**FACULTY OF ENGINEERING**

**B.E. I-Year (Main) Examination, April 2016 Subject : Engineering Chemistry Time : 3 hours Max. Marks : 75 *Note: Answer all questions from Part-A. Answer any FIVE questions from Part-B.***

**PART – A** (25 Marks)

1 Represent Quinhydrone electrode and write the electrodic reaction for reduction

process.

2 Draw the e.m.f. vs volume of titrant plot for i) strong acid vs strong base

ii) Fe2+ vs KMno4. 3

3 Explain the mechanism of electrochemical corrosion. 3

4 What is break-point chorination? Explain briefly. 2

5 Define addition and condensation polymers with suitable examples. 3

6 Explain the mechanism of conduction in polyacetylene. 2

7 What are the requirements of a good fuel? 2

8 What is trans estrification? Explain. 3

9 Define saponification number and mention its significance. 2

10 Write the principles of Green chemistry. 3

**PART – B** (50 Marks)

11 a) Calculate the e.m.f. of the following cell at 250c. 5

b) Explain the construction, working and applications of Lithium-ion batteries. 5

12 a) Discuss the factors that affecting the rate of corrosion. 6

b) What are paints? Explain the constituents of a paint and mention their

functions. 4

13 a) Explain the preparation, properties and applications of Bakelite. 6

b) What are fibre reinforced composites? What are the advantages of such

materials? 4

14 a) What are gross and net calorific value of a fuel? How would you express

them in the case of gaseous fuel? 5

b) How do you determine the calorific value of gaseous fuels by Junkers

calorimeter? Explain. 5

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15 a) Classify liquid crystals and explain their applications. 5

b) Discuss the phase diagram of water system. 5

16 a) Define the term single electrode potential and derive the Nernst equation. 5

b) How do you determine the temporary and permanent hardness of water by

EDTA method? Explain. 5

17 a) Write the differences between thermoplastics and thermosetting resins. 4

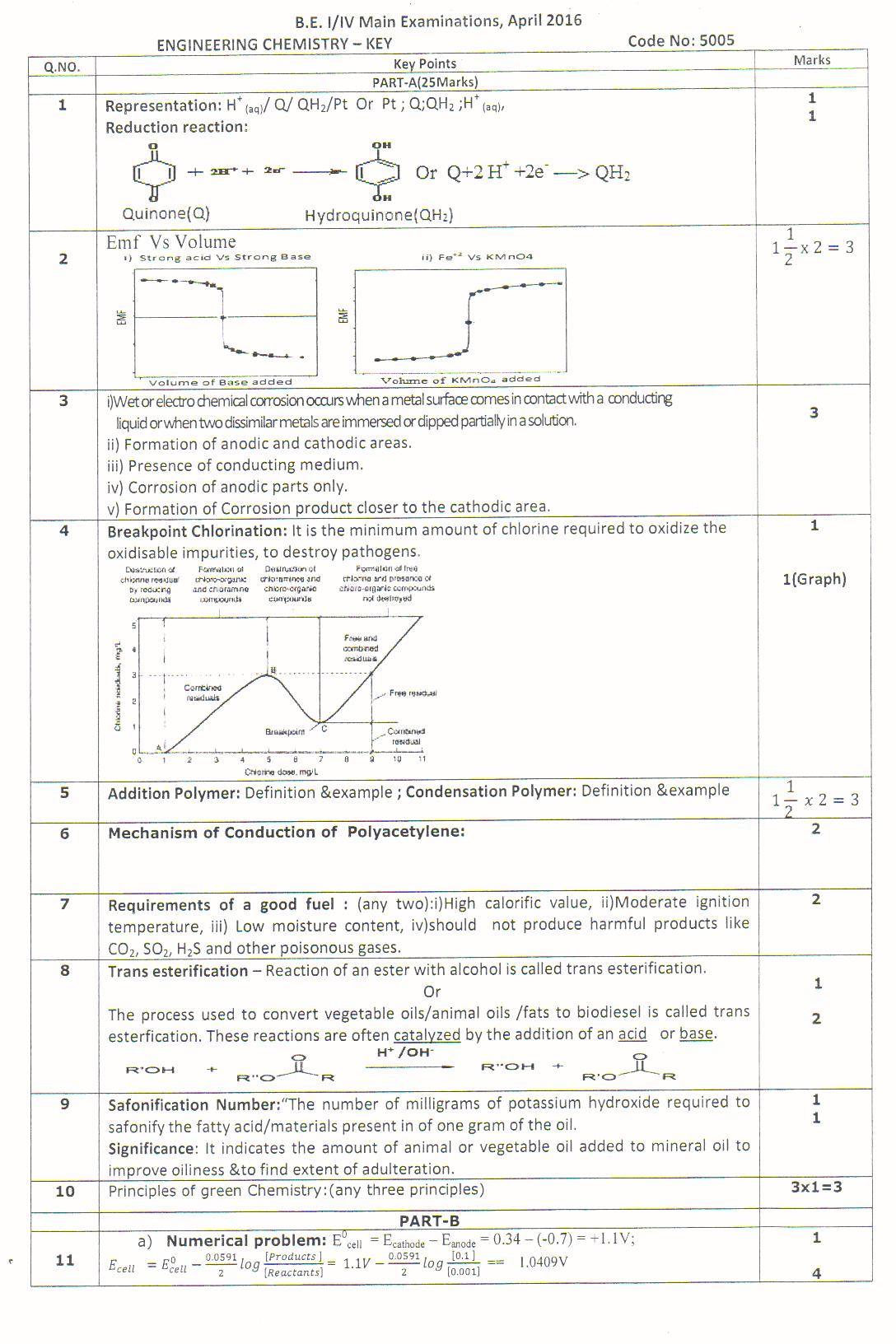
b) A sample of coal was found to contain the following constituents : C = 81% ;

