

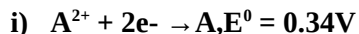
Work sheet on Electrochemistry

- Which one of the following is wrong about corrosions of metals?
 - A region of the metal surface serves as both anode and cathode.
 - The standard cell emf for this process is 1.67v
 - The cathode half-cell rxn is : $\text{Fe}^{+2}(\text{aq}) + 2\text{e} \rightarrow \text{Fe}(\text{s})$
 - The net cell rxn is: $2\text{Fe}(\text{s}) + \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) \rightarrow 2\text{Fe}^{+2}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$
 - All of the following statements are true about H-O fuel cells Except:
 - Fuel cells do not store chemical energy
 - Reactants must be continuously supplied and products removed from the cell.
 - The anode half-cell rxn is: $\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e} \rightarrow 4\text{OH}^-(\text{aq})$
 - The standard emf of the cell is 1.23v
 - The overall rxn is: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
 - A galvanic cell consists of a Mg electrode in a 1.0 M $\text{Mg}(\text{NO}_3)_2$ solution and a Ag electrode in a 1.0 M AgNO_3 solution. The standard emf of this cell at 25°C is:
 - 3.17V
 - 1.57V
 - 3.17V
 - 1.57V
 - Which of the following metals will react with (that is, be oxidized by) HNO_3 , but not with HCl ?
 - Ag
 - Cu
 - Zn
 - Pt
 - Which one of the following values favours the formation of reactants?
 - $\Delta G^0 < 0$
 - $K < 1$
 - $E^0_{\text{cell}} > 0$
 - $K > 1$
 - For a rxn: $\text{Mg}^{+2} + 2\text{e} \rightarrow \text{Mg}(\text{s}), E^0 = -2.37\text{V}$. Which of the following statement is true?
 - E depends upon temperature
 - E changes when Mg plate is made bigger in size
 - E becomes double if the above eqn is multiplied by 2
 - Mg^{+2} can be reduced to Mg metal by SHE
 - A certain half-cell rxn: $\text{X} + \text{e} \rightarrow \text{X}^-$ has a very large value of negative reduction potential. This implies that :
 - X can be readily reduced
 - X^- can be readily oxidized
 - X can be readily oxidized
 - X^- can be readily reduced
 - On the electrolysis of 10^{-6}M HCL soln,
 - CL_2 gas is produced at cathode
 - O_2 gas is produced at cathode
 - H_2 gas is produced at cathode
 - CL_2 gas is produced at anode
 - Which one of the following species can't be reduced by $\text{Cr}(E^0_{\text{red}} = -0.74\text{V})$?
 - $\text{Ni}^{+2}, E^0_{\text{red}} = -0.26\text{V}$
 - $\text{Mg}^{+2}, E^0_{\text{red}} = -2.37\text{V}$
 - $\text{Ag}^+, E^0_{\text{red}} = 0.80\text{V}$
 - $\text{Cu}^{+2}, E^0_{\text{red}} = 0.34\text{V}$
 - Which species can be oxidized by SHE?
 - $\text{Cu}, E^0_{\text{red}} = 0.34\text{V}$
 - $\text{Al}, E^0_{\text{red}} = -1.66\text{V}$
 - $\text{Au}, E^0_{\text{red}} = 1.50\text{V}$
 - $\text{Br}_2, E^0_{\text{red}} = 1.07\text{V}$
 - Which one of the following is the correct cell diagram representation for the rxn:
 $\text{Sn}(\text{s}) + 2\text{Fe}^{+3}(\text{aq}) \rightarrow \text{Sn}^{+2}(\text{aq}) + 2\text{Fe}^{+2}(\text{aq})$
 - $\text{Sn}(\text{s})/\text{Sn}^{+2}(\text{aq})//\text{Fe}^{+3}(\text{aq})/\text{Fe}^{+2}(\text{aq})/\text{Pt}$
 - $\text{Sn}(\text{s})/\text{Sn}^{+2}(\text{aq})//\text{Fe}^{+3}(\text{aq}), \text{Fe}^{+2}(\text{aq})/\text{Pt}$
 - $\text{Fe}^{+2}(\text{aq})/\text{Fe}^{+3}(\text{aq})//\text{Sn}^{+2}(\text{aq})/\text{Sn}(\text{s})/\text{pt}$
 - $\text{Pt}/\text{Fe}^{+3}(\text{aq}), \text{Fe}^{+2}(\text{aq})//\text{Sn}^{+2}(\text{aq})/\text{Sn}(\text{s})/$
