BE-I/4 CLASS TEST-I [KEY]

ENGINEERING CHEMISTRY

Q1) Fuel cell definition with example-1m, advantages-(1/2\*2=1m).

Q2) a)CaCl2 -causes permanent hardness(Soluble Chlorides(Cl- ) and Sulphates (SO4 -) of Calcium and . . Magnsium salts causes permanent hardess in water).

b)Mg(HCO3)2 -causes temporary hardness (Soluble bicarbonates(HCO-3) of Calcium and Magnsium . . salts causes temporary hardess in water).

c)AlCl3  -does not cause hardness of water)

d)Na(HCO3)-does not causes of hardness of water)

Q3)SRP of Al=-1.66V (less SRP) and Fe=-0.44V(more SRP)

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| --- |
| Electro Chemical Series(SRP -Standard Reduction Potential Values) Volts |
| Al (-1.66V) |
| Fe (-0.44V) |

If SRP values are less wrt other element in electro chemical series then it will loose electrons undergoes oxidation and undergoes corrosion. As Aluminium lies above Iron in electro chemical series as its SRP value is less than Fe, Al - should undergo coorrosion wrt Iron. But instead of Aluminium, Iron undergoes oxidation.This is an exceptional case.The reason for this is : The oxide layer of Aluminium is highly stable and more adherent to the Al– metal, due to which further oxidation or further corrosion does not occurs,where as the oxide layer of Iron is porous and non adherent to the metal Iron, due to which further corrosion can easily take place.

Q4a) Nernst equation(only derivation-3 m)

Q4b) Ans) 0.9004V EO=? (1 m); cell reaction-1m; substitution-1 m; correct answer-1 m.

Q5a) Figure -1m; principle-1.5m; example-1/2 m

Q5b) Figure -1m; discharging reaction -1m; charging rection-1m; overall reaction, voltage--1m.

Q6a)EDTA-name,structure-1m; reaction-1m; stability-1/2m; endpoint-1/2m; procedure-1m.

Q6b)Formula&substitution-1m; total hardness-1m; permanent & temporary hardness-1m.

Solution to the problems : 1.Calculate the EMF (Eocell)of the cell. Draw the diagram and write the cell notation & cell reaction Anode Anode(-) Pb/Pb2+(0.01M) //Ag+(0.001M)/Ag (+) Cathode

**1a).Data Given:** EO Pb2+/Pb = - 0.76V (**SRP value is less so it looses electrons ,undergoes oxidation and acts as Anode)** EO Ag+ /Ag = + 0.80V (**SRP value is more so it gains electrons ,undergoes reduction and acts as Cathode)**  Conc of [Pb2+]=0.001M  Conc of [Ag+]=0.01M  No: of e- involved = 2 EOCell = ? ECell = ?

**Cell Notation** Anode(-)Pb/Pb2+(0.001)**||**Ag2+(0.01M)/Ag (+)Cathode

**Cell Reaction:** At Anode: Pb ----🡪Pb2+ +2e- (Oxidation)Note: (Consider only the ionic forms in  At Cathode: 2[Ag+ + 2e---🡪 Ag] (Reduction) reactants and products) Net Reaction: Pb + 2Ag+ 🡪 Pb2+ + 2Ag . ionic form ionic forms

**Sol : EOCell  = EOCathode - EO Anode** . = EO Ag+ /Ag  - EO Pb2+/Pb . = [ 0.80 - ( -0.13) ] . = 0.90 + 0.13= 0.93V . = 0.93V

ECell  = EOCell - (0.0591/n) log[P] /[ R] .  = 0.93- (0.0591/2) log[P] / [R] . =0.93- ( 0.0591/2) log[Pb2+] / [Ag+]2 . =0.93- ( 0.0591/2) log (0.001) / (0.01)2 . =0.93- 0.0295 log10  .  =0.93- 0.00985 (1) . =0.93- 0.00985 ECell =0.9005V

**6b}Numerical 50 ml of a sample of water consumed 20 ml of 0.01 M EDTA before boiling and the same water consumed 12ml of 0.01M EDTA. Calculate total hardness,permanent harness and temporary hardness of water.**