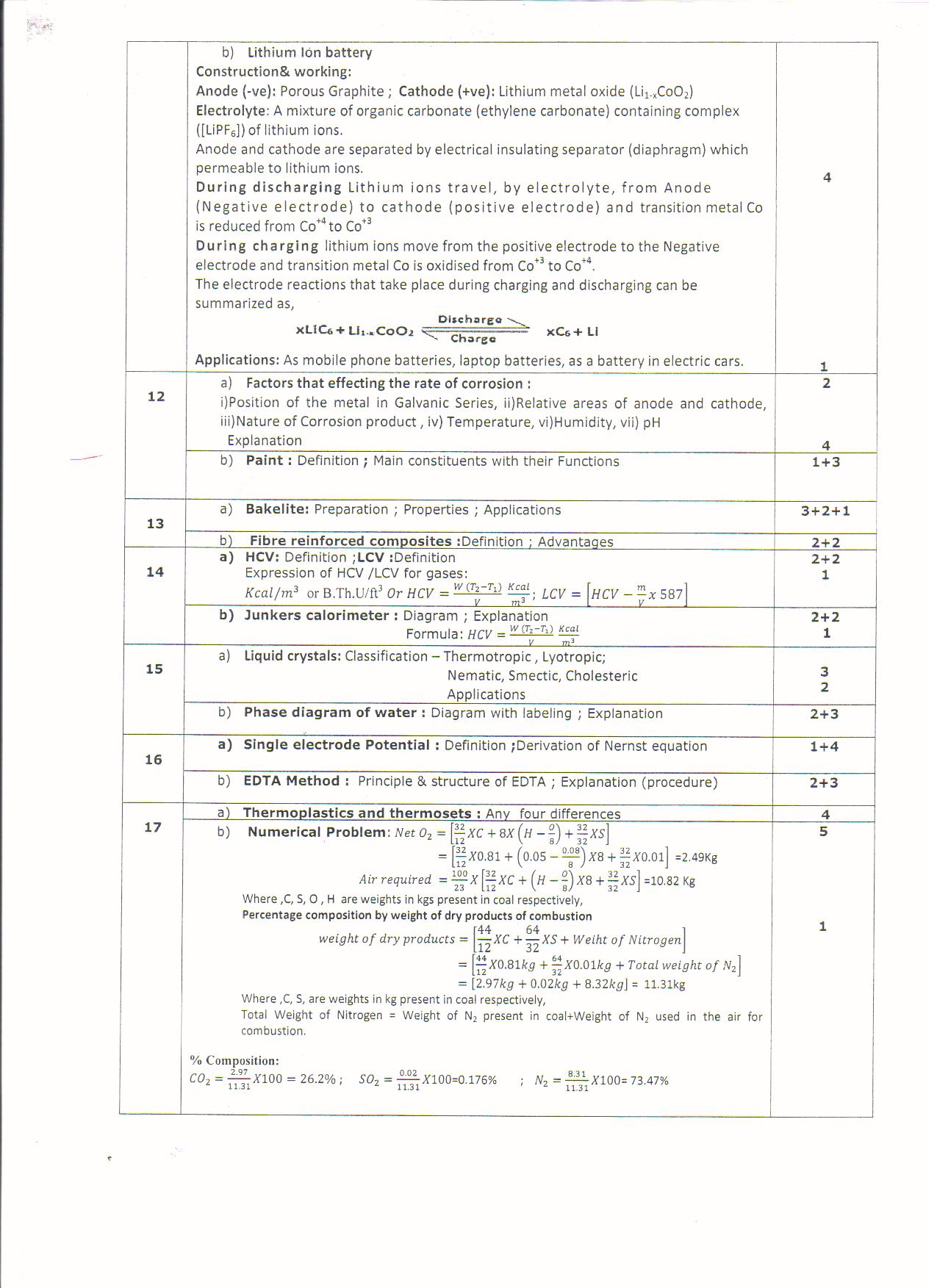
O = 8% ; S = 1% ; H = 5% ; N = 1% ; ash = 4%. Calculate the minimum

