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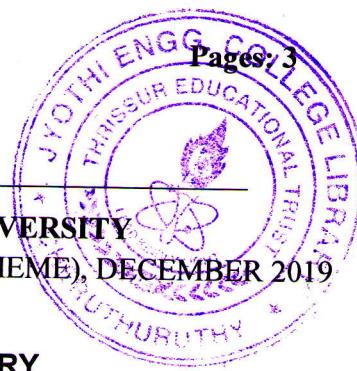
NSA192009

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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION(2019 SCHEME), DECEMBER 2019**

**Course Code: CYT100**

**Course Name: ENGINEERING CHEMISTRY**  
**(2019-Scheme)**

Max. Marks: 100

Duration: 3 Hours

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

- 1 Calculate the equilibrium constant for the following reaction at 25°C:-  
 $\text{Fe}_{(\text{s})} + \text{Cu}^{2+}_{(\text{aq})} = \text{Fe}^{2+}_{(\text{aq})} + \text{Cu}_{(\text{s})}$  Given  $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$ ,  $E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$  (3)
- 2 Give the electrochemical reaction taking place when an iron nail is dipped in dil.HCl.  $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$ ,  $E^0_{\text{Fe}^{3+}/\text{Fe}} = -0.04 \text{ V}$ ,  $E^0_{\text{H}^+/\text{H}_2} = 0 \text{ V}$ . (3)
- 3 State and explain the law governing absorption of electromagnetic radiation by matter. Give any one limitation of this law. (3)
- 4 Which molecule will absorb at longest wavelength in UV? Explain. (3)



- 5 What are the classifications of chromatography based on physical state of mobile and stationary phases? (3)
- 6 Explain the synthesis of nanoparticles by chemical reduction. (3)
- 7 Write the IUPAC name and assign R/S notation. (3)



- 8 Write the different types of copolymers formed by the monomers A and B. (3)
- 9 Calculate the hardness of (i) 0.05 M AlCl<sub>3</sub> and (ii) 0.04 N MgCl<sub>2</sub>. (3)
- 10 What is the significance of measuring BOD of waste water? (3)

**PART B***Answer one full question from each module, each question carries 14 marks***Module-I**

- 11 a) Explain the construction and working of a calomel electrode as a reference electrode. What is the variation in the potential of a calomel electrode with change in chloride ion concentration? (8)

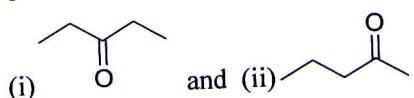
**B**

- b) Why Mg corrodes in both acidic and alkaline oxygen deficient conditions, whereas Fe does not corrode in alkaline oxygen deficient condition? (6)
- $$\text{Mg}^{2+} + 2\text{e} \rightarrow \text{Mg}, E^0 = -2.36 \text{ V}, \text{Fe}^{2+} + 2\text{e} \rightarrow \text{Fe}, E^0 = -0.44 \text{ V}, \text{H}^+ + \text{e} \rightarrow \frac{1}{2}\text{H}_2, E^0 = 0 \text{ V}$$

- 12 a) Write the construction, working and advantages of Li-ion cell. (8)
- b) What are the products of electrolysis at cathode and anode when NaCl solution is electrolysed using Cu electrodes.
- $$\text{Na}^+ + \text{e} \rightarrow \text{Na}, E^0 = -2.71 \text{ V}, \text{Cu}^{2+} + 2\text{e} \rightarrow \text{Cu}, E^0 = 0.34 \text{ V}, \text{Cl}_2 + 2\text{e} \rightarrow 2\text{Cl}^-, E^0 = 1.36 \text{ V}, \text{H}^+ + \text{e} \rightarrow \frac{1}{2}\text{H}_2, E = -0.41 \text{ V} (\text{at pH}=7), \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e} \rightarrow 4\text{OH}^-, E = 0.82 \text{ V} (\text{at pH}=7)$$

**Module-II**

- 13 a) Predict the number of signals, their relative positions and splitting pattern in the nmr spectrum of the following. (8)



- b) Compare the strengths of C-H bond and C=O bond if the absorption frequencies are  $3000\text{cm}^{-1}$  and  $1700\text{ cm}^{-1}$  respectively. (6)
- 14 a) Give the instrumentation of UV spectrophotometer and explain the components in it. Comment on the role of conjugation in the wavelength of absorption with the help of examples. (8)
- b) Briefly explain the principle involved in MRI. Mention any two applications. (6)

**Module-III**

- 15 a) Discuss in detail the Instrumentation of TG and DTA with neat sketch. (8)
- b) Discuss the various detectors used in GC and HPLC. (6)
- 16 a) Briefly explain the principle, instrumentation and applications of SEM. (8)
- b) Differentiate between TGA and DTA. (6)

**Module-IV**

- 17 a) Draw and explain the conformational isomerism in ethane and butane. Draw the energy profile diagram. Which conformer is more stable in each case? (10)
- b) Explain the classification of conducting polymers. (4)
- 18 a) What is meant by conformational isomerism? Draw the *cis* and *trans* isomers of 1,4-dimethyl cyclohexane. In each case, mention the more stable conformer. (8)
- b) Brief out the basic principle, construction and working of OLED. (6)

**Module-V**

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- 19 a) Describe the various steps involved in sewage treatment. (10)  
b) Write any four disadvantages of hard water. (4)
- 20 a) Write the principle and procedure of estimation of permanent and temporary hardness of water by complexometric titration. (8)  
b) 50 mL sewage water sample after reaction with 20 mL of  $K_2Cr_2O_7$  required 12.4 mL of 0.2 N ferrous ammonium sulphate solution. For blank titration 20 mL  $K_2Cr_2O_7$  required 20.4 mL of 0.2 N ferrous ammonium sulphate solution. (6)  
Calculate the COD of the sample.

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019**

**Course Code: CY100**

**Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 2 marks.*

- |   |   | Marks |
|---|---|-------|
| 1 | Which of the following molecules show UV-visible absorption spectrum?   | (2)   |
|   | Explain(a) methane    (b) benzene    (c) 1,3-butadiene    (d) cyclohexene   |       |
| 2 | Calculate the amount of electric energy available from a dry cell which consume 6.55g Zn. given that emf of the cell is 1.5 V and atomic weight of Zn is 65.5 u | (2)   |
| 3 | Explain elution.  | (2)   |
| 4 | What is ABS?  | (2)   |
| 5 | Calculate the HCV of CH <sub>4</sub> using Dulong's formula.  | (2)   |
| 6 | Why graphite can act as a solid lubricant?  | (2)   |
| 7 | Define temporary and permanent hardness of water with examples.   | (2)   |
| 8 | Give the advantages and disadvantages of chlorination of water.   | (2)   |

**PART B**

*Answer all questions, each carries 3 marks.*

- |    |  |     |
|----|--|-----|
| 9  | Sketch the molecular orbital energy diagram of 1,3 butadiene and show HOMO and LUMO transition. What happens to wavelength of absorption maximum when more double bonds come in conjugation? | (3) |
| 10 | What are the functions of a salt bridge?   | (3) |
| 11 | List out the applications of TGA.  | (3) |
| 12 | Sketch OLED display device, Which region (p or n) is emissive layer, why?  | (3) |
| 13 | What are Greases? Where they are used? Give the composition of calcium-based grease and axial grease.  | (3) |
| 14 | Define a chemical fuel. How are they classified? Give suitable examples.   | (3) |
| 15 | Explain the steps involved in the treatment of water for drinking purpose.   | (3) |
| 16 | Define COD and BOD. Why COD is always greater than BOD?  | (3) |

**PART C**

*Answer all questions, each carries 10 marks.*

- |    |  |     |
|----|--|-----|
| 17 | a) State Beer-Lambert's law and derive its integrated form.  | (5) |
| b) | Draw high resolution NMR spectrum of CH <sub>3</sub> -CH <sub>2</sub> -O-CH <sub>2</sub> -CH <sub>3</sub> . Explain the reason for chemical shift and spin-spin splitting pattern. | (5) |

- 18 a) Discuss the number of vibrational modes in HCl, CO<sub>2</sub> and H<sub>2</sub>O molecules, (5)  
sketch them.
- b) Give the expression for vibrational energy of a diatomic molecule, draw the (5)  
energy level diagram.
- 19 a) Derive Nernst's Equation for half-cell and complete cell. (6)
- b) What is a reversible cell? Give one example each for reversible cell and (4)  
irreversible cell.

- 20 a) What is potentiometric titration? How will you follow the end point of an acid (6)  
base titration potentiometrically?
- b) How redox titrations are done potentiometrically? Explain with an example. (4)
- 21 a) Explain the instrumentation and working of TGA with a neat labelled diagram. (5)
- b) Discuss the role of thermo gram in TGA analysis using suitable example. (5)

- 22 a) Explain the principle and instrumentation of gas chromatography with a (5)  
labelled diagram.
- b) Define i) Gas chromatogram ii) Retention time. (3)
- c) Mention the applications of Gas chromatography. (2)
- 23 a) What are carbon nanotubes? Give the classification, What are the important (5)  
properties? Give any two applications.
- b) What is Kevlar? Give two important applications. (5)

- 24 a) What is silicone rubber? How is it prepared? Give any two methods of (6)  
vulcanisation of silicone rubber. Give two important applications.
- b) Give the structure of Kevlar. Show the Hydrogen bonding between the chains. (4)
- 25 a) A sample of coal contains C = 93%, H = 6%, and Ash=1%. The following data (5)  
were obtained when the above coal was tested in Bomb calorimeter. 1) Weight  
of coal burned = 0.92gm 2) Weight of water taken = 2200gm 3) water  
equivalent of Bomb calorimeter = 550gm 4) rise in temperature = 2.42°C 5)  
Fuse wire correction = 10cal 6) Acid correction= 50cal. Calculate the Gross  
and Net calorific value of the coal sample.  
(Latent heat of condensation of steam = 580cal/kg.

