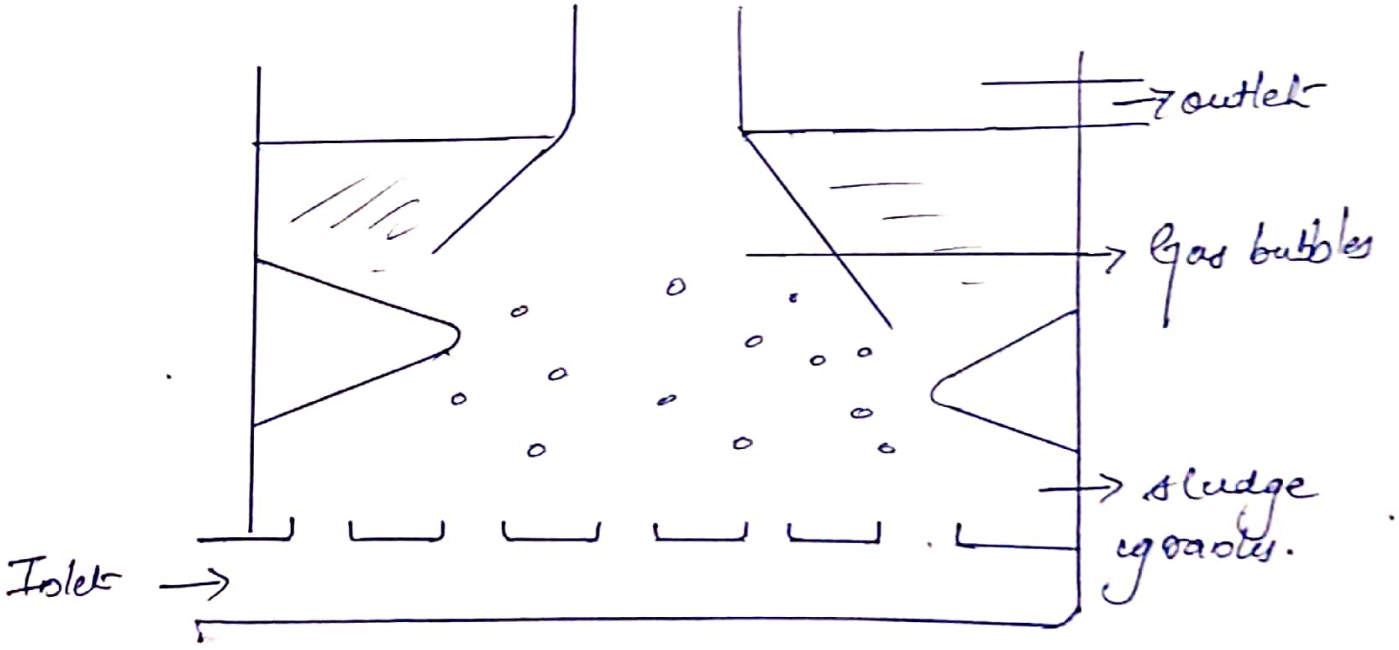
Temperory hardness = Total - permenant hardness

$= \frac{0.02 (V_2 - V_3)}{V_1} \times 50 \times 10^3$ mg/L

b) Dissadvantages of Hardwater

- Scale and sludge coating inside boilers.
- Boiler corrosion.
- Bad to dying cloth.
- Tastes bitta but good for bones.
- Stains in bathroom fittings
- Wastage of soap, preventing foam formation.





Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

First Semester B.Tech Degree Regular and Supplementary Examination December 2020 (2019 scheme)

Course Code: CYT100

Course Name: ENGINEERING CHEMISTRY

(2019-Scheme)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks. Marks

1 What will be the standard electrode potential of Ni^{2+} / Ni electrode if the cell potential of the cell Ni / Ni^{2+}(1M) // Cu^{2}(0.1M) / Cu is 0.59 V at 25 °C? (3)

$E^{0}_{Cu2+/Cu}$= 0.34 V

2 Briefly explain the principle of electroless plating. (3)

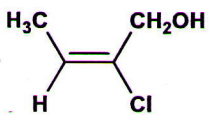
3 Give the mechanism of interaction of electromagnetic radiation with oscillating dipole. (3)

4 State Beer-Lambert's law and write the differential form. (3)

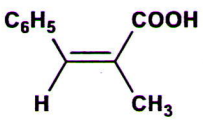
5 Write any three differences of TGA and DTA. (3)

6 Explain sol-gel method for the synthesis of nano particles (3)

7 Determine the configuration of the following alkenes as ***E*** or ***Z***: (3)



A



B

8 Mention any three advantages of OLEDs over LED and LCD. (3)

9 Explain disinfection by chlorination. (3)

10 Compare BOD and COD. (3)

PART B

Answer one full question from each module, each question carries 14 marks

Module-I

11 a) Explain the mechanism of electrochemical corrosion in different environmental conditions. (10)

b) How is the cell constant of a conductivity cell measured? (4)

12 a) Describe the construction and working of Li-ion battery. What are the major advantages of it? (10)

b) Calculate the EMF of the cell at 25°C: (4)

$Al / Al^{3+}(0.1M) // Sn^{4+}(0.1M) / Sn^{2+}(0.01M)$

$E^0_{Al^{3+}/Al} = -1.66$ V, $E^0_{Sn^{4+}/Sn^{2+}} = 0.15$ V

Module-II

13 a) Define chemical shift in NMR and explain the factors affecting chemical shift with examples. (8)

b) Calculate the force constant of H-F molecule that is showing IR absorption signal at 4000 cm^{-1}. By what factor do you expect this frequency to shift if Deuterium is substituted for Hydrogen in this molecule? Given that atomic masses of H and F are 1u and 19 u, respectively. (6)

14 a) How many vibrational modes are possible for the molecules CO, NO, CO_2 and H_2O? Draw the vibrational modes of CO_2 and H_2O and explain their IR active modes. (8)

b) Each compound gives only one signal in its 1H-NMR spectrum. Propose a structural formula for each. a) C_8H_{18} and b) $C_8H_{18}O$ (6)

Module-III

15 a) Describe the instrumentation, principle and working of SEM with the help of a labelled diagram. Give any two applications. (10)

b) Explain the visualization techniques used in thin layer chromatography. (4)

16 a) Describe the principle, instrumentation, procedure and applications of HPLC. (10)

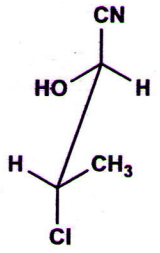
b) How TGA is used to analyze thermal stability of polymers? (4)

Module-IV

17 a) Discuss the conformations in butane by depicting the Newman formula about C2-C3 bond of all the conformers. Also draw the energy level diagram with dihedral angle. (10)

b) How is ABS synthesized? Mention some applications. (4)

18 a) Explain the rules for assigning ***R-S*** configuration and determine the ***R-S*** configuration of all the asymmetric carbon atoms in the molecule after writing its Fischer projection formula. (8)



b) What is meant by doping of polymers? Describe the different types of doping. (6)

Module-V

19 a) Describe the steps involved in municipal water treatment. (10)

b) The following data are obtained for a hard water sample from an EDTA experiment (4)

i) 20 mL standard hard water (5 g/L $CaCO_3$) = 25 mL EDTA solution

ii) 100 mL of hard water sample = 24 mL EDTA solution

iii) 100 mL of boiled hard water sample = 18 mL EDTA solution

Calculate the temporary and permanent hardness.

20 a) With the help of a flow diagram explain the steps involved in sewage treatment. (10)

b) Calculate the temporary and permanent hardness of water sample containing the following dissolved salts. (4)

$Ca(HCO_3)_2$ = 28 mg/L; $CaSO_4$ = 18 mg/L; $Mg(HCO_3)_2$ = 32 mg/L;

$MgCl_2$ = 30 mg/L; NaCl =58 mg/L.

