VIT® UNIVERSITY (Estd. u/s 3 of UGC Act 1956)

Final Assessment Test (FAT) – May 2017

Course: CHY1001 - Engineering Chemistry

Class NBR(s):4926 / 4927 / 4928 / 4931 / 4932 / 4941 Slot: D1+TD1

Time: Three Hours Max. Marks: 100

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. a) 100mL of a raw water sample on titration with N/50 H_2SO_4 required 12.4mL of the acid to phenolphthalein end-point and 15.2 mL of the acid to methyl orange end-point. Determine the type and extent of alkalinity present in the water sample. [5]

   b) Write in detail on types of water impurities pertaining to chemical and physical impurities which would cause hardness to water. [5]

2. a) Calculate the quantity of lime and soda required for softening 5000 litres of water containing the following salts per litre; $Ca(HCO_3)_2$: 8.1mg; $Mg(HCO_3)_2$: 7.5mg; $CaSO_4$: 13.6mg; $MgSO_4$: 12mg; $MgCl_2$: 2mg; NaCl : 10mg. [5]

   b) Foaming and caustic embrittlement predominantly cause boilers trouble. Wherever applicable, explain it with relevant chemical equation and provide justification on how chemistry is aiding in controlling boilers trouble. [5]

3. a) Diffusion is one of the important properties on the influence of solute in solution under colligative properties. By tweaking this concept, scientists were able to use it for day to day application. Elaborate on this. [5]

   b) Discuss in detail break-point chlorination with a graph. [5]

4. a) Explain differential aeration corrosion and pitting corrosion taking suitable examples. [5]

   b) Different metals form different types of oxide layer on its surface. The oxide layer on the metal will either accelerate or retard the corrosion process. The following metals form oxide on its surface; Al, Pt, Mo and Fe. Categorize the types of oxide layer formed on its surface. Are they friend or foe to the metal against corrosion? [5]

5. a) What are special coatings in corrosion prevention? Discuss salient features of any one special coating in protective coating technique. [5]

   b) An element with electronic configuration, $[Ar]3d_{10}\ 4s_2$ and the post transition metal, stannum, are widely used in coating to prevent corrosion. Discuss about coating process involved in using these two elements separately. [5]

6. a) Compare working of fluid-free cell and alkaline cell with their relevant cell reactions. [5]

   b) With respect to cells and batteries, correlate the following terms; [5]

   (i) Capacity, (ii) Nominal voltage (iii) Service life and (iv) Shelf life (v) Depth of discharge

7. a) Special materials are used as electrodes and electrolytes in solid oxide fuel cell. List out the materials used in FC and reason out why solid oxide fuel cells are suitable for continuous power generation. [5]

   b) Lead-Sulfuric acid and combination of Nickel and Cadmium are frequently used metals in secondary batteries. Electrochemical reactions are behind the discharging and charging mechanisms in secondary batteries. Discuss on discharging and charging chemical mechanisms in such types of systems. [5]

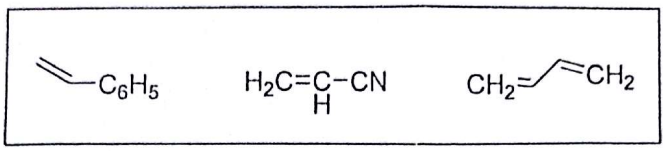
8. a) What is the relationship between GCV and NCV? When will the Gross and Net calorific values of the coal are same? [5]

   b) Discuss on the salient features of Boy's calorimeter and explain in detail how calorific value is determined with it. [5]

9. a) A gas used in an internal combustion engine had the following composition by volume Hydrogen : 45%; Methane : 36%; Carbon monooxide: 15%; Nitrogen : 4%. Find the volume of air required for the combustion of $1m^3$ of the gas. [5]

b) Octane and cetane rating are a measure of fuel's ability to resist knocking. This can be overcome by adding appropriate chemical additives to fuels. Discuss in detail including the chemistry behind this anti-knocking process. [5]

10. a) How would you use the following precursors altogether to prepare a high utility polymer? Discuss its properties and any specific application of the polymer. [5]



b) Orientation of functional groups in a polymer chain can take either order or disorder arrangements with respect to backbone chain of the polymer. Discuss in detail on the orientation of functional groups in the polymer synthesis and their characteristic nomenclature using a suitable example. [5]

11. a) Apart from metals, certain materials possess electrical conductivity properties. There are some important factors contribute to the electrical conductivity of those materials. Taking $C_6H_5NH_2$ as a building block, how do you prepare a conducting polymer, discuss on structural features of this conducting material and its applications. [5]

b) Usage of non-biodegradable materials for day to day use should be dissuaded to minimize its impact on our environment. One way to bring in solution to this menace is to make eco-friendly polymers be available so that it can break down after its intended use. In this context, discuss about the biodegradable polymers and its use? [5]

12. a) Long chain organic polymers carrying acid functional groups and amine functional groups are capable of selectively removing ions present in the water. Discuss in detail with diagram the chemistry behind this process and advantages and disadvantages associated with the process. [5]

b) Explain the construction and working principle of secondary lithium batteries. [5]

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