- b) Differentiate between vegetable oil and mineral oil lubricants. (5)

- 26 a) Enumerate the important characteristics of good fuel. (5)
- b) How is aniline point determined? Why do we say a higher aniline point is (5)  
desirable for lubricants?

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- 27 a) Describe the process of demineralization of water using ion-exchange resins with equations. (6)  
b) Compare aerobic and anaerobic oxidation of sewage water. (4)

**OR**

- 28 a) Explain the principle and procedures of EDTA method with equations. (6)  
b) 50 ml of a water sample requires 9 ml of an EDTA solution for the titration. 11 ml of the same EDTA solution was required for the titration of 50 ml of standard hard water containing 1 gm of  $\text{CaCO}_3$  per litre. Calculate the hardness of water sample in ppm.

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Reg No.: \_\_\_\_\_

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019**

**Course Code: CY100**

**Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 2 marks.*

- |   |  |     |
|---|--|-----|
| 1 | CHCl <sub>3</sub> protons show a shift in frequency of 728 Hz from TMS signal in a 100MHz NMR instrument, How much would be the shift in frequency for the same proton from TMS in a 300 MHz NMR instrument? | (2) |
| 2 | If you take a mixture of ZnSO <sub>4</sub> and CuSO <sub>4</sub> solutions in a beaker and a Zinc rod and a Copper rod are inserted in it will you get electricity? Give the reason.                         | (2) |
| 3 | Explain partition chromatography   | (2) |
| 4 | What are Carbon nanotubes?   | (2) |
| 5 | Arrange n-heptane, iso-octane, benzene, branched alkanes in increasing order of knocking tendency in petrol engine.  | (2) |
| 6 | Oils having high viscosity need not be having high viscosity index. Comment.   | (2) |
| 7 | A water sample contains 204 mg of CaSO <sub>4</sub> per litre. Calculate its hardness in terms of CaCO <sub>3</sub> equivalents.   | (2) |
| 8 | Define reverse osmosis.  | (2) |

**PART B**

*Answer all questions, each carries 3 marks.*

- |    |  |     |
|----|--|-----|
| 9  | What interpretations are obtained from the chemical shifts in a molecule?  | (3) |
| 10 | A Zn rod is dipped in 0.4 M CuSO <sub>4</sub> solution, displacement reaction takes place and allowed to attain equilibrium. Calculate the equilibrium constant and [Cu <sup>2+</sup> ] at equilibrium. Given that $E^0_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ and $E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ | (3) |
| 11 | Write the major applications of DTA.   | (3) |
| 12 | What are co-polymers? Illustrate with addition co-polymer and condensation co-polymer.   | (3) |
| 13 | Describe with the significance: i) cloud and pour points ii) Flash and fire points.  | (3) |
| 14 | What is mean by aniline point? How is it determined?   | (3) |
| 15 | How is the exhausted resin regenerated from an ion-exchange process?   | (3) |
| 16 | What is disinfection? How is it carried out using (a) UV light and (b)   | (3) |

Chlorination?

### PART C

*Answer all questions, each carries 10 marks.*

- 17 a) Discuss the factors affecting chemical shift. (5)  
 b) Draw the instrumentation of UV-visible spectrometer, explain the various parts. (5)

### OR

- 18 a) How will you distinguish the isomers of  $C_4H_{10}$  using NMR spectroscopy? (5)  
 b) Calculate the force constant of HF molecule, if it shows IR absorption at  $4138\text{ cm}^{-1}$ . Given that atomic masses of hydrogen and fluorine are  $1\text{u}$  and  $19\text{u}$  respectively. What would be the wavenumber if hydrogen atoms are replaced by deuterium atoms? (5)
- 19 a) What are the various types of electrodes? (5)  
 b) Calculate the single electrode potentials of  $H_2$  electrode at  $25\text{ }^{\circ}\text{C}$  and 1 atm pressure when the solution has  $pH=0$  and  $pH = 14$ . Based on this which metal (Al or Fe) can liberate  $H_2$  only from acids? Which metal can liberate  $H_2$  from both acid and alkali? Given that  $E^0 Fe^{2+}/Fe = -0.44\text{ V}$  and  $E^0 Al^{3+}/Al = -1.66\text{ V}$ . (5)

### OR

- 20 a) Discusses the variation in emf of a Daniel cell with respect to temperature at different concentration ratios of  $Zn^{2+}$  and  $Cu^{2+}$  (5)  
 b) A cell reaction is given by  $A + B^{n+} \rightarrow A^{n+} + B$  Calculate the  $E^0_{cell}$  and number of electrons n involved in cell reaction. Given that concentration ratio of  $A^{n+}$  to  $B^{n+}$  is 0.1 and the cell shows an emf of  $1.13006\text{ V}$  at  $30\text{ }^{\circ}\text{C}$  and  $1.13105\text{ V}$  at  $40\text{ }^{\circ}\text{C}$ . (5)
- 21 a) Make a comparison between GSC and GLC. (5)  
 b) Discuss the terms i) Carrier gas ii) columns iii) stationary phase iv) detectors (5)

### OR

- 22 a) Write down the experimental procedures for the measurement of conductivity. (4)  
 b) Describe the terms i) cell constant ii) specific conductance iii) conductivity cell (6)
- 23 a) What is poly pyrrole? How will you synthesise it? (6)  
 b) Which kind of doping is possible (p or n) in poly pyrrole why? Give two properties and applications. (4)

### OR

- 24 a) What is ABS? What are its important properties and applications? (6)

- b) What is Buna-S.? Mention the Historical importance? (4)
- 25 a) A sample of coal contains 60% C, 33% O, 6% H, 0.5% S, 0.2% N, and 0.3% Ash. Calculate the GCV and NCV of coal. (4)
- b) What are greases? Under what conditions they are preferred over a liquid lubricant. (6)

**OR**

- 26 a) What is Natural gas? Distinguish between LNG and CNG. What is the technical difficulty to use LNG fuel in a car? (5)
- b) Calculate the HCV and LCV of ethanol using Dulong's formula. (5)
- 27 a) 100 mL sewage water is diluted to 1000 mL with dilution water; the initial dissolved oxygen was 7.6 ppm, dissolved oxygen level after five days of incubation was 3.2 ppm. Find the BOD of the sewage water. (5)
- b) Compare aerobic and anaerobic oxidation of sewage water. (5)

**OR**

- 28 a) Discuss the steps involved in sewage water treatment. (5)
- b) Explain the working of trickling filter process with a neat labelled sketch. (5)

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Reg No.: \_\_\_\_\_

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**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018**

**Course Code: CY100****Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 2 marks.*

Marks

- |   |  |     |
|---|--|-----|
| 1 | Which of the following molecules can give IR absorption spectrum? Write the condition for IR activity. (a) O <sub>2</sub> (b) H <sub>2</sub> (c) CO    (d) CO <sub>2</sub>   | (2) |
| 2 | An iron nail is dipped in 1 M HCl, what are the redox reactions taking place? Justify it based on the following standard reduction potentials $2H^+ + 2e \rightarrow H_2 E^0 = 0 V$ ; $Fe^{3+} + 3e \rightarrow Fe E^0 = -0.04 V$ ; $Fe^{2+} + 2e \rightarrow Fe E^0 = -0.44V$ | (2) |
| 3 | Draw the thermo gram of Calcium oxalate.   | (2) |
| 4 | What are Copolymers?   | (2) |
| 5 | What are the advantages of liquid fuels over solid and gaseous fuels?  | (2) |
| 6 | What are semi solid lubricants?  | (2) |
| 7 | Dissolved oxygen of a water sample is inversely proportional to its temperature. Justify.  | (2) |
| 8 | In the determination of hardness of water by EDTA method NH <sub>4</sub> OH-NH <sub>4</sub> Cl buffer solution is used. Why?   | (2) |

**PART B***Answer all questions, each carries 3 marks.*

- |    |  |     |
|----|--|-----|
| 9  | A 100 ppm standard solution of Fe <sup>3+</sup> after developing colour with excess ammonium thiocyanate solution shows a transmittance of 0.4 at 622 nm, while an unknown solution of Fe <sup>3+</sup> after developing colour with excess ammonium thiocyanate solution shows a transmittance of 0.6 at same wave length. Calculate the concentration of Fe <sup>3+</sup> in unknown solution. | (3) |
| 10 | Calculate single electrode potential of calomel electrode at 25 °C when the concentration of KCl solution is 0.1M, given that E <sup>0</sup> standard calomel electrode = 0.2810 V.  | (3) |
| 11 | Differentiate TGA and DTA.   | (3) |
| 12 | How do you classify Nanomaterials based on dimensions?   | (3) |

