MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL UNIVERSITY
I SEMESTER B.E DEGREE EXAMINATION NOVEMBER 2008

SUBJECT: ENGG. CHEMISTRY.(CHM 101/102)
Scheme of Valuation

Time: 3 Hrs] [Max. Marks: 50

Note: Answer any **FIVE** full questions

1. a) Give reason
i) $E = E^o - 0.0592 \log [Cl^-]$----------½M Explanation---------- ½M
ii) Two reasons ----------1 M

b) i) Defination ------1M Derivation of Mn & Mw --- -2M
ii) One major difference with an example----------½M + -½M

c) i) Diagram-----½M Conditions like Temp, Pressure & Catalyst----1M
Process-----1M Merits (any two)---------- ½M
ii) Calculation of G.C.V

$L = (W + w)(t_2 - t_1)/x$

$= (1458 + 456)(19.2 - 13,25)/0.945$

$= 12.051$ k cal g^{-1} ½M

LCV = 12051 – 8x0.09x586
= 11.629 k cal g^{-1} ½M

2. a) Give reason
i) The secondary reaction taking place in a dry cell is not a electrochemical reaction It is the conversion of Zn into diammine Zn (II) chloride. So it do not contribute towards the overall

$NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(g) + H_2O(l)$
$Zn^{2+}(aq) + 2NH_3(s) + 2Cl^- \rightarrow [Zn(NH_3)_2Cl_2]$ 1M

ii) Due to overcharging electrolysis of water will take place which results in the accumulation of hydrogen and oxygen leading to explosion of the cell. If kept in a partially discharged condition sulphatation will take place. 1M

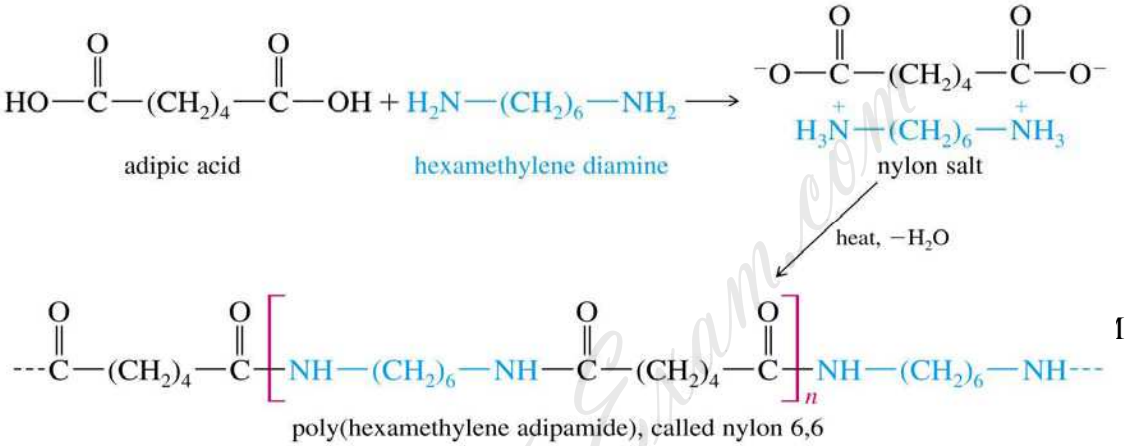
b) i)Explanation of function of anodic inhibitor with with an example 1M
Explanation of functions of 2 types of cathodic inhibitor with an example each 2M

ii) Example and function of a salt bridge 1 M

c) i) Definition of electroless plating ½M

The catalytic metals such as Ni, Co, Steel, Pd etc., do not require any surface preparation before electro less plating on them. Non catalytic metals such as Cu, brass, Ag etc., need activation. This can be done by dipping in palladium chloride solution.Non conductors like glass, plastics, etc., are first activated in a solution of $SnCl_2$ and HCl.After rinsing its immersed in a solution of $PdCl_2$ and HCl. This treatment yields a thin layer of Pd on the treated surface.

1½ M



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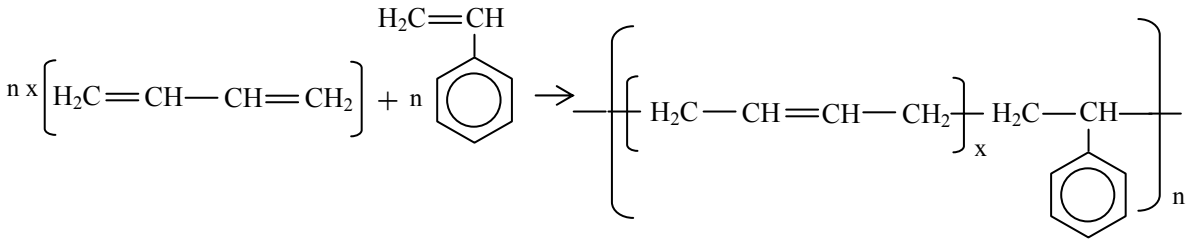
(i) It is used as a plastic as well as fibre.

(ii) This is used to produce tyre cord.

(iii)It is used to make mono filaments and roaps.

(iv)Nylon 6,6 is used to manufacture articles like brushes and bristles.

Preparation of SBR



Uses:

Mainly used for the manufacture of motor tyres.

Other uses of this elastomer are floor tiles, shoe soles, gaskets, foot-wear components, wire and cable insulations, carpet backing, adhesives, tank-lining, etc.,

3. a) Give reason:
i) Mentioning 2 types of cathodic reactions in aerated acid soulutions ½M
Equations ½M
ii) Reason with proper explanation regarding passivating potential 1M

b) i) Development of electrode potential in a glass electrode:

The glass is a partially hydrated aluminosilicate containing sodium or calcium ions. The hydration of a pH sensitive glass membrane involves an ion-exchange reaction between singly charged cations in the interstices of the glass lattice and protons from the solution. The ion-exchange reaction can be written as

H^+ + Na^+ <=====> Na^+ + H^+
Solution glass solution glass ½M

Explanation for development of potential ½M.