**Data: a) Sol: MI VI = M2V2**

**Before Boiling Mwater \* Vwater = MEDTA \* VEDTA**

Vsample water =50ml Mwater \* 50 = 0 .01 \* 20 = 0.004

VEDTA Sol = 20ml Total Hardness of water = Mwater \*100\*1000

MEDTA sol = 0.01M = 0.004\*100\*1000= 400mg/lit (or) 400PPM

**After Boiling b) Sol: MI VI = M2V2**

Vsample water =50ml Mwater \* Vwater = MEDTA \* VEDTA

VEDTA Sol = 12ml Mwater \* 50 = 0.01 \* 12 = 0.0024

**Permanent Hardness of water = Mwater \*100\*1000**

= 0.0024\*100\*1000= 240mg/lit (or) 240PPM

**c) Total Hardness of water =Temporary Hardness+Permanent Hardness**

Temporary Hardness = Total Hardness - Permanent Hardness

= 400 – 240 = 160PPM

The **gialvanic series** (or **electropotential series**) determines the [nobility](https://en.wikipedia.org/wiki/Noble_metal) of [metals](https://en.wikipedia.org/wiki/Metal) and [semi-metals](https://en.wikipedia.org/wiki/Semi-metal). When two metals are submerged in an [electrolyte](https://en.wikipedia.org/wiki/Electrolyte), while also electrically connected by some external conductor, the less noble (base) will experience [galvanic corrosion](https://en.wikipedia.org/wiki/Galvanic_corrosion). The rate of corrosion is determined by the electrolyte, the difference in nobility, and the relative areas of the anode and cathode exposed to the electrolyte. The difference can be measured as a difference in voltage potential: the less noble metal is the one with a lower (that is, more negative) [electrode potential](https://en.wikipedia.org/wiki/Electrode_potential) than the nobler one, and will function as the [anode](https://en.wikipedia.org/wiki/Anode) (electron or anion attractor) within the electrolyte device functioning as described above (a [galvanic cell](https://en.wikipedia.org/wiki/Galvanic_cell)). Galvanic reaction is the principle upon which [batteries](https://en.wikipedia.org/wiki/Battery_(electricity)) are based.**Galvanic series (most noble at top)** **The following is the galvanic series for stagnant (that is, low**[**oxygen**](https://en.wikipedia.org/wiki/Oxygen)**content)**[**seawater**](https://en.wikipedia.org/wiki/Seawater)**. The order may change in different environments.It  It is measured in terms of mg/cm2/year .**

* [Graphite](https://en.wikipedia.org/wiki/Graphite)
* [Palladium](https://en.wikipedia.org/wiki/Palladium)
* [Platinum](https://en.wikipedia.org/wiki/Platinum)
* [Gold](https://en.wikipedia.org/wiki/Gold)
* [Silver](https://en.wikipedia.org/wiki/Silver)
* [Titanium](https://en.wikipedia.org/wiki/Titanium)
* [Stainless steel](https://en.wikipedia.org/wiki/Stainless_steel) 316 ([passive](https://en.wikipedia.org/wiki/Passivation_(chemistry)))
* Stainless Steel 304 (passive)
* [Silicon](https://en.wikipedia.org/wiki/Silicon) [bronze](https://en.wikipedia.org/wiki/Bronze)
* Stainless Steel 316 (active)
* [Monel](https://en.wikipedia.org/wiki/Monel) 400
* [Phosphor bronze](https://en.wikipedia.org/wiki/Phosphor_bronze)
* [Admiralty brass](https://en.wikipedia.org/wiki/Brass)
* [Cupronickel](https://en.wikipedia.org/wiki/Cupronickel)
* [Molybdenum](https://en.wikipedia.org/wiki/Molybdenum)
* [Red brass](https://en.wikipedia.org/wiki/Gunmetal)
* Brass [plating](https://en.wikipedia.org/wiki/Plating)
* [Yellow brass](https://en.wikipedia.org/wiki/Brass)
* [Naval brass 464](https://en.wikipedia.org/wiki/Brass)
* Uranium 8% Mo
* [Niobium](https://en.wikipedia.org/wiki/Niobium) 1% [Zr](https://en.wikipedia.org/wiki/Zirconium" \o "Zirconium)
* [Tungsten](https://en.wikipedia.org/wiki/Tungsten)
* [Tin](https://en.wikipedia.org/wiki/Tin)
* [Lead](https://en.wikipedia.org/wiki/Lead)
* Stainless Steel 304 (active)
* [Tantalum](https://en.wikipedia.org/wiki/Tantalum)
* [Chromium](https://en.wikipedia.org/wiki/Chromium) plating
* [Nickel](https://en.wikipedia.org/wiki/Nickel) (passive)
* [Copper](https://en.wikipedia.org/wiki/Copper)
* Nickel (active)
* [**Cast iron**](https://en.wikipedia.org/wiki/Cast_iron)**(it has highly porous oxide layer/film therefore undergoes further corrosion)**
* [Steel](https://en.wikipedia.org/wiki/Steel)
* [Indium](https://en.wikipedia.org/wiki/Indium)
* [**Aluminum**](https://en.wikipedia.org/wiki/Aluminum)**(it has stable oxide film/layer therefore no further corrosion)**
* [Uranium](https://en.wikipedia.org/wiki/Uranium) (pure)
* [Cadmium](https://en.wikipedia.org/wiki/Cadmium)
* [Beryllium](https://en.wikipedia.org/wiki/Beryllium)
* [Zinc](https://en.wikipedia.org/wiki/Zinc) plating (see [galvanization](https://en.wikipedia.org/wiki/Galvanization))
* [Magnesium](https://en.wikipedia.org/wiki/Magnesium)
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