- 13 Explain what are solid lubricants with suitable examples? (3)
- 14 Explain the preparation of Bio-diesel. What are the important constituents of Bio-diesel? (3)
- 15 Plot a diagram of break point chlorination and What is its significance? (3)
- 16 Calculate the carbonate and non carbonate hardness of a sample water containing 7.3 mg/L of  $Mg(HCO_3)_2$ , 40.5 mg/L of  $Ca(HCO_3)_2$ , 13.6 mg/L of  $CaSO_4$ . (3)

**PART C***Answer all questions, each carries 10 marks.*

- 17 a) What are the various types of electronic transitions in UV-visible spectroscopy? (5)  
 b) Discuss the applications of IR spectroscopy. (5)

**OR**

- 18 a) What are the different types of NMR active nuclei? How many spin orientations are possible in a magnetic field when  $I=1/2$  and  $I=1$  give examples. (5)  
 b) Explain the terms shielding and de-shielding in NMR spectroscopy. (5)
- 19 a) What are fuel cells? Explain the construction and working of  $H_2 - O_2$  fuel cell. (6)  
 b) What are the advantages and disadvantages of a fuel cell? (4)

**OR**

- 20 a) What are reference electrodes? Give examples for primary reference and secondary reference electrodes and give their electrode reactions. (6)  
 b) Explain how single electrode potential of Zn electrode is determined? (4)
- 21 a) Write down the principle and instrumentation of DTA with a neat diagram. (5)  
 b) Draw the DTA of calcium oxalate and explain the different reactions. (5)

**OR**

- 22 a) Explain the principle and classification of chromatography. (5)  
 b) Write a note on column chromatography. (5)
- 23 a) Discuss the working of OLED with diagram. Give its two important advantages over conventional display devices. (5)  
 b) How do you synthesise polyaniline, Give two properties and applications. (5)

**OR**

- 24 a) What are conducting polymers? Give the classification. (5)  
 b) How will you dope a conducting polymer? Give the mechanism of conduction in doped polymer. (5)

- 25 Write the working of Bomb calorimeter for the determination of calorific value (10) of a solid fuel with the help of a neat diagram.

**OR**

- 26 a) With the help of a neat labelled diagram, describe the fractional distillation of (5) crude petroleum and name the various products obtained.  
b) What are the major characteristics required for a good lubricating oil? (5)
- 27 a) Explain the working of trickling filter process with a neat labelled sketch. (6)  
b) How is exhausted resins regenerated in an ion-exchange method? (4)

**OR**

- 28 a) Explain reverse osmosis with a labelled figure and mention its advantages and (6) disadvantages.  
b) Discuss the ion-exchange process of softening of water. (4)

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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE EXAMINATION, JULY 2018**

Course Code: CY100

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 2 marks*

- |   |  | Marks |
|---|--|-------|
| 1 | HCl is IR active but N <sub>2</sub> is not. Why?   | (2)   |
| 2 | List out the advantages of fuel cell.  | (2)   |
| 3 | What are the visualisation techniques used in TLC for colourless compounds?  | (2)   |
| 4 | Give the structure of ABS polymer. List two properties.  | (2)   |
| 5 | What are the functions of lubricants?  | (2)   |
| 6 | Indicate the significances of flash and fire points.   | (2)   |
| 7 | A sample of water contains 325 mg of MgSO <sub>4</sub> per litre. Calculate the hardness in terms of CaCO <sub>3</sub> equivalents. (Equivalent weight of MgSO <sub>4</sub> = 60). | (2)   |
| 8 | Briefly explain any one method for disinfection of water.  | (2)   |

**PART B***Answer all questions, each carries 3 marks*

- |    |   |     |
|----|---|-----|
| 9  | Distinguish between absorption spectrum and emission spectrum.  | (3) |
| 10 | Calculate the emf of the following cell, Zn(s)/Zn <sup>2+</sup> (0.3M)//Ag <sup>+</sup> (0.04 M)/Ag(s) at 25°C. Write the cell reaction. The E <sup>0</sup> cell is 1.56 V at 25°C. | (3) |
| 11 | Define retention factor and retention time.   | (3) |
| 12 | Brief out fullerenes. Give two properties.  | (3) |
| 13 | Define Cetane number and indicate its significance.   | (3) |
| 14 | A Sample of coal contains: C = 70%, O = 14.7%, H = 10%, S = 5% and 0.3% ash. Calculate GCV and NCV of coal using Dulong's formula. Given latent heat of steam=587cal/g.             | (3) |
| 15 | What is the principle behind ion exchange process for softening of water?   | (3) |
| 16 | Define COD and comment on the significance of COD.  | (3) |

**PART C***Answer all questions, each carries 10 marks*

- |    |   |     |
|----|---|-----|
| 17 | a) Explain the basic principle and instrumentation of UV-Visible spectroscopy   | (5) |
|    | b) What is meant by spin-spin splitting? Predict the number of signals and splitting pattern of the NMR spectrum of CH <sub>3</sub> CH <sub>2</sub> OH. | (5) |

**OR**

- |    |   |     |
|----|---|-----|
| 18 | a) State Beer-Lambert's law. A solution shows a transmittance of 30%, when taken in a cell of 4 cm thickness. Calculate the concentration of the solution, if the molar absorption coefficient is 3000 dm <sup>3</sup> mol <sup>-1</sup> cm <sup>-1</sup> . | (5) |
|    | b) How many vibrational modes are possible for CO <sub>2</sub> and H <sub>2</sub> O? Sketch the possible vibrational modes for both.  | (5) |
| 19 | a) Explain the working of calomel electrode with a neat sketch.   | (5) |

- b) What is meant by potentiometric titration? Explain the principle of redox titration by potentiometric method. (5)

**OR**

- 20 a) Explain the working of Lithium-ion cell. Give two applications. (5)  
 b) What is meant by single electrode potential? How is electrode potential determined using SHE? (5)
- 21 a) Describe the experimental determination of conductance of an electrolytic solution. (5)  
 b) Explain the working of DTA apparatus with a block diagram. (5)

**OR**

- 22 a) Discuss the principle behind gas chromatography. Write three differences between GSC and GLC. (5)  
 b) Explain the principle of HPLC and draw the schematic diagram of the instrument. (5)
- 23 a) What are conducting polymers? Give the preparation and applications of polyaniline. (5)  
 b) What are carbon nanotubes? How they are classified? List out two applications. (5)

**OR**

- 24 a) Discuss OLED. List out two advantages. (5)  
 b) Explain the classification of nanomaterials based on dimension with examples. (5)  
 Discuss one chemical method for the preparation of nanomaterials.
- 25 a) What do you mean by viscosity index of lubricating oil? How is it determined? (5)  
 b) Define Calorific value of a fuel. Calculate the HCV and LCV of a coal sample from the following data obtained from a bomb calorimeter. Weight of coal = 0.83 g, weight of water in the calorimeter = 2500 g, water equivalent of calorimeter = 470 g, initial temperature = 22 °C and final temperature = 26°C, % of H = 3 and latent heat of steam = 587 cal/g.

**OR**

- 26 a) Give an account of biodiesel. What are the advantages? (5)  
 b) What is grease? Explain the classification of grease. (5)
- 27 a) Comment on different types of hardness. Define two units to express hardness. (5)  
 b) Describe UASB process with a neat sketch. (5)

**OR**

- 28 a) What is desalination of water? Discuss reverse osmosis and its advantages. (5)  
 b) Standard hard water contains 5 g of  $\text{CaCO}_3$  per litre. 20 ml of this solution required 48 ml of EDTA solution for titration. 20 ml of hard water sample required 15 ml of EDTA solution for titration. 20 ml of the same water sample on boiling, filtering etc. required 10 ml of EDTA solution. Calculate the temporary and permanent hardness of water.

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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018**

**Course Code: CY100****Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each question carries 2 marks*

- |  | Marks |
|--|-------|
| 1. How many signals are observed in the $^1\text{H}$ NMR spectrum of $\text{Cl}-\text{CH}_2-\text{CH}_2-\text{Cl}$ ? Substantiate your answer. | (2)   |
| 2. Draw a schematic, neatly labelled diagram of Saturated Calomel Electrode.   | (2)   |
| 3. Define $R_f$ value of a compound.   | (2)   |
| 4. Give any two applications of carbon nanotubes.  | (2)   |
| 5. Suggest any two methods for increasing the octane number of a fuel.   | (2)   |
| 6. Comment on the significance of viscosity index of a lubricant.  | (2)   |
| 7. What are ion exchange resins? Give one example.   | (2)   |
| 8. State the importance of measuring dissolved oxygen in water.  | (2)   |

**PART B***Answer all questions, each question carries 3 marks*

- |   |     |
|---|-----|
| 9. Calculate the molar absorptivity of $0.5 \times 10^{-3}\text{M}$ dye solution in ethanol, which shows an absorbance of 0.17, when 1.3cm cuvette is used. | (3) |
| 10. Describe the principle and working of glass electrode. Give the standard representation.  | (3) |
| 11. List out any three important applications of HPLC.  | (3) |
| 12. Explain the preparation and properties of Kevlar.   | (3) |
| 13. How is aniline point determined?  | (3) |
| 14. What are biofuels? Comment on their environmental benefits.   | (3) |
| 15. Suggest an anaerobic process for the treatment of waste water. Explain the principle.   | (3) |
| 16. Explain temporary hardness of water. How is it removed?   | (3) |

**PART C***Answer all questions, each question carries 10 marks*

- |  |     |
|--|-----|
| 17. a) Sketch the modes of vibrations possible for $\text{CO}_2$ . Which are IR active? Give reason. | (4) |
| b) Explain spin-spin splitting in the $^1\text{H}$ NMR spectrum of ethanol.                          | (6) |

**OR**

- |   |     |
|---|-----|
| 18. a) What are the various electronic transitions possible for a molecule?           | (4) |
| b) Discuss the instrumentation of UV spectroscopy with labelled sketch.               | (6) |
| 19. a) Explain how the single electrode potential of an electrode is determined using | (5) |

**B****B2802****Pages: 2**

standard hydrogen electrode, with a suitable example.

