Assignment-2

1. In a galvanic cell the cathode is an Ag^+ (1.0 M)/Ag(s) halfcell. The anode is a standard hydrogen electrode immersed in a buffer solution containing 0.10 *M* benzoic acid (C_6H_5COOH) and 0.050 *M* sodium benzoate ($C_6H_5COO^-Na^+$) . The measured cell voltage is 1.030 V. What is the p^{Ka} of benzoic acid?
2. Metallic magnesium can be made by the electrolysis of molten $MgCl_2$. **(a)** What mass of Mg is formed by passing a current of 4.55 A through molten $MgCl_2$, for 4.50 days? **(b)** How many minutes are needed to plate out 25.00g Mg from molten $MgCl_2$ using 3.50 A of current? **(c)** Predict the products resulting from the electrolysis of 1 M $MgCl_2$ (aq).
3. Using the data given in annexure address the following questions (a) Why does gold not tarnish air? (b) Will the following disproportionation occur spontaneously?
   $3Au^+_{(aq)} \rightarrow Au^{3+}_{(aq)} + 2Au_{(s)}$
   (c) Predict the reaction between gold and fluorine gas.
4. A voltaic cell is constructed from an $Ni^{2+}(aq)/Ni(s)$ half-cell and an $Ag^+(aq)/Ag(s)$ half-cell. The initial concentration of Ni^{2+} in $Ni^{2+}(aq)/Ni(s)$ half-cell is 0.01M. The initial cell voltage is 1.12V. **(a)** By using data in annexure, calculate the standard emf of this voltaic cell. **(b)** Will the concentration of Ni^{2+} increase or decrease as the cell operates? **(c)** What is the initial concentration of Ag^+ in the Ag^+/Ag half-cell?
5. Describe the method of electroplating Cu in sulphate bath with suitable diagram

Instructions:

(1) Problems must be solved step by step.

(2) The assignment must be handwritten, scanned by mobile phone, and submitted as a pdf file

(3) The assignment must be submitted on or before 28/01/2021. Assignment submitted after due date will not be considered.

(4) The assignment must be submitted at chemistry@nitgoa.ac.in

(5) Your email submission must strictly have the subject as “Assignment-2, Roll No: 12ABC3456”.

(6) YOU MUST STRICTLY FOLLOW THE INSTRUCTION 1-5, OR ELSE YOUR ASSIGNMENT WILL NOT ACCEPTED.

