Reg No.:_____   Name:_____

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   (2)
    condition for IR activity. (a) O_2 (b) H_2 (c) CO   (d) CO_2

2   An iron nail is dipped in 1 M HCl, what are the redox reactions taking place?   (2)
    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

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   (2)
    temperature. Justify.

8   In the determination of hardness of water by EDTA method NH_4OH-NH_4Cl (2)
    buffer solution is used. Why?

PART B
Answer all questions, each carries 3 marks.

9   A 100 ppm standard solution of Fe^{3+} after developing colour with excess   (3)
    ammonium thiocyanate solution shows a transmittance of 0.4 at 622 nm, while
    an unknown solution of Fe^{3+} after developing colour with excess ammonium
    thiocyanate solution shows a transmittance of 0.6 at same wave length.
    Calculate the concentration of Fe^{3+} in unknown solution.

10 Calculate single electrode potential of calomel electrode at 25 ^oC when the   (3)
    concentration of KCl solution is 0.1M, given that E^0 standard calomel electrode
    = 0.2810 V.

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   (3)
Bio-diesel?

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   (3)
containing 7.3 mg/L of $Mg(HCO_3)_2$, 40.5 mg/L of $Ca(HCO_3)_2$, 13.6 mg/L of
$CaSO_4$.

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   (5)
orientations are possible in a magnetic field when $I = \frac{1}{2}$ and $I=1$ give examples.

      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   (5)
over conventional display devices.

      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   (5)
in doped polymer.

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 SEMESTER B.TECH DEGREE EXAMINATION(2019 SCHEME), DECEMBER 2019

Course Code: CYT100

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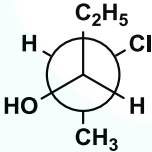
(**2019-Scheme**)

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 25^0C:-
   $Fe_{(s)} + Cu^{2+}_{(aq)} = Fe^{2+}_{(aq)} + Cu_{(s)}$ Given $E^0_{Fe^{2+}/Fe}$= -0,44 V, $E^0_{Cu^{2+}/Cu}$ = 0.34 V   (3)

2. Give the electrochemical reaction taking place when an iron nail is dipped in dil.HCl. $E^0_{Fe^{2+}/Fe}$= -0,44 V, $E^0_{Fe^{3+}/Fe}$= -0,04 V, $E^0_{H^+/H2}$= 0 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)

   a)   b)

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 $AlCl_3$ and (ii) 0.04 N $MgCl_2$.   (3)

10. What is the significance of measuring BOD of waste water?   (3)

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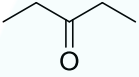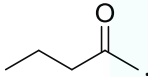*Answer one full question from each module, each question carries 14 marks*

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) Why Mg corrodes in both acidic and alkaline oxygen deficient conditions, whereas Fe does not corrode in alkaline oxygen deficient condition?

$Mg^{2+}+ 2e \rightarrow Mg$, $E^0 = -2.36$ V, $Fe^{2+}+ 2e \rightarrow Fe$, $E^0 = -0.44$ V, $H^+ + e \rightarrow \frac{1}{2}H_2$, $E^0 = 0$ V (6)

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.

$Na^+ + e \rightarrow Na$, $E^0 = -2.71$ V , $Cu^{2+}+ 2e \rightarrow Cu$, $E^0 = 0.34$ V, $Cl_2 + 2e \rightarrow 2Cl^-$, $E^0 = 1.36$ V , $H^+ + e \rightarrow \frac{1}{2}H_2$, $E = -0.41$ V (at pH=7), $O_2 + 2H_2O + 4e \rightarrow 4OH^-$, $E = 0.82$ V (at pH=7) (6)

Module-II

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

(i) [structure] and (ii) [structure] .

b) Compare the strengths of C-H bond and C=O bond if the absorption frequencies are 3000 cm^{-1} and 1700 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

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. Calculate the COD of the sample.   (6)

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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}H NMR spectrum of Cl-CH$_2$-CH$_2$-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 0.5×10^{-3}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 CO$_2$. Which are IR active? Give reason.   (4)

    b) Explain spin-spin splitting in the ^{1}HNMR 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)

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 $Fe/Fe^{2+}(0.01)//Ag^+(0.1)/Ag$ 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. (4)

OR

26. a) How lubricants are classified based on physical state? Explain with examples. (7)

b) Compare CNG and LNG. (3)

27. a) Detailthe 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: $Mg(HCO_3)_2$ = 16.8mg/L, $MgCl_2$ = 19 mg/L, $CaCO_3$ = 20 mg/L and $MgSO_4$ = 24.0 mg/L. Calculate the temporary, permanent and total hardness of the water sample. (5)

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10009

B

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) $_1^1H$ b) $_6^{12}C$ c) $_9^{19}F$ d) $_8^{16}O$

2. At 25°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°C is 0.0002765 ohm^{-1} 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 $CaCO_3$ equivalent ?

                                                         (8×2=16 Marks)

PART – B

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

9. The vibrational frequency of HCl molecule is 2886cm^{-1}. Calculate the force constant of the molecule. Reduced mass of HCl is 1.63×10^{-27} 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. $Ca^{2+} = 320$ mg/L, $Mg^{2+} = 72$ mg/L, $HCO_3^- = 610$ mg/L, $Cl^- = 355$ mg/L and $Na^+ = 23$ mg/L. Calculate the temporary and permanent hardness of water sample. **(8×3=24 Marks)**

PART – C

Each question carries **10** marks.

17. a) How can you distinguish NMR spectrum of CH_3CH_2Cl and CH_3CHCl_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 $CH_3 - CHCl - CH_3$.

    b) Write the theory of vibrational spectroscopy.

    c) Sketch the various modes of vibrations possible for CO_2. Which are IR active ? Write reason for your answer.

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^{2+} solution at 298 K. E^0 $Cu^{2+}/Cu = 0.34$ 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 $H_2 - O_2$ 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)**

<div align="center">OR</div>

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)**

<div align="center">OR</div>

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.:_____   Name: _____

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 A^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 27^0C is 0.028 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; andgive 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 $2140cm^{-1}$. Calculate the force constant of the molecule, given atomic masses of C and O are 12u and 16 u respectively 1u $=1.67 \times 10^{-27}$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;

$2Al(s) +3Fe^{2+}_{(aq)} \rightarrow 2Al^{3+}_{(aq)} +3Fe_{(s)}$. Derive Nernst equation for the cell.

(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 $25^{\circ}C$ for solution of pH=0 and pH=14

(c)Why Aluminium metal when reacts with acid and base liberates H_2 gas; whereas Fe metal can liberate H_2 only from acids. $E^0Al^{3+}/Al=-1.66V$ and $E^0Fe^{2+}/Fe=-0.44V$

(4+3+3)

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

(b)Differentiate between DTA thermogramand TGAthermogram 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)

2

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°C to 29.2°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)

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 $CaCO_3$ 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)

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 $Ca(HCO_3)_2$, 43.8 mg/L $Mg(HCO_3)_2$, 24.0 mg/L $MgSO_4$, 27.2 mg/L $CaSO_4$ and 16.8 mg/L $NaHCO_3$. Calculate the carbonate and non-carbonate hardness of water. (5 +5)

(6x10=60 marks)