- b) Discuss the working of Li-ion cell with electrode reactions. (5)

**OR**

20. a) Derive Nernst equation for Daniel cell. Explain the significance. (6)  
 b) Calculate the emf of the cell  $\text{Fe}/\text{Fe}^{2+}(0.01)/\text{Ag}^+(0.1)/\text{Ag}$  at 298K if standard electrode potentials of Fe and Ag are -0.42V and 0.8V respectively. (4)
21. a) Illustrate the instrumentation of DTA. Mention the advantages compared to TGA. (6)  
 b) Explain with an example how TG data is used to determine the composition of binary mixtures? (4)

**OR**

22. a) Explain the principle and instrumentation of gas chromatography. (5)  
 b) Interpret the TGA curve of calcium oxalate monohydrate. (5)
23. a) Write a short note on OLED. (5)  
 b) Describe any two methods for the preparation of nanomaterials. (5)

**OR**

24. a) Discuss the structure and properties of BS and ABS. (5)  
 b) Explain the synthesis and applications of silicone rubber. (5)
25. a) Differentiate between: (6)  
 i) Flash point and Fire point ii) Cloud point and Pour point  
 b) On burning 0.95g of a solid fuel (H = 5%) in a bomb calorimeter, the temperature of 700g water increased by 2.48°C. Water equivalent of calorimeter and latent heat of steam are 2000g and 587cal/g respectively. Calculate HCV and LCV.

**OR**

26. a) How lubricants are classified based on physical state? Explain with examples. (7)  
 b) Compare CNG and LNG. (3)
27. a) Detail the principle and advantages of UV disinfection of water. (4)  
 b) Define BOD. How is it determined? Give the significance. (6)

**OR**

28. a) Explain the trickling filter process used in sewage water treatment. (5)  
 b) A water sample from an industry had the following data:  $\text{Mg}(\text{HCO}_3)_2 = 16.8\text{mg/L}$ ,  $\text{MgCl}_2 = 19\text{ mg/L}$ ,  $\text{CaCO}_3 = 20\text{ mg/L}$  and  $\text{MgSO}_4 = 24.0\text{ mg/L}$ . Calculate the temporary, permanent and total hardness of the water sample.

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**B****B7024****Total Pages: 2**

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017**

**Course Code: CY100****Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each question carries 2 marks*

- |   |   |   |
|---|---|---|
| 1 | Calculate the fundamental vibrational frequency HCl molecule, if the value of force constant of the molecule is $483 \text{ Nm}^{-1}$ . The atomic masses are ${}^1\text{H} = 1.673 \times 10^{-27} \text{ kg}$ and ${}^{35}\text{Cl} = 58.06 \times 10^{-27} \text{ kg}$ . | 2 |
| 2 | Represent electrode reactions at different electrodes of a Li –ion cell during discharging.   | 2 |
| 3 | Distinguish between retention factor and retention time in chromatography   | 2 |
| 4 | What is ABS? How is it prepared?  | 2 |
| 5 | Define a) Octane number and b) Cetane number.   | 2 |
| 6 | Calculate the theoretical GCV of a petroleum fuel with composition C= 84%, H= 15% , O= 0.4%, N= 0.3% and S=0.3%   | 2 |
| 7 | Give the principle of reverse osmosis?  | 2 |
| 8 | Calculate the BOD of a water sample containing 75 mg of carbohydrate ( $\text{CH}_2\text{O}$ ) per litre.   | 2 |

**PART B***Answer all questions, each question carries 3 marks*

- |    |   |   |
|----|---|---|
| 9  | State and explain Beer- Lamberts law. Mention any two limitations of the law.   | 3 |
| 10 | A zinc rod is dipped 0.3 M $\text{CuSO}_4$ solution. Displacement reactions take place and allowed to attain equilibrium. Find the equilibrium constant of the reaction. [Given that $E^0_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{V}$ and $E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V}$ .  | 3 |
| 11 | Explain the visualisation techniques in TLC.  | 3 |
| 12 | Explain the synthesis and applications of polypyrrole.  | 3 |
| 13 | On burning 0.75g of fuel in a bomb calorimeter, the temperature of 2000g of water increases from $27.0^\circ\text{C}$ to $29.8^\circ\text{C}$ . The water equivalent of calorimeter and latent heat of steam are 385.0g and 587.0 cal/g respectively. If the fuel contains 0.9% hydrogen, calculate its gross and net calorific values. | 3 |
| 14 | Write a short note on biodiesel.  | 3 |
| 15 | Illustrate break point chlorination with the help of suitable graph. Give any two advantages of break point chlorination.   | 3 |
| 16 | Briefly explain the UASB process for sewage water treatment.  | 3 |

**PART C***Each question carries 10 marks.*

- |       |   |   |
|-------|---|---|
| 17 a) | Outline the principles of IR spectroscopy.                                  | 5 |
| b)    | How will you distinguish ethanol and dimethyl ether using NMR spectroscopy? | 5 |

**B****B7024**

OR

- 18 a) Define chemical shift in NMR spectroscopy. Also explain the factors influencing chemical shift. 5  
 b) Discuss the possible electronic transitions in acetaldehyde. 5
- 19 a) Outline the setting up of a calomel electrode with a neat diagram. 5  
 b) How will you employ the calomel electrode for the determination of electrode potential of copper and zinc? 5

OR

- 20 a) Explain the working and electrode reactions in H<sub>2</sub>-O<sub>2</sub> fuel cells. 5  
 b) Give the procedure for potentiometric estimation of an alkali using a standard acid. 5
- 21 Explain the principles, instrumentation, working and applications of TGA. 10

OR

- 22 Explain the principles, instrumentation, working and applications of HPLC. 10  
 23 a) Briefly outline chemical synthesis of nanoparticles. 5  
 b) What are conducting polymers? Briefly explain their classification. 5

OR

- 24 a) Discuss the classification of nanomaterials. 5  
 b) Outline the preparation, properties and application of silicone rubbers. 5
- 25 Discuss the determination of calorific value of a fuel using a bomb calorimeter. 10

OR

- 26 a) What are lubricants? How are they classified? 5  
 b) Briefly outline following properties of lubricants a) viscosity index b) flash and fire points. 5
- 27 Describe the EDTA method for determination of Hardness of water. 10

OR

- 28 a) What is meant by COD? How it is determined? Explain its significance in sewage treatment. 5  
 b) A sample of water on analysis gave the following results: Ca<sup>2+</sup> = 200 mg/L, Mg<sup>2+</sup> = 180 mg/L, HCO<sub>3</sub><sup>-</sup> = 360 mg/L, Na<sup>+</sup> = 80 mg/L and Cl<sup>-</sup> = 200 mg/L. Calculate the temporary, permanent and total hardness of the sample. 5

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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017**

Course Code: CY100

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 2 marks.*

- 1 Which of the following nuclei do not show NMR spectrum? why?  
<sup>1</sup>H, <sup>12</sup>C, <sup>19</sup>F, <sup>16</sup>O, <sup>14</sup>N
- 2 Calculate the equilibrium constant for the reaction, Zn + Cd<sup>2+</sup> (aq) ⇌ Zn<sup>2+</sup>(aq) + Cd, E<sub>0</sub> cell is 0.36V at 25°C
- 3 What is meant by R<sub>f</sub> in chromatography? What is its use?
- 4 What is ABS polymer? Give two important uses.
- 5 Write two advantages of CNG over gasoline.
- 6 What is the need of determining aniline point of a lubricant?
- 7 Distinguish between carbonate hardness and non-carbonate hardness of water.
- 8 Why is hardness of water expressed in terms of CaCO<sub>3</sub> equivalent?

**PART B***Answer all questions, each carries 3 marks.*

- 9 List the electronic transitions possible when UV light is absorbed by the following molecules.  
i) CH<sub>4</sub>      ii) CH<sub>3</sub>Cl      iii) HCHO
- 10 You are provided with a zinc container and silver container. Which container can be used to store CuSO<sub>4</sub> solution? Give reason with proper chemical explanation.
- 11 A conductivity cell is found to have two parallel plates of area 1.5cm<sup>2</sup> kept at 9.8cm apart. It gives a resistance 1500ohm when filled with the electrolytic solution. Find the cell constant and conductivity of the solution.
- 12 How is silicone rubber prepared from dimethyl silicon chloride? Write the chemical reaction and two uses of silicone rubber.
- 13 Explain why graphite is employed as a lubricant.
- 14 What is the principle involved in the determination of calorific value of a solid fuel using bomb calorimeter?
- 15 What is brackish water? Explain the procedure for converting brackish water into pure water?
- 16 A water sample contains 272mg CaSO<sub>4</sub> per litre. Calculate the hardness in terms of CaCO<sub>3</sub> equivalent.