amount of air required for the complete combustion of 1 kg of coal. Also

calculate the percentage composition by weight of the dry products of

combustion. Oxygen in air is 23% by weight.



Part – B (50M)

**11.a)Calculate the EMF of the following cell at 25oC**

**EOZn2+/Zn = - 0.76V (Standard reduction potential of Zn  *EOCu2+/Cu = + 0.34V* (Standard reduction potential of Cu  EOCell = ? ECell  = ? Conc Zn2+ (aq) = 0.1M Conc Cu2+(aq) =  0.001M No: of e- involved = 2 Step:1 EOCell  = EOCathode - EO Anode  EOCell = EOCu2+/Cu - EOZn2+/Zn   EOCell = [ 0.34 - (-0.76) ] = 0.34 + 0.76 = 1.1V Step:2 Cell Reaction: At Anode : Zn 🡪 Zn2+ +2e**- **(Oxidation) At Cathode : Cu2+ + 2e 🡪 Cu(Reduction) Net Reaction: Zn + Cu2+ 🡪 Zn2+ + Cu I I I I [R] reactant(0.1M) [P] product(0.001M) I 1mole (ie): (0.1)1 1 mole (ie): (0.001)1**

**Step:3 E Cell = EOCell - (0.0591/n) log[P] / [ R] = EOCell - (0.0591/n) log[Zn2+] / [Cu2+] = EOCell - (0.0591/2) log[o.1] / [ 0.001] = 1.1 - 0.02955l (og100) = 1.1- 0.02955 (2) = 1.1+ 0.05910 E Cell = 1.1591V**

17a.) Weight required of air required = 100/23 (Net Oxygen) (No: of Kgs of coal) Net Oyygen required = 100/23 [32/12C+8 [H - O/8 ] +S = [32/12(8.1)C+8 [0.05 - 0.08/8] +0.01 = [21.6+8 [0.05 +0.01 ] +0.01 = [21.6+8 [0.04] +0.01 = [21.6+0.32] +0.01 = [21.92] +0.01 =21.93 = Weight required of air required = 100/23 (Net Oxygen) (No: of Kgs of coal) = 100/23 [21.92] [1] = 95.3Kg of air is required.

**10.)Write are the principles of green chemistry.**

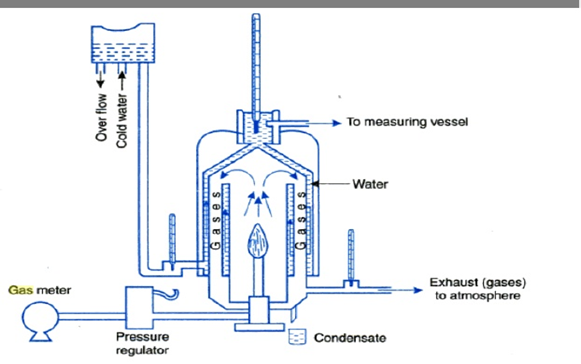
Requirements of a good fuels are: 1.High calorific value, 2.Should have harmless combustion products 3.Moderate ignition temperature,4.Low moisture content,5.Cotrollable combustion 6.Easy to transport .

**14a.)What are Gross and Net calorific values of a fuel?How would you express them in case of gaseous fuel?** Ans.) Calorific value of the fuel can be defined as the total quantity of heat liberated by burning a unit mass of or volume of fuel completely.Afuel is evaluated from its calorific value by calculating HCV & LCV.