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12. Under what conditions the voltage produced by the cell equals to the emf at standard condition?
 A. When the [reactants] > [products] B. When the [reactants] < [products]
 C. When the [reactants] = [products] D. Unpredictable
13. The voltage produced by a Daniell cell is observed to be 1.22v. If the $[Cu^{+2}] = 1M$, then the $[Zn^{+2}]$ in the cell become:
 A. 0.1M B. $10^{-4}M$ C. 0.5M D. 0.2M
14. Which one of the following rxn is spontaneous ?
 A. $Cr(s) + 3Fe^{+3}(aq) \rightarrow Cr^{+3}(aq) + 3Fe(aq)$ B. $Cu(s) + 2H^{+}(aq) \rightarrow Cu^{+2}(aq) + H_2(g)$
 C. $I_2(s) + 2Fe^{+2}(aq) \rightarrow 2Fe^{+3}(aq) + 2I^{-}(aq)$ D. $2Ag(s) + Cu^{+2}(aq) \rightarrow 2Ag^{+}(aq) + Cu(s)$
 Given that: E^0_{red} of $Cu^{+2}/Cu = 0.34v$, $Ag^{+}/Ag = 0.80v$, $Cr^{+3}/Cr = -0.74v$, $I_2/I^{-} = 0.53v$, $Fe^{+3}/Fe^{+2} = 0.77v$
15. 0.5 farads of electricity was passed in to an electrolytic cell to deposits all the copper present in 500ml of $CuSO_4$ soln. The molarity of the electrolyte is:
 A. 0.5M B. 0.25M C. 1.5M D. 1M
16. The time required to remove electrolytically one-fourth of Ag from 200ml of 0.1M $AgNO_3$ soln by a current of 0.5A is about:
 A. 64 minute B. 16 minute C. 28 minute D. 32minute
17. The mass of copper that will be deposited at cathode in electrolysis of 0.2M soln of $CuSO_4$ when a quantity of electricity equal to that required to liberate 2.24L of H_2 from 0.1M H_2SO_4 will be:
 A. 1.59gm B. 3.18gm C. 6.35gm D. 12.7gm
18. The equilibrium constant for the redox reaction at $25^{\circ}C$ is:
 $Sn(s) + 2Cu^{+2}(aq) \leftrightarrow Sn^{+2}(aq) + 2Cu^{+}(aq)$. E^0_{red} of $Cu^{+2}/Cu^{+} = 0.15V$ and that of $Sn^{+2}/Sn = -0.14V$
 A. 7×10^9 B. 5×10^4 C. 6×10^7 D. 5×10^9
19. The best oxidizing agent among the following is:
 A. Fe B. Ag C. Na D. Zn
20. The cell emf of the galvanic cell represented as: $2Ag^{+}(0.05M) + Zn(s) \rightarrow 2Ag(s) + Zn^{+2}(0.01M)$ is:
 A. 1.58V B. 1.56V C. -1.42V D. -1.58V
21. The emf of the Zn-Cu cell under the conditions : $Zn(s) + Cu^{+2}(0.2M) \rightarrow Cu(s) + Zn^{+2}(0.4M)$ is:
 A. 1.10V B. 1.09V C. 0.10V D. 1.11V
22. The standard free-energy change for the following reaction at $25^{\circ}C$ is:
 $2Au(s) + 3Ca^{+2}(1.0M) \rightarrow 2Au^{+3}(1.0M) + 3Ca(s)$, E^0_{red} of $Au^{+3}/Au = 1.50V$, $Ca^{+2}/Ca = -2.87V$
 A. $2.53 \times 10^3 KJ/mol$ B. $1.48 \times 10^2 KJ/mol$ C. $8.63 \times 10^3 KJ/mol$
 D. $4.56 \times 10^2 KJ/mol$
23. Which one of the following metals can't be prepared by chemical reduction process?
 A. Cu B. Zn C. Al D. Ag
24. An electrochemical cell constructed as: $Cu^{+2}(aq) + M(s) \rightarrow Cu(s) + M^{+2}(aq)$ has an $E^0_{cell} = 0.75V$. If the E^0_{red} of Cu^{+2}/Cu is 0.34v, what is the E^0_{red} value for the metal M?
 A. -1.09V B. -0.41V C. 0.41V D. 1.09V
25. A soln at $25^{\circ}C$ contains the metal ions: Ni^{+2} , Pt^{+2} and Pd^{+2} , all at 1M conce. If the E^0_{red} values of Ni, Pt and Pd respectively are -0.23V, 1.20V and 0.99V, then which metal will plate out first when the soln is electrolyzed?
 A. Ni B. Pd C. Pt D. Ni & Pd
26. An electrolytic cell contains a soln of Ag_2SO_4 and has Pt electrodes. A current is passed till 1.6gm of O_2 gas has been liberated at anode. The amount of Ag metal deposited at cathode will be:
 A. 108gm B. 1.6gm C. 3.2gm D. 21.6gm