**PART C***Each question carries 10 marks.*

- 17 a) Predict the number of signals in the NMR spectrum of the following compounds? (4)  
i) Cyclobutane ii) 1,2-Dichloro ethane iii) 2-Chloropropane iv) Vinyl chloride

- b) Draw the structure of the following compounds satisfying the given NMR (6) spectral data: -

- i)  $C_3H_7Cl$  – one doublet (6H) and one septet (1H)  
ii)  $C_4H_{10}O$  – one singlet (3H), one doublet (6H) and one septet (1H)

**OR**

- 18 a) a) Write the principle behind IR spectroscopy b) How will you distinguish (5) between intermolecular and intramolecular hydrogen bonding using IR spectroscopy?

- b) What are the different kinds of electronic transitions possible in organic (5) molecules? Give two applications of UV-Visible spectroscopy.

- 19 a) Calculate the potential of a Cu electrode dipped in 0.206M  $CuSO_4$  solution at  $24^0$  (4) C.  $E^0_{Cu}is$  0.34 V.

- b) Explain the working of  $H_2-O_2$  fuel cell with a neat diagram (6)

**OR**

- 20 a) How can the standard electrode potential of Zn electrode be measured using a (5) saturated calomel electrode? Draw the experimental set up for this.

- b) Explain the working of Li ion battery. Write the electrode reactions. (5)

- 21 Write the principle and instrumentation of TGA and HPLC. (10)

**OR**

- 22 a) Describe the following: - (6)  
i) Retention volume ii) Retention time iii) Elution in chromatography.

- b) List out two applications of DTA and TGA. - (4)

- 23 a) Explain the chemical synthesis of poly aniline. Write three applications of poly (5) aniline.

- b) What is Kevlar? Explain the exceptional properties of Kevlar based on the (5) structure.

**OR**

- 24 a) What are carbon nanotubes? How are they classified? Give two applications. (5)

- b) Explain the following methods for the preparation of nanomaterials: - (5)

- i) Hydrolysis ii) Reduction

- 25 a) Give the composition, properties and advantages of natural gas. (4)

- b) Write a short note on knocking of liquid fuels. (6)

**OR**

- 26 Describe any five properties of lubricants with their significance. (10)

- 27 a) Explain ion-exchange process of softening water. (7)

- b) Write three differences between aerobic oxidation and anaerobic oxidation of (3) sewage.

**OR**

- 28 100ml water sample required 13.5ml 0.02M EDTA solution for hardness (10) estimation. Another 100ml water sample from the same source was boiled and removed precipitate by filtration. This filtrate required 6ml 0.02M EDTA for titration. Calculate total hardness, permanent hardness and temporary hardness of water sample.

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Reg. No. \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**SECOND SEMESTER B.TECII DEGREE EXAMINATION, MAY 2017**

Course Code: CY100

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each question carries 2 marks.*

1. Chemical shift value of methyl chloride is lower compared to that of methyl fluoride. Why?
2. Can a Ni spatula be used to stir CuSO<sub>4</sub> solution? Give reason.  
 $E^{\circ}_{Ni} = -0.23V$ ,  $E^{\circ}_{Cu} = 0.34V$
3. Why TLC is superior to column chromatography for checking purity of a compound?
4. List out the advantages of OLEDs.
5. Write the chemical transformation of a vegetable oil to biodiesel.
6. Distinguish between flash point and fire point of a lubricant.
7. Calculate the hardness of a solution obtained by mixing 100ml 0.02M CaCl<sub>2</sub> and 200ml 0.02M MgSO<sub>4</sub> solutions.
8. What is the chemistry behind the removal of temporary hardness by boiling?

**PART B***Answer all questions, each question carries 3 marks.*

9. List all the electronic transitions possible for CH<sub>3</sub>Cl and HCHO.
10. Derive an expression connecting electrolytic concentration to electrode potential.
11. Compare HPLC and column chromatography.
12. Brief out the preparation of silicones.
13. Calculate GCV and NCV of butane using Dulong's formula.
14. Based on the structure comment on the lubricating action of graphite.
15. Outline a process by which sea water can be made fit for domestic applications.
16. BOD is an index of organic load in waste water. Justify.

**PART C***Each question carries 10 marks.*

17. (a) Predict the splitting pattern in the nmr spectra of CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>3</sub> and CH<sub>3</sub>CHCl<sub>2</sub>.  
(b) The fundamental vibrational frequency of carbon monoxide (<sup>12</sup>C<sup>16</sup>O) is 2140 cm<sup>-1</sup>. Without calculating force constant, find the fundamental frequency of <sup>13</sup>C<sup>17</sup>O in cm<sup>-1</sup>. [5+5]

**OR**

18. (a) Which among the following molecules will give n→π\* transition.  
C<sub>2</sub>H<sub>6</sub>, CH<sub>3</sub>CHO, C<sub>6</sub>H<sub>5</sub>CONH<sub>2</sub>, C<sub>2</sub>H<sub>5</sub>OH, C<sub>2</sub>H<sub>4</sub>. Rationalize your answer.  
(b) Briefly explain chemical shift and factors affecting it. [5+5]

19. (a)  $O_2 + 4H^+ + 4e \rightarrow 2 H_2O$ ;  $E^\circ = 1.23V$ . Find the electrode potential for pH=0 and pH=14. Based on this, suggest the condition, (O<sub>2</sub> rich acidic or O<sub>2</sub> rich basic), leading to the faster oxidation of Fe. Also given  $Fe^{2+} + 2e \rightarrow Fe$ ;  $E^\circ = -0.44V$ .  
 (b) Describe the working and advantages of H<sub>2</sub>-O<sub>2</sub> fuel cell. [5+5]

**OR**

20. (a) How can you estimate an acid using standard alkali with the help of a potentiometer.  
 (b) Explain the working of a calomel electrode. [5+5]
21. (a) Compare the instrumentation and thermo grams of thermo gravimetric and differential thermal analyses.  
 (b) What are the various steps involved in column chromatography? [5+5]

**OR**

22. (a) Write down the major applications of TGA and DTA.  
 (b) Detail the chromatographic technique used for the separation of components in a volatile organic mixture. [5+5]
23. (a) Write the preparation and important properties of Kevlar and ABS.  
 (b) Describe two chemical methods of preparation of nanomaterials. [5+5]

**OR**

24. (a) Polypyrrole is a conducting polymer. Substantiate using its structure. Give the preparation and applications of polypyrrole.  
 (b) Discuss carbon nanotubes. [5+5]
25. (a) Explain knocking in petrol engine and define the term used to express antiknocking ability of fuels.  
 (b) What are greases? Which are the different types? Under what condition, greases are preferred to liquid lubricants? [5+5]

**OR**

26. Describe the principle and working of a Bomb Calorimeter and arrive at an expression for finding HCV of a solid fuel. [10]
27. (a) Explain the principle and calculations in EDTA method for estimating hardness of a given sample of water.  
 (b) With the help of a neat diagram, briefly explain one aerobic process of sewage treatment. [5+5]

**OR**

28. (a) Explain the action of Cl<sub>2</sub> as a disinfectant. Mention the merits of breakpoint chlorination.  
 (b) In an EDTA experiment, the following values are obtained. Calculate the different types of hardness.  
 i) 20ml standard hard water (10g CaCO<sub>3</sub> per litre) = 25ml EDTA solution  
 ii) 50ml hard water sample = 25ml EDTA solution  
 iii) 50ml boiled water sample = 14ml EDTA solution [5+5]

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**B****B1B006**

Reg. No. \_\_\_\_\_

**Total Pages:3**

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017**

Course Code: **CY 100**  
Course Name: **ENGINEERING CHEMISTRY**

Max.Marks : 100

Duration: 3 Hours

**PART-A**

*Answer all Questions. Each question carries 2 marks.*

1. Which of the following molecules can give IR absorption? Give reason.  
a) O<sub>2</sub> b) HCl c) N<sub>2</sub> d) CO<sub>2</sub>
2. What do you mean by single electrode potential?
3. The Specific conductance of a decinormal solution of KCl at 18°C is 0.0112 ohm<sup>-1</sup>cm<sup>-1</sup>. The resistance of the cell containing the solution at 18°C was found to be 55 Ω. What is cell constant?
4. What is Poly aniline? Give its Structure.
5. What is Octane number?
6. Define Viscosity index.
7. Calculate the hardness of 0.05M CaCl<sub>2</sub> solution.
8. What do you understand by hard water and soft water? Give the causes of hardness.

**PART-B**

*Answer all Questions. Each question carries 3marks.*

9. The fundamental vibrational frequency of CO is 2140cm<sup>-1</sup>. Calculate force constant of the bonds if reduced mass of CO is  $1.14 \times 10^{-26}$  Kg.
10. What is electrochemical series? Give its two applications.
11. What are the methods employed for visualization of spots in TLC
12. Write the structural formula of the following polymers  
i) Kevlar ii ) Polybutadiene iii) ABS
13. What is Biodiesel? How it is prepared? Give its two advantages.
14. Explain the following i) Aniline point ii) Flash point
15. Explain breakpoint of chlorination.
16. Differentiate between aerobic and anaerobic oxidation.

