Tutorial Sheet
In Corrosion Engineering

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1- Determine the thermodynamic tendency for silver to corrode in a deaerated acid solution of pH = 1.0 Assume = $\alpha\ Ag^{+} = 10^{-6}$ and $PH_2 = 1$ atm . [$E^{0}_{Ag/Ag+}$= 799 mv].

2- Determine the tendency for iron to corrode in deaerated water. Assume $a_{Fe2+} = 10^{-5}$, pH =7 , and P_{H2} = 1atm ($E^{0}_{Fe/Fe2+}$ = -440 mv)

3- Calculate the theoretical tendency for nickel to corrode in deaerated water (pH=8). Assume the corrosion product is Ni $(OH)_2$, the solubility product of which is $1.6X\ 10^{-16}$. $E^{o}{}_{Ni/Ni}{}^{2+}$ = -0.25 v

4- Determine the pressure of hydrogen required to stop corrosion of iron immersed in a deaerated 0.1 m $FeCl_2$ solution at pH=3 .Assume $\gamma_{Fe}{}^{2+} = 1.0$

5- Determine the pressure of hydrogen required to stop corrosion of iron in deaerated water with $Fe(OH)_2$ as the corrosion product. The solubility product for Fe $(OH)_2$ is $1.6\ X\ 10^{-14}$. Assume PH=7.0

6- Determine the thermodynamic tendency for silver to corrode in a aerated acid solution at pH = 1.0 Assume = $\alpha_{Ag+} = 10^{-6}$ and P_{H2} = 1atm , and P_{O2} = 0.2atm compare the result to that of Example 1 (deaerated solution) , [$E^{0}_{Ag/Ag+}$= 799 mv]

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No.	Reference Electrode	Metal A	Metal B	Metal C
1	**$Pb/PbCl_2$**	0.721	0.13	0.62
2	**$Zn/ZnCl_2$**			
3	**Ag/AgCl**			
4	**SCE**			

8- Copper surface area, A= 100 cm^2, is exposed to an acid solution. After 24 hours, the loss of copper due corrosion (oxidation) is $15x10^{-3}$g. calculate:
a) the current density I in μA/ cm^2, b) the corrosion rate in mm/yr. atomic wt.= 63.54 g/mol , p=8.96g/cm^3

9- The electrode potential of metal is (-0.16 v) SHE and metal B is (+0.25 v) SHE. What will be the potential if the following reference electrodes are used?
SCE = 0.24 v, $Cu/CuSO_4$ = 0.3v, $Pb/PbCl_2$ =-0.33 v $Zn/ZnCl_2$ = -0.76 v

10- Calculate E for the half cell in which the reaction:
Cu++ (0.1 M) + 2 e- = Cu(s) takes place at 25 ^oC. activity coefficient = 0.047

11- A tin can immersed in seawater shows a current density of 2.45×10^{-6} A/cm2. What is the rate of corrosion in mdd?

Select one best answer:

1. The electrode potential of a metal is:
   [a] The potential which exists at the interface between the metal and the electrolyte
   [b] The potential between the anodic and cathodic areas of the metal
   [c] The potential between two metals immersed completely in the same electrolyte
   [d] The potential of a metal with respect to another metal, which is at a higher concentration.

2. The double layer is formed as a result of
   [a] attractive forces of negative charged metallic surface and positive ions only
   [b] repulsive forces between like positive ions only
   [c] both attractive and repulsive forces between ions
   [d] None of the above

3. The most acceptable method of obtaining standard electrode potential is by
   [a] comparing the electrode potentials of a metal half cell with a hydrogen half cell
   [b] comparing the electrode potential of a metal immersed in a solution of its ions at any concentration, with the hydrogen half cell
   [c] comparing the electrode potential of a metal with any standard electrode, such as Ag-AgCl or Calomel electrode

   [d] None of the above

4. A galvanic cell is formed
   [a] when two metals are immersed in solutions differing in concentration
   [b] when two different metals are immersed in one electrolyte
   [c] when two different metals are exposed to air
   [d] when two metals are brought close together and electrically insulated from one another

5. In concentration cells
   [a] the metal is in contact with two half cells having the same electrolyte but at different concentrations
   [b] the metal is in contact with two half cells, having the same electrolytes with the same concentration
   [c] no liquid junction is present
   [d] there is no migration of ions from one electrolyte to another electrolyte

6. If the free energy of a reversible process is negative, it implies that
   [a] the cell reaction is spontaneous
   [b] the cell reaction is not spontaneous
   [c] the cell reaction proceeds from right to left
   [d] no reaction takes place at all