HCV-H igher Calorific Value (or) GCV-Gross Calorific Value----It is the total amount of heat liberated when 1Unit mass (or)unit volume of fuel has been burnt completely and the products of combustion are cooled down at room temperature. HCV can be calculated by Dulongs formula. HCV = 1/100[8080C+34500(H - O/8)+2240S] Cal/gm Note:[IfC=80% then substitute as 80/100 = 0.8 in the formula]

LCV -Lower calorific value (or) NET-Net Calorific Value----It is the heat produced when a unit mass (or) unit volume of the fuel is burnt completely and the combustion products are allowed to escape. LCV = HCV – Latent Heat of Vapourisation LCV = HCV – %H(.09)Latent Heat of Steam LCV = HCV – %H(.09) 587 Kcal/Kg For gaseous fuels calorific value can be expressed in terms of K.cal/m3

**14b.)How do you determine the calorific value ofgaseous fuels by Junkers calorimeter?Ex[plain.**



**PRINCIPLE :** This Gas Calorimeter works on the Junker's principle of burning of a known volume of gas and imparting the heat with maximum efficiency to steadily flowing water and finding out of the rise in temperature of a measured volume of water. The formula,CalorificValue of Gas X Volume of Gas = Volume of water X Rise in Temperature, is then used to determine the Calorific Value of the Gas (assuming that heat capacity of water is unity).

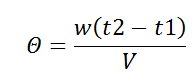
Used for

Determination of Calorific Value of Fuel / Flue Gases by the Junker's Method, involving  
Measuring of rise in temperature of a known volume of water due to combustion of a know volume of the Gas.

**DESCRIPTION:**This equipment consists of the Calorimeter with Powder Coated Stainless Steel exterior with burner (with choice of two nozzles) on a tripod stand, a Gas Flow Meter (Cat. No. IRI 08) and a pressure governor. Requisite tubing & measuring jars as well as thermometers (0.1oC graduation) for reading inlet & outlet water temperatures are also provided along with a detailed instructionmanual..

This Calorimeter covers a wide range between 120 BTU (1000 to 26000 K Cal/m3). The Calorimeter is fixed on a tripod stand having leveling screws to keep the Calorimeter in perfectly vertical position. The Calorimeter mainly consists of a gas combustion chamber, heat exchanger and water flow system. Heat exchanger is designed for maximum efficiency of heat transfer and is fabricated out of heavily tinned copper sheet. A constant water head maintenance device provided in the feed water pipe along with the inlet water flow regulator is fixed  to the outer housing of teh Calorimeter. The outer housing is of powder coated stainless steel. This constant water level attachment has an over flow device through which excess water drains out. Water from this constant head device enters the bottom of the heat exchanger through inlet water flow regulator and raised along the annular space, comes up to the filtering position at the top and gets collected at the swinging funnel attachment. While going up it absorbs the heat generated by burning the gas in the burner located at the bottom of the central chamber of the Calorimeter. Two thermometers are provided in the water inlet and outlets ports. Temperature of the effluent gas can be measured from the thermometer fixed at the exhaust gas outlet. Provision for fixing the burner is provided at the Calorimeter base. An outlet for collection of condensate is provided at the bottom.

**CALCULATIONS:** The high calorific value (HCV/GCV) (Θ) of the gaseous fuel can be calculated from the following relation:

[](http://3.bp.blogspot.com/-DJKZDao9gDE/VJ7HyTrzgbI/AAAAAAAABiA/xgtDiA-U9Gg/s1600/Junker's+Gas+Calorimeter+equation+1.png)

[http://4.bp.blogspot.com/-rnwbgVjvLrc/VJ7H3uxZX_I/AAAAAAAABiI/cmuk_l119I0/s1600/Junker's%2BGas%2BCalorimeter%2Bequation%2B2.png](http://4.bp.blogspot.com/-rnwbgVjvLrc/VJ7H3uxZX_I/AAAAAAAABiI/cmuk_l119I0/s1600/Junker's+Gas+Calorimeter+equation+2.png)  W = wt. of cooling water passed in time t.

V = volume of gas burnt at S.T.P. in time t.

T1 = temperature of the incoming water.

T2= temperature of the outgoing water.

Now to calculate Net calorific value (NCV/LCV), the amount of water condensed from the stream produced by burning 1 m3 of gas =m/V: and the latent heat of steam per 1 m3 of gas = 587 Kcal.

m = weight of steam condensed in time t.

Since the calorific value of gases is expressed on volumetric basis, it is essential to define the conditions of temperature and pressure for the value being referred.