**PART-C**

17. a) Explain Spin-Spin splitting .Write the splitting pattern in the NMR spectrum of  $\text{CH}_2\text{Cl}-\text{CH}_2-\text{CH}_2\text{Cl}$ .  
b) Explain the various modes of vibrations possible for  $\text{H}_2\text{O}$ . Which of them are IR active? Give reasons.  
c) A solution shows a transmittance of 20 % when taken in a cell of 2.5cm thickness.Calculate its concentration if the molar absorption coefficient is  $12000 \text{ dm}^2\text{mol}^{-1}$  (4+3+3)

**OR**

18. a) What is Chemical Shift? Explain Shielding and Deshielding  
b) Give a neat labelled sketch of UV-Visible Spectrometer.

(6+4)

19. a) Explain the Construction and Working of Lithium ion cell  
b) Explain with a suitable example, the variation of EMF of a cell with temperature.  
c) Derive Nernst equation for electrode potential. (5+2+3)

**OR**

20. a) Potential of  $\text{H}_2$  electrode set up in an acid solution of unknown strength is 0.295 volts at  $25^\circ\text{C}$  when coupled with SHE.Find the pH of the solution.  
b) What do you mean by potentiometric titrations? Explain the principle of Redox titration by potentiometric method.  
c) Write the electrode reaction and expression for electrode potential of the following electrodes.

- i) Metal- Metal ion electrode                           ii) Gas electrode  
iii) Redox electrode   (2+5+3)

21. a) What is thermal analysis? List two techniques of it. Compare their principles.  
b) Explain the principle, instrumentation and application of HPLC. (5+5)

**OR**

22. a) Differentiate between DTA thermogram and TGA thermogram graphically. Give one important application of each type.  
b) State the Principle, Instrumentation and Applications of GC. (5+5)
23. a) What is Silicon rubber?How it is prepared? List two important applications.  
b) Write notes on fullerenes.

**B**

**B1B006**

**Total Pages:3**

- c) What are carbon nanotubes? How are they classified? State their two applications. (4+3+3)

**OR**

24. a) What are conducting polymers? Write the structure of two conducting polymers and give their method of preparation.  
b) Write a note on OLED.  
c) What are copolymers? Give two examples. (5+3+2)

25. a) Explain knocking of Diesel.

- b) On burning 0.83 g of a solid fuel in a bomb calorimeter, the temperature of 3500g of water increased from 26.5 to 29.2°C. Water equivalent of calorimeter and latent heat of steam are 385g and 587cal/g respectively. If the fuel contains 0.7% hydrogen calculate HCV and LCV of the fuel.  
c) Distinguish between Flash and Fire point and write their significance. (3+4+3)

**OR**

26. a) Describe how calorific value of a fuel is determined using a Bomb Calorimeter experiment.  
b) Distinguish between HCV and LCV and derive the relation between them. (5+5)
27. a) Describe EDTA method for the estimation of hardness of water.  
b) 1.0 g of  $\text{CaCO}_3$  was dissolved in HCl and diluted to 1 litre. 50ml of this standard hard water requires 48 ml of EDTA while 50 ml of hard water sample requires 15ml of EDTA. On the other hand 50ml of boiled hard water sample requires 10ml of EDTA solution. Calculate total, temporary and permanent hardness of water. (5+5)

**OR**

28. a) With the help of a neat diagram explain the Reverse Osmosis process.  
b) Explain Trickling filter process.  
c) A water sample contains  $\text{Ca}(\text{HCO}_3)_2 = 6.48 \text{ ppm}$ ,  $\text{CaSO}_4 = 8.16 \text{ ppm}$ ,  $\text{MgSO}_4 = 6 \text{ ppm}$ . Find its temporary and permanent hardness.  
(At. Wt. of Ca=40, Mg=24, C=12, S=32, O=16, H=1) (4+3+3)

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE SPECIAL EXAMINATION, AUGUST 2016**

**Course Code: CY100**

**Course Name: ENGINEERING CHEMISTRY**

**Max. Marks: 100**

**Duration: 3 Hours**

**PART A**

**Answer all questions, each question carries 2 marks**

1. How many modes of vibrations are there in water molecule? State whether all are IR active?
2. Calculate the amount of electrical energy available from a dry cell corresponding to the consumption of 6.55g zinc metal ( cell emf= 1.5V ,atomic wt. of Zn = 65.5 )
3. Differentiate between the terms retention time and retention factor used in chromatography.
4. Write down the structures of BS and Kevlar.
5. Lubricants with higher aniline point are desirable. Why?
6. What is natural gas? Give its approximate composition.
7. What is the role of NH<sub>3</sub>-NH<sub>4</sub>Cl buffer solution in the determination of hardness of water by EDTA method?
8. The dissolved oxygen content of a sample of water is low. What comments you can make about the water quality?

**PART B**

**Answer all questions, each question carries 3 marks**

9. Why is TMS taken as reference to determine chemical shift value in NMR spectroscopy?
10. Draw a well labelled diagram of calomel electrode. Write down the electrode representation.
11. What are the methods used for visualisation of spots in TLC?
12. Carbon nano materials are promising materials in electronics and reinforcing field. Justify the statement.
13. A sample of fuel was found to have the following percentage composition.C-72%, H-8.2%, O- 12%, N-3.3% and ash 4.5%. Calculate HCV and LCV of coal sample.
14. What is biodiesel? Write any three advantages of the fuel.
15. Why chloramine is a better disinfectant than chlorine?
16. Write a note on sewage water treatment by USAB process.

## PART C

**Each question carries 10 marks**

17. (a) Write the mathematical representation of the law governing absorption of light by molecules of a solution. A dye solution of concentration 0.05M shows an absorbance of 0.055 at 540nm while a test solution of the same has an absorbance of 0.025 under same conditions. Calculate concentration of test solution.
- (b) What is meant by the term shielding in NMR spectroscopy? Arrange the  $\text{CH}_3\text{F}$ ,  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_3\text{Br}$  and  $\text{CH}_3\text{I}$  in the increasing order of shielding effect. Give the reason for your answer.
- (c) Give the reason for high  $\delta$ -value of aromatic protons. (3+3+4)

**OR**

18. (a) Define IR spectrum. Why  $\text{HCl}$  is IR active, but hydrogen molecule is not. Write the reason for the statement.
- (b) What is meant by spin-spin coupling in NMR spectroscopy? Predict the different types of protons, the number of signals and the ratio of area of peaks in the NMR spectrum of  $\text{CH}_3\text{-O-CH}_2\text{-CH}_3$
- (c) What is MRI? How is it useful in the field of medicine? (3+4+3)

19. (a) Write the half-cell reactions when a Li - ion cell acts as an electrolytic cell.
- (b) Sketch the electrochemical cell, write the cell reactions of the following cell:  $\text{Cd(s)} \mid \text{CdSO}_4(0.01\text{M}) \parallel \text{CuSO}_4(0.5\text{M}) \mid \text{Cu(s)}$ . Calculate the emf of the cell at  $25^\circ\text{C}$  if the  $E^0$  cell is 0.38V.
- (c) What are the functions of a salt bridge? (4+3+3)

**OR**

20. (a) Write the construction and working of a hydrogen oxygen fuel cell.
- (b) A hydrogen electrode is immersed in a solution of pH 4.9 and is coupled with SHE. Calculate the emf of the cell? (7+3)
21. (a) What is HPLC? Give its principle.
- (b) Give a well labelled diagram of HPLC.
- (c) List two applications of HPLC.
- (d) How does HPLC differ from GC? (3+3+2+2)

**OR**

22. (a) Give the principle of DTA.
- (b) Give a neat labelled diagram of DTA apparatus.
- (c) List applications of DTA. (3+3+4)
23. (a) What are nano materials? How are they classified based on dimension? Give one example for each type.

(b) Write the main difference between intrinsically conducting polymers and extrinsically conducting polymers. List two advantages of using conducting polymers instead of metals.

(4+6)

OR

24. (a) What are conducting polymers? Write the structure of two conducting polymers with their respective monomers.

(b) What is OLED? Give an example.

(c) Write three advantages of OLED display?

(4+3+3)

25. (a) Distinguish between (i) cloud point and pour point and (ii) flash point and fire point. Write the significance of these terms of lubricating oil.

(b) Write the working of a Bomb calorimeter for the determination of calorific value of a solid fuel with a neat diagram.

(5+5)

OR

26. (a) Write a note on liquid lubricants.

(b) Differentiate between oil dag and aquadag? Mention their applications.

(c) What is meant by knocking of petrol? Arrange the following compounds benzene, n-hexane and cyclohexane in the increasing order of knocking tendency. Reason your answer.

(4+3+3)

27. (a) Water for use in a hospital has to be disinfected. An ozone plant and a chlorination plant are under consideration. What are the advantages and disadvantages of the suggested methods?

(b) Calculate the temporary and permanent hardness of a sample of water containing  $Mg(HCO_3)_2$ -10mg/L,  $Ca(HCO_3)_2$ -10mg/L,  $CaSO_4$ -12mg/L and  $MgSO_4$ -14mg/L

(c) Correlate COD and BOD. Give the significance of BOD in water analysis.