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Second Semester B.Tech Degree Examination July 2021 (2019 scheme)

Course Code: CYT100
Course Name: ENGINEERING CHEMISTRY
(2019 Scheme)

Max. Marks: 100 Duration: 3 Hours

PART A
Answer all questions, each carries 3 marks. Marks

1 What is galvanic series? How is galvanic series advantageous over electrochemical series in corrosion chemistry? (3)

2 Why full charging is not allowed in Li-ion cell? (3)

3 $CHCl_3$ gives a singlet at 7.26 ppm, while CH_3Cl shows singlet at 3.06 ppm in the ^1H NMR spectrum. Give reason. (3)

4 Explain the reason for broadening of UV-Visible (electronic) spectrum. (3)

5 Write any three applications of TGA. (3)

6 Explain the terms retention time (t_R) and relative peak area (RPA) in GC. (3)

7 Draw the Fischer projection formula for the ***meso*** form of the following and convert it into Saw-Horse structure. C_6H_5-CH(Cl)- CH(Cl)-C_6H_5 (3)

8 Write the synthesis of polypyrrole. (3)

9 Which buffer is used in EDTA method? What is its role in titration? (3)

10 Explain break point of chlorination. (3)

PART B
Answer one full question from each module, each question carries 14 marks

Module-I

11 a) Derive Nernst equation and apply it for the emf of Daniel cell. (8)

b) How is electroless nickel plating done? Write the reactions involved. Give any two applications of it. (6)

12 a) With the help of electrochemical equations, show that rusting of iron is more severe in oxygen rich acidic medium than alkaline medium. (8)

b) A glass electrode- calomel electrode assembly shows an emf of 212 mV with pH= 4 buffer solution and -30mV with pH= 9.2 buffer solution. Find the pH of the test solution if it shows an emf of 120 mV. Also find E^0_G if E_{SCE} = 0.2422 V (6)

Module-II

13 a) Draw the molecular orbital energy diagram of i) Ethene, ii) 1, 3-butadiene iii) 1,3,5 hexatriene and iv) benzene to explain their UV-Vis absorption. (8)

b) Explain the origin of spin-spin splitting and draw the splitting pattern in CH_3-CH_2-CH_2-Cl. (6)

14 a) Discuss the principle of IR spectroscopy. Arrive at the expression for vibrational energy states of a diatomic molecule. Draw the potential energy diagram. (8)

b) An organic compound C_3H_6O contains a carbonyl group. How will its NMR spectrum decide whether it is an aldehyde or a ketone? (6)

Module-III

15 a) Discuss the principle and procedure in column chromatography. Explain how TLC is useful in checking the purity of each fraction. (10)

b) Sketch the Derivative TG graph of Calcium oxalate monohydrate. (4)

16 a) Explain the various chemical methods used for the synthesis of nanomaterials. (10)

b) Explain the experimental procedure of TLC. (4)

Module-IV

17 a) How many optical isomers are possible for H_3C-CH(OH)-CH(OH)-CHO? Draw the Fischer projection formula of all the isomers. Which among them are optically active? (8)

b) What are OLEDs? Give the construction and working. (6)

18 a) What is meant by structural isomerism? What are the different types of structural isomerism in organic molecules? Explain with examples. (10)

b) Write the structure of ABS and its monomers. Also list any two applications of ABS. (4)

Module-V

19 a) Explain trickling filter and UASB processes in waste water treatment. (10)

b) Discuss the procedure for the determination of DO in water. (4)

20 a) Define reverse osmosis. Explain the method for the desalination of water using reverse osmosis. Give its advantages. (8)

b) Explain the ion exchange process in water treatment. How is the exhausted resin regenerated? (6)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Second Semester B.Tech Degree Examination June 2022 (2019 scheme)

