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RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B. Sc (General/Special) Degree

Third Year Semester I Examination – Oct. / Nov. 2015

CHE 3207 ELECTROCHEMISTRY

Answer any **Four** questions Time: **02** hours

1. (a) Describe what is meant by the term
   (i) Equilibrium potential and (ii) cathodic overpotential for a net cathodic process.

   (b) Draw fully labeled diagrams which illustrate the change in free energy against distance for: (i) an electrode at equilibrium; (ii) an electrode made cathodic by polarization; (iii) an electrode made anodic by polarization.

   (c) Describe a silver/silverchloride or calomel electrode as a reference electrode in electrochemical studies.

   (d) Write down all half-reactions taking place at the anode and cathode of a corroding metallic iron in an acidic environment. Explain the rate of corrosion of the same system under deareated condition

2. (a) Describe a graphical method based on the Nernst equation for the determination of the standard redox potential of Cu^{2+} /Cu electrode

   (b) The purity of a sample of $Na_2S_2O_3$ was determined by a coulometric redox titration using I^- as a mediator, and 1_3^- as the "titrant". A sample weighing 0.1342 g is transferred to a 100-mL volumetric flask and diluted to volume with distilled water. A 10.00-mL portion is transferred to an electrochemical cell along with 25 ml, of 1 M KI, 75 mL of a pH 7.0 phosphate buffer, and several drops of a starch indicator solution. Electrolysis at a constant current of 36.45 mA required 221.8 s to reach the starch indicator end point. Determine the purity of the sample.

$$2\,S_2O_3^{2-}(aq) + I_3^-(aq) \rightarrow S_4O_6^{2-}(aq) + 3\,I^-$$

3. (a) With suitable energy level diagrams, explain intrinsic and extrinsic semiconductors

   (b) Explain how band bending occurs when a semiconducting material is brought into contact with an electrolyte containing a suitable redox couple.

   (c) Briefly explain "electrocoagulation technique" in water treatment.

4. The Figure shown below the Pourbaix diagram for zinc-water equilibria. The equlibria represented by the lines 1 to 5 are

$$Zn^{2+} + 2e = Zn \qquad E^{\theta} = -0.76V$$

$$Zn(OH)_2 + 2H^+ + 2e = Zn + 2H_2O \qquad E^{\theta} = +0.42V$$

$$ZnO_2^{2-} + 2H_2O + 2e = Zn + 4OH^- \qquad E^{\theta} = +0.44V$$

$$Zn^{2+} + 2H_2O = Zn(OH)_2 + 2H^+$$

$$Zn(OH)_2 = ZnO_2^{2-} + 2H^+$$

(a) Locate the species Zn^{2+}, Zn, $Zn(OH)_2$, *and* ZnO_2^{2-}, in the respective areas in the diagram.

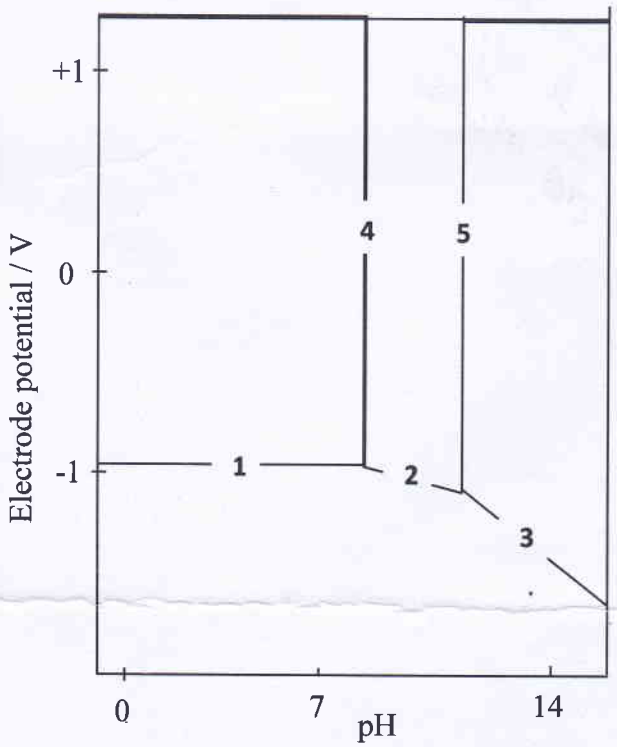
(b) Identify and label each region as corrosion, immunity and passivation

(c) Describe, with the help of above reactions, the following features in the given diagram

i. Line 1 is parallel to the pH axis

ii. Lines 2 and 3 have different slops

iii. Lines 4 and 5 are parallel to potential axis



5. (a) What are the salient features of a battery and a fuel cell?
(b) Discuss the chemical process takes place in an alkaline Hydrogen-Oxygen fuel cell.
(c) How does an enzymatic fuel cell differ from any type of alkaline fuel cell?
(d) State the main steps involve in electroplating.