(4+3+3)

OR

28. (a) Name the indicator used in EDTA titration for estimation of hardness of water. How does it act?

(b) An advertisement of a water purifier mentions that it uses an ion exchange resin capsule, activated carbon and UV light for purification of water. How does each of these help in the purification of water?

(c) 25 mL of standard hard water containing 1 mg of pure  $CaCO_3$  per mL consumed 10 mL of EDTA. 25 mL of water sample consumed 12.5 ml of the same EDTA solution. Calculate the total hardness of water sample in ppm.

(3+3+4)

10010

Reg. No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**FIRST/SECOND SEMESTER B.TECH DEGREE EXAMINATION, JULY 2016**  
**Course Code: CY100**  
**Course Name: ENGINEERING CHEMISTRY**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each question carries 2 marks*

1. Which of the following molecule can give an IR spectrum? Give reason. (a)H<sub>2</sub> (b) N<sub>2</sub> (c) HCl (d) Cl<sub>2</sub>
2. What are redox electrodes? Indicate the electrode reaction and electrode potential with a suitable example.
3. Distinguish between the terms conductance and specific conductance.
4. What is Kevlar? Mention its two important properties.
5. Differentiate between HCV and LCV.
6. How does graphite acts as a lubricant?
7. In the deionisation process water is first passed through cation exchanger and then through anion exchanger. Why?
8. A water sample contains 204 mg of CaSO<sub>4</sub> per litre. Calculate the hardness in terms of CaCO<sub>3</sub> equivalent?

**PART B***Answer all questions, each question carries 3 marks*

9. Derive Beer-Lambert's law.
10. Write the origin of electrode potential. Electrode potential of zinc is assigned a negative value, whereas that of copper a positive value. Give reason.
11. What do you mean by R<sub>f</sub> value in chromatography? Give the use of the term in the technique.
12. Give the structure and any two properties of ABS.
13. What are the advantages of liquid fuels over solid fuels?
14. What is the significance of viscosity index of a lubricant? How can you calculate it?
15. How BOD differs from COD?
16. What do you understand by hardness of water? Distinguish between temporary and permanent hardness of water.

## PART C

*Each question carries 10 marks*

17. (a) State the principle of vibrational (IR) spectroscopy. Arrange the following bonds in the order of increasing stretching frequencies C-C, C=C and C≡C; Write suitable explanation for your answer. (5)
- (b) What is spin-spin splitting? Write the splitting pattern in the NMR spectrum of CH<sub>2</sub>Cl-CH<sub>2</sub>-CH<sub>2</sub>Cl. (3)
- (c) Write two important applications of electronic spectroscopy. (2)

## **OR**

18. (a) Explain the principle of NMR spectroscopy. Which of the following nuclei can have a presence in NMR spectrum? (i)  $^{16}_8\text{O}$  (ii)  $^{13}_6\text{C}$  (iii)  $^2_1\text{H}$ . Reason for your answer. (4)
- (b) Define chemical shift. Interpret the number of signals, the position of signals and the intensity of signals in the NMR spectrum of CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>Cl. (4)
- (c) Most absorption bands in the electronic spectra are very broad. Give reason. (2)
19. (a) How is a calomel electrode constructed? Sketch the electrode. (4)
- (b) Give the working principle of H<sub>2</sub>-O<sub>2</sub> fuel cell with cell reactions. (4)
- (c) A hydrogen electrode at 25°C is immersed in a solution of pH 2.5 and coupled with the half-cell SHE. Calculate the emf of the cell. (2)

## **OR**

20. (a) How does a lithium-ion cell work? Write the cell reactions. (4)
- (b) Calculate the emf of the following cell at 25 °C;  
 $\text{Zn} \mid \text{Zn}^{2+}(a=0.0004) \parallel \text{Cd}^{2+}(a=0.2) \mid \text{Cd}$  ;  
 Given  $E^\circ \text{Zn}^{2+} \mid \text{Zn} = -0.76 \text{ V}$  ;  $E^\circ \text{Cd}^{2+} \mid \text{Cd} = -0.403 \text{ V}$  (3)
- (c) Give the principle of acid-base titration by potentiometry. (3)
21. (a) Draw the block diagram of TGA apparatus. (4)
- (b) State the principle and applications of GC. (4)
- (c) Write the demerits of TGA. (2)

## **OR**

22. (a) What is the basic principle of thermo gravimetric analysis? List its important applications.
- (b) Write experimental arrangement and procedure for measuring conductance of an electrolytic solution.
- (c) List important applications of TLC. (3+4+3)
23. (a) How is polyaniline synthesised? Mention two applications of polyaniline.
- (b) Write a note on OLED.

(c) What is silicone rubber? List two important properties of silicone rubber. (4+3+3)

OR

24. (a) What are carbon nanotubes?

(b) Write the characteristic properties of carbon nano tubes.

(c) What are fullerenes? List two applications of fullerenes. (4+3+3)

25. (a) 0.72g of a fuel containing 80% C, when burnt in a bomb calorimeter increased the temperature of water from 27.3 to 29.1°C. If the calorimeter contains 250g of water and its water equivalent is 150g, calculate the HCV of the fuel.

(b) Write a method of preparation of biodiesel. What are its merits and demerits?

(c) Distinguish between flash and fire points, write the significance of the terms in the selection of a lubricant. (3+3+4)

OR

26. (a) What do you mean by a lubricant? Write its functions.

(b) Calculate gross and net calorific value of a fuel having following composition 82% C, 8% H, 5% O, 2.5% S, 1.4% N and 2.1% ash.

(c) What is knocking? Mention disadvantages of knocking. (3+4+3)

27. (a) How is reverse osmosis process applied in the desalination of brackish water? Mention the advantages of the process.

(b) What is the principle of EDTA method? 0.30 g of  $\text{CaCO}_3$  was dissolved in HCl and the solution was made to one litre with distilled water. 100 mL of the above solution required 30 mL of EDTA solution. 100 mL of hard water required 33mL of the EDTA solution on titration. After boiling 100 mL of this water required 10 mL of EDTA solution. Calculate temporary and permanent hardness of water. (5+5)

OR

28. (a) How is UASB process useful in waste water treatment?

(b) What are the factors which govern the amount of dissolved oxygen in water?

(c) A sample of water is found to contain 16.2mg/L calcium bicarbonate, 7.3mg/L magnesium bicarbonate, 9.5mg/L magnesium chloride, and 13.6mg/L calcium sulphate. Calculate temporary and permanent hardness? What happen to the temporary and permanent hardness of the water sample if 10.6mg/L  $\text{Na}_2\text{CO}_3$  is added? (4+3+3)



Reg. No. :

Name :

SECOND SEMESTER B.TECH. DEGREE EXAMINATION, MAY/JUNE 2016

Course Code : CY100

Course Name : ENGINEERING CHEMISTRY

Max. Marks : 100

Duration : 3 Hours

## PART – A

Answer all questions, each question carries 2 marks.

1. Which of the following nuclei can give NMR spectrum ? Give reason.  
 a)  $^1H$       b)  $^{12}_6C$       c)  $^{19}_9F$       d)  $^{16}_8O$
2. At  $25^\circ C$  the standard emf of a cell having reaction involving two electron charge is found to be 0.295 V. Calculate the equilibrium constant of the reaction.
3. The specific conductivity of N/50 KCl solution at  $25^\circ C$  is  $0.0002765 \text{ ohm}^{-1} \text{ cm}^{-1}$ . If the resistance of the cell containing this solution is 500 ohm, what is the cell constant ?
4. What are co-polymers ? Give an example.
5. Distinguish between gross and net calorific values of fuel.
6. What is meant by cetane value of a diesel fuel ?
7. Hard water will not give a ready lather with soap solution. Give the chemical explanation.
8. Why do we express hardness of water in terms of  $\text{CaCO}_3$  equivalent ?

(8x2=16 Marks)

## PART – B

Answer all questions, each question carries 3 marks.

9. The vibrational frequency of HCl molecule is  $2886\text{cm}^{-1}$ . Calculate the force constant of the molecule. Reduced mass of HCl is  $1.63 \times 10^{-27} \text{ kg}$ .

P.T.O.