Course Code: CYT100

Course Name: ENGINEERING CHEMISTRY

(2019 -Scheme)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks Marks

1 How will you determine the standard electrode potential of Fe/Fe^{2+} electrode using calomel electrode? (3)

2 A Zn rod is dipped in 0.3 M $CuSO_4$ solution at 25°C. Displacement reaction takes place then it attains equilibrium. Find the equilibrium constant for this reaction. The standard reduction potential of Zn and Cu are –0.76 V and +0.34 V respectively. (3)

3 Which of the following molecules can give UV visible spectrum (200nm - 800nm)? (3)

a) CH_4 b) N_2 c) Butadiene d) Benzene

4 How many vibrational modes are possible for CO_2 molecule? Sketch the vibrational modes (3)

5 List any three application of DTA (3)

6 Distinguish between isocratic elution and gradient elution in HPLC (3)

7 What is tautomerism? Illustrate tautomerism in CH_3-CO-CH_3 (3)

8 What are conducting polymers? Draw the structure of polyacetylene and polyaniline (3)

9 Calculate the temporary and permanent hardness of water sample having following composition, Ca^{2+}=300 ppm Mg^{2+}= 192 ppm, HCO_3^- = 122 ppm (3)

10 What is COD? How is it determined? (3)

PART B

Answer one full question from each module, each question carries 14 marks.

MODULE 1

11 a What is electrochemical series? Discuss any five applications. (7)

	b	Define conductivity. How cell constant is determined? How conductivity of a water sample is determined?	(7)
12	a	Explain the principle of electroless copper plating and give two applications	(7)
	b	Explain various types of cathodic protection	(7)

MODULE 2

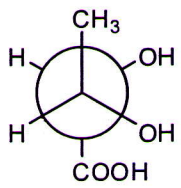
13	a	Write a note on magnetic resonance imaging (MRI). List applications of it in medical diagnosis	(8)
	b	Predict high resolution ^1H NMR spectra of 1-Chloroethane and 2-Chloropropane	(6)
14	a	Define Beer Lambert law and deduce the integrated form. Discuss the plot of absorbance verses concentration, what does the slope of the graph represents?	(8)
	b	The CO molecule absorbs infrared radiation of wavenumber 2154 cm^{-1}. Calculate the force constant of the chemical bond, given that atomic masses of C =12 amu and O=16 amu (Given that 1 amu = 1.66×10^{-27}Kg)	(6)

MODULE 3

15	a	What is thermogravimetric analysis? Explain the instrumentation. Illustrate the thermogram of $CaC_2O_4.H_2O$	(10)
	b	How will you compare thermal stability of polymers from TGA?	(4)
16	a	What is thin layer chromatography? Explain the procedure and visualisation techniques	(7)
	b	What is gas chromatography? Explain the instrumentation and working. What is the importance of temperature programme in GC?	(7)

MODULE 4

17	a	What is optical isomerism and give the condition for optical activity? Explain with an example. How can we distinguish enantiomers based on physical, chemical and biological properties?	(7)
	b	Convert the Newman projection formula into Fischer projection formula and assign R,S notation	(7)



18	a	What is ABS? How it is synthesised? Discuss any two properties and applications.	(7)

	b	What is Kevlar? How is it synthesised? Discuss any two properties and applications.	(7)

MODULE 5

19	a	What are ion exchange resins? Explain ion exchange process used for demineralisation of water. How exhausted resins are regenerated?	(8)
	b	What is reverse osmosis? How is it used for the purification of sea water? Give the advantages	(6)
20	a	Explain primary, secondary and tertiary process involved in sewage water treatment with the help of flow diagram	(10)
	b	100 mL of sewage water sample is diluted to 600 mL with dilution water, the initial dissolved oxygen was 7.4 ppm. The dissolved oxygen level after 5 days of incubation was 3.8 ppm. Find the BOD of the water sample.	(4)

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