Development of electrode potential of glass electrode:

The overall potential of the glass electrode has three components.
The boundary potential $_b$, which varies with the pH of the analyte solution. It is made up of two potentials, E_1 & E_2 which develop at the two surface of the glass membrane i.e. the potential developed at the inner glass surface & the potential developed at the outer glass surface.

$E_b = E_1 - E_2$ _____ (1)

Where E_b is the boundary potential
E_1 = potential developed at the interface between the exterior of the glass and the analyte solution
E_2 = Potential developed at the interface between the internal solution and the interior of the glass. The boundary potential is related to the concentration of hydrogen ion in each of the solution by the Nernst-like equation.
$E_b = E_1 - E_2 = 0.0592 \log C_1 / C_2$ _____ (2)
Where C_1 = concentration of the analyte solution
C_2 = concentration of the internal solution
For a glass pH electrode the hydrogen ion concentration of the internal solution is held constant. So eqn. (2) simplifies to

$E_b = K + 0.0592 \log C_1$ _____(3) 1M
K – 0.0592 pH where $K = -0.0592 \log C_2$

The boundary potential is then a measure of the hydrogen ion concentration of the external solution.

2) The potential of the internal Ag/AgCl reference electrode. E Ag/AgCl.

3) A small unpredictable contribution called the asymmetry potential, E_{asym}. The sources of the symmetry potential include the following.
(i) Differing conditions of strain in the two glass surfaces during manufacture
(ii) Mechanical abrasion on the on the outer surface during use
(iii) Chemical etching of the outer surface during use. ½M

The asymmetry potential changes slowly with time. The glass electrode potential can be written in the equation form as

$E_G = E_b + E_{Ag/AgCl} + E_{asym}$ _____ (4)

Substitution of eqn – (3) for E_b, gives
$E_G = K+0.0592 \log C_1 + E_{Ag/AgCl} + E\ asym$
$= K – 0.0592 \log pH + E_{Ag/AgCl} + E\ asym$ ___(5)
or $E_G = E^o_G – 0.0592PpH$ _____(6)
where $E^o_G = K + E_{Ag/AgCl} + E_{asym.}$
a combination of three constant terms = constant ½M

ii) $pH = E_{cell} / 0.0592$

$= 0.34/0.0592$

$= 5.74.$

1M

c) i) Mechanism of petroleum knocking 1M
Prevention 1M
ii) Explanation for suspension polymerization 1½M
Any two differences between suspension and emulsion polymerization ½M

4. a) Reason:
i) Lower in C.V due to volatile matter ½M
Lower in C.V due to ash ½M
ii) Reason 1M

b) i) Cell Scheme:
$Cd/Cd(OH)_2,KOH,Ni(OH)_2, Ni(OH)_3/Ni$ ½M

Electrode reactions
Anode:

$Cd(OH)_2(s)+2e- \rightarrow Cd(s) +2OH^-(aq)$ ½M

Cathode:

$2Ni(OH)_{2(s)} +2OH^-(aq) \rightarrow 2Ni(OH)_{3(s)}+2e^-$ ½M

Net:

$2Ni(OH)_{2(s)}+Cd(OH)_{2(s)} \rightarrow 2Ni(OH)_{3(s)}+ Cd(s)$ ½M

ii) Any four requirements of the fuel cell 1M
Any two merits and demerits 1M

c) i)Explanation of caustic embrittlement with equations 2M
ii) Definition of Tg ½M
Comparison of Tg values with structure 1 ½M

5. a)Give reason:
i) Reason with proper explanation 1M
ii) Reason with suitable explanation 1M
b) i) $\Delta G = -nFE$ However all electrochemical reactions are accompanied by decrease in free energy of the system. Thus

, $-\Delta G = -nFE$ Hence e.m.f of the cell is positive 1M

$\Delta H = nF[T(\delta E/ \delta T)_P - E]$

$= 2 \times 96500 (-2.952 \times 10^{-3} \times 298 - 0.7653)$

$= -2 \times 96500 \times 1.6444$

$= -317.48$ k J K^{-1} . ½M

$\Delta S = nF (\delta E / \delta T)_P$

$= -2 \times 96500 \times 2.952 \times 10^{-3}$

$= -0.5695$ kJ ½M

ii) Stucture Property relationship with respect ot plastic deformation and Chemical resistance 2M
c) i) Detailed procedure for ultimate analysis of coal of determination of carbon and hydrogen with calculation steps. 2M

Percentage of nitrogen = $\frac{\text{Volume of acid used} \times \text{Normality of acid} \times 1.4}{\text{Weight of coal taken}}$

= 43.75 x 0.1x1.4/ 1.56

= 3.92% 1M

Percentage of sulphur:

$$\frac{\text{Wt. of } BaSO_4 \text{ obtained} \times 32}{\text{Wt. of coal taken} \times 233} \times 100$$

= 0.1755 x32x100/ 2.60 x 233

= 0.9270 % 1M

6. a) Give reason

i) Explanation with equation 1M

ii) Explanation for differential areation corrosion 1M

b) i) Explanation for the effect of two parameters on the rate of corrosion 1 mark each 2M

ii) Tacticity : Def ½M

Three different stuctural configuration of polypropylene 1 ½M

c) Origin of single electrode potential. 1½M

Explanation of the galvanization 2M

Reason ½M