10. What is meant by potentiometric titrations ? Mention two merits of potentiometric titrations.
11. Give the principle of column chromatography. List the various steps to be undertaken in this method.
12. Draw the structure of bifunctional silicon chloride. How silicone rubber prepared from it ?
13. An oil of unknown viscosity-index has a Saybolt universal viscosity of 58 seconds at 210°F and of 580 seconds at 100°F. The high viscosity index standard (Pennsylvanian) oil has Saybolt viscosity of 58 seconds at 210°F and 430 seconds at 100°F. The low viscosity index standard (Gulf oil) has a Saybolt universal viscosity of 58 seconds at 210°F and 780 seconds at 100°F. Calculate the viscosity index of oil sample.
14. What is natural gas ? Distinguish between LNG and CNG.
15. What is disinfection ? Give the advantages and disadvantages of UV disinfection of water.
16. A sample of water on analysis gives following results.  $\text{Ca}^{2+} = 320 \text{ mg/L}$ ,  $\text{Mg}^{2+} = 72 \text{ mg/L}$ ,  $\text{HCO}_3^- = 610 \text{ mg/L}$ ,  $\text{Cl}^- = 355 \text{ mg/L}$  and  $\text{Na}^+ = 23 \text{ mg/L}$ . Calculate the temporary and permanent hardness of water sample. **(8x3=24 Marks)**

### PART – C

**Each question carries 10 marks.**

17. a) How can you distinguish NMR spectrum of  $\text{CH}_3\text{CH}_2\text{Cl}$  and  $\text{CH}_3\text{CHCl}_2$  applying the concept of spin-spin splitting ?
- b) Which of the following molecules show UV-visible absorption ? Give reason  
 (i) ethane (ii) butadiene (iii) benzene (iv) phenol
- c) What is a spectrometer ? Write the principal components of UV-visible spectrometer. **(3+3+4)**

OR

18. a) Predict NMR spectrum of  $\text{CH}_3 - \text{CHCl} - \text{CH}_3$ .
- b) Write the theory of vibrational spectroscopy.
- c) Sketch the various modes of vibrations possible for  $\text{CO}_2$ . Which are IR active ? Write reason for your answer. **(3+2+5)**



19. a) What is meant by standard electrode potential ? How would you measure the single electrode potential of an electrode using a saturated calomel electrode ?  
b) Find the single electrode potential for copper metal in contact with 0.1 M Cu<sup>2+</sup> solution at 298 K. E<sup>0</sup> Cu<sup>2+</sup>/Cu = 0.34 V  
c) How is glass electrode constructed ? What is its use ? (4+2+4)

OR

20. a) Write electrode reaction and expression for the electrode potential of following electrodes :  
i) Metal-metal ion electrode  
ii) Gas electrode  
iii) Metal-metal insoluble salt electrode  
iv) Redox electrode.  
b) How will you explain the working of H<sub>2</sub> – O<sub>2</sub> fuel cell ? Draw a neat labelled diagram of the cell. (4+6)

21. a) What is thermal analysis ? List two techniques of it. Compare their principles.  
b) Write the basic components of a gas chromatographic instrument. Draw the diagram of a gas chromatograph. (6+4)

OR

22. a) Write the procedure for doing column chromatography.  
b) What is HPLC ? Draw a labelled diagram of HPLC instrument. Write its two important applications. (5+5)

23. a) What are conducting polymers ? Write the structure of two conducting polymers.  
b) Write a note on structure and applications of fullerene.  
c) Write a note on biological nanomaterials. (3+4+3)

OR

24. a) What are carbon nanotubes ? How are they classified ? State their two applications.  
b) Write the structure and two applications of Kevlar. (6+4)



25. a) Differentiate between vegetable oil and mineral oil lubricants.  
b) Write the working of a Bomb calorimeter for determining the calorific value of a solid fuel with the help of a neat diagram. (3+7)

OR

26. a) What are lubricants ? How are they classified on the basis of their physical state ? What are their important functions ?  
b) Write any four desirable properties of a lubricant and indicate the significance of the properties. (5+5)
27. a) What is the main purpose of secondary sewage water treatment ? Explain trickling filter process.  
b) What is desalination ? How is it performed by reverse process ? (5+5)

OR

28. a) How is UASB process useful in waste water treatment ?  
b) What are the factors which governs the amount of dissolved oxygen in water ? (5+5)

Reg. No.: \_\_\_\_\_

FIRST SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2016

Course Code: CY100

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100

Duration: 3 Hours

**Part A**

*Answer all questions, each question carries 2 marks*

1. The absorbance of a 0.01M dye solution in ethanol is 0.62 in a 2cm cell for light of wavelength 5000  $\text{\AA}^0$ . If the path length of light through the sample is doubled and the concentration is made half, what will be the value of absorbance?
2. A zinc wire is dipped in silver nitrate solution taken in beaker A and a silver wire is dipped in zinc sulphate solution taken in beaker B. Predict in which beaker the ions present will get reduced. Given that the standard reduction potential of zinc and silver are -0.76V and 0.80V respectively.
3. Write the essential components of gas chromatography equipment.
4. What is poly aniline? Give its structure and two applications.
5. What is cetane number?
6. Write two examples of solid lubricants. Compare their structure.
7. Hard water does not produce much lather with soaps or detergents. Give reason.
8. Write the significance of BOD.

(8 x 2 = 16 Marks)

**Part B**

*Answer all questions, each question carries 3 marks*

9. Write three points of comparison between UV and IR spectrum.
10. Write three advantages of hydrogen - oxygen fuel cell.
11. Define the term cell constant. The specific conductivity of a 0.3N KCl solution at 27 $^{\circ}\text{C}$  is 0.028  $\text{S cm}^{-1}$ . Resistance of the cell containing this solution is 300 ohms. Determine cell constant.
12. What is the nature of bonding in carbon nanotubes? Write two applications of carbon nanotubes (CNTs).
13. Write the composition and uses of natural gas.
14. What is viscosity index (V.I)? Oils having high viscosity need not necessarily have high V.I Comment.
15. Give three points of difference between aerobic oxidation and anaerobic oxidation.
16. What are ion exchange resins? Give examples for cation and anion exchange resins.

(8 x 3 = 24 Marks)

**Part C**

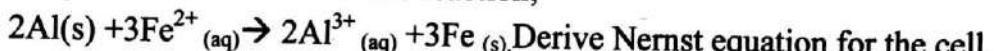
*Each question carries 10 marks*

17. (a) Why does a signal for a particular set of protons split into a multiplet? Give number of signals, peak ratio and multiplicity of different sets of protons in the NMR spectrum of 1-bromopropane.  
(b) Give a neat and labelled sketch of instrumentation of UV-visible spectrometer.  
(c) Write a note on vibrational modes of carbon dioxide molecule. State which of these modes are IR active; and give reason for their activity. (4+3+3)

**OR**

18. (a) What is chemical shift? Write the cause of chemical shift.  
(b) CO molecule absorbs at  $2140\text{cm}^{-1}$ . Calculate the force constant of the molecule, given atomic masses of C and O are 12u and 16 u respectively  $1\text{u} = 1.67 \times 10^{-27}\text{kg}$ .  
(c) What are the various energy transitions possible in a molecule? Why does electronic spectrum appear broad? (4+3+3)

- 19/(a) Design a reversible cell for the reaction;



- (b) Explain the variation of emf of Daniel cell with respect to temperature and concentration. (5+5)

**OR**

20. (a) Draw a well labelled diagram of calomel electrode. Write electrode reaction and representation of the electrode.  
(b) Find the potential of hydrogen electrode at  $25^\circ\text{C}$  for solution of  $\text{pH}=0$  and  $\text{pH}=14$   
(c) Why Aluminium metal when reacts with acid and base liberates  $\text{H}_2$  gas; whereas Fe metal can liberate  $\text{H}_2$  only from acids.  $E^0\text{Al}^{3+}/\text{Al}=-1.66\text{V}$  and  $E^0\text{Fe}^{2+}/\text{Fe}=-0.44\text{V}$

(4+3+3)

21. (a) Explain the principle and instrumentation of HPLC.

- (b) Differentiate between DTA thermogram and TGA thermogram graphically. Give one important application of each type. (5+5)

**OR**

22. (a) Give a comparison of GSC and GLC.  
(b) Write the working of TLC. List the important applications. (5+5)

23. (a) Give the classification of conducting polymers and write the mechanism of conduction in them.  
(b) Write structural formulae and important uses of the polymers Kevlar and ABS. (6+4)

**OR**

24. (a) Write the preparation and important properties of silicone rubber.

(b) Write the sol-gel method for the synthesis of nanomaterials.

(5+5)

25. (a) What are greases? Write a brief note on their classification.

(b) The temperature of 1000g of water was increased from  $26.5^{\circ}\text{C}$  to  $29.2^{\circ}\text{C}$  on burning 0.80g of a solid fuel in a bomb calorimeter. Water equivalent of calorimeter and latent heat of steam are 385 g and 587 cal/g respectively. If fuel contains 0.7% hydrogen calculate its gross and net calorific value.

(6+4)

**OR**

26. (a) Calculate the net and gross calorific value of a coal sample having following composition: C=82%, H=8%, O=5%, N=1.4% and ash=3.6 %.

(b) Define the properties of a liquid lubricant which are useful for their evaluation under the following conditions (i) fire hazards (ii) very low temperature.

(c) What is biodiesel? List its environmental advantages.

(4+3+3)

27. (a) Give the theory of EDTA method for estimating the hardness of water.

(b) 2.8g of  $\text{CaCO}_3$  was dissolved in HCl and the solution diluted to one litre. 100 mL of this solution required 28 mL of EDTA solution, while 100 ml of the hard water required 35 mL of the same EDTA solution. On the otherhand 100 mL of the boiled sample water when titrated against EDTA required 10 mL of EDTA solution. Calculate the temporary and permanent hardness of water?

(4+6)

**OR**

28. (a) With the help of a neat diagram outline the reverse osmosis process.

(b) A sample of water is found to contain 48.6 mg/L  $\text{Ca}(\text{HCO}_3)_2$ , 43.8 mg/L  $\text{Mg}(\text{HCO}_3)_2$ , 24.0 mg/L  $\text{MgSO}_4$ , 27.2 mg/L  $\text{CaSO}_4$  and 16.8 mg/L  $\text{NaHCO}_3$ . Calculate the carbonate and non-carbonate hardness of water.

(5 +5)

(6x10=60 marks)