**Attempt ALL the Questions. Internal choice is given in Part-A. Parts of question should be solved together.**

| Q. No. | | Question Description | Marks |
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| | | **PART A – (60 Marks)** | |
| 1 | (a) | 0.45 gm of CaCO3 was dissolved in HCI and the solution made up to 500 mL with distilled water. 50 ml of this solution required 50 ml of EDTA solution for titration. 50 ml of hard water sample required 18 ml of EDTA and after boiling and filtering required 10 ml of EDTA solution. Calculate each type of hardness of water. | 12 |
| | | **OR** | |
| | (b) | Differentiate between lime-soda and zeolite processes for softening of water giving merits and demerits of the two processes.<br><br>Write short notes on carry over or priming and foaming. | 12 |
| 2 | (a) | Draw the phase diagram for a mixture of Ag and Pb and suggest the application of information obtained from this phase diagram. | 12 |
| | | **OR** | |
| | (b) | Sketch the phase diagram of water. How is it helpful in explaining:<br>(i) Ice skating<br>(ii) Flow of glaciers | 12 |
| 3 | (a) | What are concentration cells? How can the EMF of a concentration cell be evaluated? | 12 |
| | | **OR** | |
| | (b) | What is the current measured in a circuit involving the half-cell reaction $Sn^{4+} + e^{-} \rightarrow Sn^{2+}$ which is occurring at a rate of $4.2 \times 10^{-3}$ mole/hr? | 12 |
| 4 | (a) | A battery made up of lead and $PbO_2$ is used in a car, with a capacity of 2.0 V. Discuss the working principle, construction and chemistry of this cell during its discharging and charging process. | 12 |
| | | **OR** | |
| | (b) | What are fuel cells? Elaborate the hydrogen-oxygen fuel cell and its advantages | 12 |

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| 5 | (a) | How can you calculate the % Carbon, Nitrogen, Hydrogen and Sulphur in wet coal by ultimate analysis? | 12 |
| | | **OR** | |
| | (b) | A sample of coal contains 89 % C, 8% H and 3 % ash. When this coal was tested in the Bomb calorimeter, the following data were obtained:<br><br>Weight of coal burnt = 0.85 g, weight of water taken = 650 g, water equivalent of calorimeter = 2500 g, rise in temperature = 2.5°C, cooling corrections = 0.03 °C, fuse corrections = 10 cal, acid corrections= 50 cal. Calculate the HCV and LCV in Kcal/gm. | 12 |
| | | **PART B – (40 Marks)** | |
| 6 | | A wall clock fixed with a primary battery was packed and kept as such for a long period. On opening the packing, the cell was found to have got opened and the equipment got spilled. Give the reason for it and also suggest an alternate battery to avoid the problem and explain its function. | 10 |
| 7 | | Corrosion is metal's biggest enemy, and it's fair to say that nobody wants any appliance they own to suffer from the weakening effects of corrosion. It's one that especially applies to water heaters, which combine metal, water, and oxygen—the perfect mixture to start the chemical reaction that leads to corrosion. What features would you incorporate in your boiler's design to prevent it from the dangers of rust and other forms of corrosion. | 10 |
| 8 | | A fuel sample has following composition: $C_6H_{12}$ = 84 %, $CH_4$ = 3.5 %, $O_2$ = 3.0 %, S = 0.5%, moisture = 3.5 %, $N_2$ = 0.5 % and ash = 5 %. Calculate:<br>• Theoretical weight of air required for complete combustion of 1 kg of the fuel.<br>• Its volume in $m^3$. | 8 |
| 9 | | I. Calculate the standard cell potential for<br><br>$Pt / H_2(1\ atm), H^+(1.0\ M) // Br_2(1.0\ M), Br^-(1.0\ M) / Pt.$<br><br>$1/2\ Br_2 + e^- \rightarrow Br^-\ E^0 = 1.065\ V$<br><br>II. To the cathode compartment of the above described cell, $Ag^+$ ions are added until AgBr precipitates. At this point $[Ag^+]$ reaches 0.060 M, the cell voltage is 1.710 V, the pH = 0, the partial pressure of hydrogen gas is 1.00 atm and $[Br_2]$ is kept at 1.00 M. Calculate $[Br^-]$ under these conditions. | 12 |