Potentials in Alphabetical Order

Reduction half-reaction	$E°$ (V)	Reduction half-reaction	$E°$ (V)
$Ag^+ + e^- \rightarrow Ag$	+0.80	$In^{2+} + e^- \rightarrow In^+$	−0.40
$Ag^{2+} + e^- \rightarrow Ag^+$	+1.98	$In^{3+} + e^- \rightarrow In^{2+}$	−0.49
$AgBr + e^- \rightarrow Ag + Br^-$	+0.07	$In^{3+} + 2\ e^- \rightarrow In^+$	−0.44
$AgCl + e^- \rightarrow Ag + Cl^-$	+0.22	$In^{3+} + 3\ e^- \rightarrow In$	−0.34
$AgF + e^- \rightarrow Ag + F^-$	+0.78	$K^+ + e^- \rightarrow K$	−2.93
$AgI + e^- \rightarrow Ag + I^-$	−0.15	$La^{3+} + 3\ e^- \rightarrow La$	−2.52
$Al^{3+} + 3\ e^- \rightarrow Al$	−1.66	$Li^+ + e^- \rightarrow Li$	−3.05
$Au^+ + e^- \rightarrow Au$	+1.69	$Mg^{2+} + 2\ e^- \rightarrow Mg$	−2.36
$Au^{3+} + 3\ e^- \rightarrow Au$	+1.40	$Mn^{2+} + 2\ e^- \rightarrow Mn$	−1.18
$Ba^{2+} + 2\ e^- \rightarrow Ba$	−2.91	$Mn^{3+} + e^- \rightarrow Mn^{2+}$	+1.51
$Be^{2+} + 2\ e^- \rightarrow Be$	−1.85	$MnO_2 + 4\ H^+ + 2\ e^- \rightarrow Mn^{2+} + 2\ H_2O$	+1.23
$Bi^{3+} + 3\ e^- \rightarrow Bi$	+0.20	$MnO_4^- + e^- \rightarrow MnO_4^{2-}$	+0.56
$Br_2 + 2\ e^- \rightarrow 2\ Br^-$	+1.09	$MnO_4^- + 8\ H^+ + 5\ e^- \rightarrow Mn^{2+} + 4\ H_2O$	+1.51
$BrO^- + H_2O + 2\ e^- \rightarrow Br^- + 2\ OH^-$	+0.76	$MnO_4^{2-} + 2\ H_2O + 2\ e^- \rightarrow MnO_2 + 4\ OH^-$	+0.60
$Ca^{2+} + 2\ e^- \rightarrow Ca$	−2.87	$NO_3^- + 2\ H^+ + e^- \rightarrow NO_2 + H_2O$	+0.80
$Cd^{2+} + 2\ e^- \rightarrow Cd$	−0.40	$NO_3^- + 4\ H^+ + 3\ e^- \rightarrow NO + 2\ H_2O$	+0.96
$Cd(OH)_2 + 2\ e^- \rightarrow Cd + 2\ OH^-$	−0.81	$NO_3^- + H_2O + 2\ e^- \rightarrow NO_2^- + 2\ OH^-$	+0.01
$Ce^{3+} + 3\ e^- \rightarrow Ce$	−2.48	$Na^+ + e^- \rightarrow Na$	−2.71
$Ce^{4+} + e^- \rightarrow Ce^{3+}$	+1.61	$Ni^{2+} + 2\ e^- \rightarrow Ni$	−0.23
$Cl_2 + 2\ e^- \rightarrow 2\ Cl^-$	+1.36	$Ni(OH)_3 + e^- \rightarrow Ni(OH)_2 + OH^-$	+0.49
$ClO^- + H_2O + 2\ e^- \rightarrow Cl^- + 2\ OH^-$	+0.89	$O_2 + e^- \rightarrow O_2^-$	−0.56
$ClO_4^- + 2\ H^+ + 2\ e^- \rightarrow ClO_3^- + H_2O$	+1.23	$O_2 + 4\ H^+ + 4\ e^- \rightarrow 2\ H_2O$	+1.23
$ClO_4^- + H_2O + 2\ e^- \rightarrow ClO_3^- + 2\ OH^-$	+0.36	$O_2 + H_2O + 2\ e^- \rightarrow HO_2^- + OH^-$	−0.08
$Co^{2+} + 2\ e^- \rightarrow Co$	−0.28	$O_2 + 2\ H_2O + 4\ e^- \rightarrow 4\ OH^-$	+0.40
$Co^{3+} + e^- \rightarrow Co^{2+}$	+1.81	$O_3 + 2\ H^+ + 2\ e^- \rightarrow O_2 + H_2O$	+2.07
$Cr^{2+} + 2\ e^- \rightarrow Cr$	−0.91	$O_3 + H_2O + 2\ e^- \rightarrow O_2 + 2\ OH^-$	+1.24
$Cr_2O_7^{2-} + 14\ H^+ + 6\ e^- \rightarrow 2\ Cr^{3+} + 7\ H_2O$	+1.33	$Pb^{2+} + 2\ e^- \rightarrow Pb$	−0.13
$Cr^{3+} + 3\ e^- \rightarrow Cr$	−0.74	$Pb^{4+} + 2\ e^- \rightarrow Pb^{2+}$	+1.67
$Cr^{3+} + e^- \rightarrow Cr^{2+}$	−0.41	$PbSO_4 + 2\ e^- \rightarrow Pb + SO_4^{2-}$	−0.36
$Cs^+ + e^- \rightarrow Cs$	−2.92	$Pt^{2+} + 2\ e^- \rightarrow Pt$	+1.20
$Cu^+ + e^- \rightarrow Cu$	+0.52	$Pu^{4+} + e^- \rightarrow Pu^{3+}$	+0.97
$Cu^{2+} + 2\ e^- \rightarrow Cu$	+0.34	$Ra^{2+} + 2\ e^- \rightarrow Ra$	−2.92
$Cu^{2+} + e^- \rightarrow Cu^+$	+0.15	$Rb^+ + e^- \rightarrow Rb$	−2.93
$F_2 + 2\ e^- \rightarrow 2\ F^-$	+2.87	$S + 2\ e^- \rightarrow S^{2-}$	−0.48
$Fe^{2+} + 2\ e^- \rightarrow Fe$	−0.44	$SO_4^{2-} + 4\ H^+ + 2\ e^- \rightarrow H_2SO_3 + H_2O$	+0.17
$Fe^{3+} + 3\ e^- \rightarrow Fe$	−0.04	$S_2O_8^{2-} + 2\ e^- \rightarrow 2\ SO_4^{2-}$	+2.05
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	+0.77	$Se + 2\ e^- \rightarrow Se^{2-}$	−0.67
$Ga^+ + e^- \rightarrow Ga$	−0.53	$Sn^{2+} + 2\ e^- \rightarrow Sn$	−0.14
$2\ H^+ + 2\ e^- \rightarrow H_2$	**0,** by definition	$Sn^{4+} + 2\ e^- \rightarrow Sn^{2+}$	+0.15
$2\ HBrO + 2\ H^+ + 2\ e^- \rightarrow Br_2 + 2\ H_2O$	+1.60	$Sr^{2+} + 2\ e^- \rightarrow Sr$	−2.89
$2\ HClO + 2\ H^+ + 2\ e^- \rightarrow Cl_2 + 2\ H_2O$	+1.63	$Te + 2\ e^- \rightarrow Te^{2-}$	−0.84
$2\ H_2O + 2\ e^- \rightarrow H_2 + 2\ OH^-$	−0.83	$Ti^{2+} + 2\ e^- \rightarrow Ti$	−1.63
$H_2O_2 + 2\ H^+ + 2\ e^- \rightarrow 2\ H_2O$	+1.78	$Ti^{3+} + e^- \rightarrow Ti^{2+}$	−0.37
$H_4XeO_6 + 2\ H^+ + 2\ e^- \rightarrow XeO_3 + 3\ H_2O$	+3.0	$Ti^{4+} + e^- \rightarrow Ti^{3+}$	0.00
$Hg_2^{2+} + 2\ e^- \rightarrow 2\ Hg$	+0.79	$Tl^+ + e^- \rightarrow Tl$	−0.34
$Hg^{2+} + 2\ e^- \rightarrow Hg$	+0.85	$U^{3+} + 3\ e^- \rightarrow U$	−1.79
$2\ Hg^{2+} + 2\ e^- \rightarrow Hg_2^{2+}$	+0.92	$U^{4+} + e^- \rightarrow U^{3+}$	−0.61
$Hg_2Cl_2 + 2\ e^- \rightarrow 2\ Hg + 2\ Cl^-$	+0.27	$V^{2+} + 2\ e^- \rightarrow V$	−1.19
$I_2 + 2\ e^- \rightarrow 2\ I^-$	+0.54	[redacted]	[redacted]
$I_3^- + 2\ e^- \rightarrow 3\ I^-$	+0.53	$Zn^{2+} + 2\ e^- \rightarrow Zn$	−0.76
$In^+ + e^- \rightarrow In$	−0.14		