27. A current of 1.72 A is passed through an electrolytic cell containing a dilute sulfuric acid solution for 6.42 h. The volume of O₂ and H₂ gases generated at STP respectively are:
 A. 5.32L, 1.82L B. 2.31L, 4.62L C. 4.62L, 2.31L D. 1.82L, 5.32L
28. How many moles of MnO₂ are produced in a basic soln when MnO₄⁻ and CN⁻ ions react to form MnO₂ and CNO⁻ ?
 A. 1 B. 2 C. 3 D. 5
29. How long will it take to deposit Cadmium from 300ml of 0.4M Cadmium sulfate soln by using a current of 2A?
 A. 193 minute B. 60 minute C. 248 minute D. 92 minute
30. The number of moles hydroxide when the rxn: CrO₄²⁻ + Fe(OH)₂ → Cr(OH)₃ + Fe(OH)₃ is balanced in basic media become: A. 3 B. 2 C. 5 D. 4
31. Consider the galvanic cell: Al(s)/ Al³⁺(aq)//Fe²⁺(aq)/ Fe(s). What is the cell reaction?
 A. Al(s) + Fe²⁺(aq) → Fe(s) + Al³⁺ B. Fe(s) + Al³⁺(aq) → Al(s) + Fe²⁺(aq)
 C. 2Al(s) + 3Fe²⁺(aq) → 3Fe(s) + 2Al³⁺(aq) D. Al(s) + Al³⁺(aq) → Fe²⁺(aq) + Fe(s)
32. During charging of a car battery(Lead-storage battery),the anode half-cell rxn is:
 A. Pb(s)+SO₄²⁻(aq) ↔ PbSO₄(s)+2e B. PbSO₄(s)+2H₂O(l) ↔ PbO₂(s)+4H⁺(aq)+SO₄²⁻(aq)+2e
 C. PbSO₄(s)+2e ↔ Pb(s)+SO₄²⁻(aq) D. PbO₂(s)+4H⁺(aq)+2e ↔ PbSO₄(s)+2H₂O(l)
33. During galvanizing iron with zinc to prevent corrosion, the substance that act as cathode is:
 A. Zn B. Fe C. graphite D. both Zn & Fe
34. 3gms of Al is given off by passing a current through an electrolytic cell. Using the same quantity of electricity, we can produce all of the following Except:
 A. 7.67gm Na B. 6.67gm Ca C. 36gm Ag D. 2gm Mg
35. Unlike the electrolytic cell, galvanic cell:
 A. is used in electroplating process.
 B. has a spontaneous process
 C. is used in the productions of metals from their ores
 D. uses electrical energy to generate chemical energy
36. Permanganate ion oxidizes sulfite ion in basic solution according to the following skeleton equation: MnO₄⁻(aq) + SO₃²⁻(aq) → MnO₂(s) + SO₄²⁻(aq) . The coefficient of OH⁻ when the rxn is balanced in basic media become:
 A. 2 B. 3 C. 6 D. 4
37. In hydrogen-oxygen fuel cell, the anode rxn is:
 A. 2H₂ + O₂ → 2H₂O B. 2H₂ + 4OH⁻ → 4H₂O + 4e
 C. O₂ + 2H₂O + 4e → 4OH⁻ D. H₂ → 2H⁺ + 2e
38. A current of 2A passing through the molten tin salt for five hours deposits 22.2gm of tin. The oxidation state of tin in the salt is: A. +4 B. +2 C. +3 D. +1

39. An electrochemical cell has two half-cell rxns as:



A. 2.71V

B. 2.03V

C. -2.71V

D. -2.03V

40. If the electropositive character the following metals is given as : $Mg > Al > Zn > Cu > Ag$, what will happen if copper spoon is used to stir a soln of aluminium nitrate ?

A. The spoon gets coated with Al

B. An alloy of Al and Cu is formed

C. No reaction occurs

D. The solution starts turning blue

41. Define : Sacrificial anode , Cathodic protection , Chromeplating

42. Predict whether the following reaction would proceed spontaneously as written at 298 K:



43. Consider the cell diagram: $Mg(s) / MgSO_4(0.40 M) // NiSO_4(0.60 M) / Ni(s)$.

A. Calculate the cell voltage at 25°C.

B. How does the cell voltage change when (a) $[Mg^{2+}]$ is decreased by a factor of 4 and (b) $[Ni^{2+}]$ is decreased by a factor of 3?

44. Given that $E^0 = 0.52 V$ for the reduction: $Cu^+(aq) + e^- \rightarrow Cu(s)$.

calculate E^0 , ΔG^0 and K for the following reaction at 25°C: $2Cu^+(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$

45. In a certain electrolysis experiment, 1.44 g of Ag were deposited in one cell (containing an aqueous $AgNO_3$ solution), while 0.120 g of an unknown metal X was deposited in another cell (containing an aqueous XCl_3 solution) in series with the $AgNO_3$ cell.

Calculate the molar mass of the unknown metal X

46. The concentration of a hydrogen peroxide solution can be conveniently determined by titration against a standardized potassium permanganate solution in an acidic medium according to the following unbalanced equation:

$MnO_4^- + H_2O_2 \rightarrow O_2 + Mn^{2+}$. If 36.44 mL of a 0.01652 M $KMnO_4$ solution are required to completely oxidize 25.00 mL of a H_2O_2 solution, calculate the molarity of the H_2O_2 solution.

47. Zinc metal reacts with nitric acid, HNO_3 , to produce a number of products, depending on how dilute the acid solution is. In a concentrated solution, zinc reduces nitrate ion to ammonium ion; zinc is oxidized to zinc ion, Zn^{2+} . Write the net ionic equation for this reaction.

48. The cell potential of a particular voltaic cell with the cell reaction

$Hg_2^{2+}(aq) + H_2(g) \rightarrow 2Hg(l) + 2H^+(aq)$ is 0.650 V. Calculate the maximum electrical work of this cell when 0.500 g H_2 is consumed.
