Chem12 Electrochem : Exam Probs - 100

1) Which of the following sets of conditions must be maintained when determining the E° of an electrochemical cell ?

a) 25°C, 1.0 M solution, 101.3 kPa
b) 0°C, 0.1 M solution, 100 kPa
c) 25°C, 0.1 M solution, 100 kPa
d) -273°K, 1.0 M solution, 760 kPa

2) A chemist wishes to change the table of standard reduction potentials so that the standard Co^{2+}/Co cell will have a voltage of zero. What value will he assign for the voltage of the standard Cl_2/Cl^- cell ?

a) -1.64 b) -1.08 c) 1.08 d) 1.64

3) Which one of the following metals will provide the best cathodic protection to an iron pipeline ?

a) Cr b) Mg c) Pb d) Sn

4) A student is conducting an experiment in which he must determine the E° of a cell. He must ensure that the cell temperature is

a) 0°K b) 25°K c) 0°C d) 25°C

5) An electrochemical cell has a strip of Zn dipping into 1.0 M $Zn(NO_3)_2(aq)$ in one half-cell and a strip of Ni dipping into 1.0 M $Ni(NO_3)_2$ in the other half-cell. A salt bridge connects the two half-cells. Which one of the following statements about the cell is incorrect ?

a) The $[Zn^{2+}]$ will increase b) The nickel strip will lose mass
c) Nickel(II) ions will migrate toward the nickel
d) Electrons will flow from the zinc to the nickel

6) An electrochemical cell has a strip of Zn dipping into 1.0 M $Zn(NO_3)_2$ in one half-cell and a strip of Ni dipping into 1.0 M $Ni(NO_3)_2$ in the other half-cell. A salt bridge connects the two half cells. If 0.500 moles of electrons flow in the cell, which one of the following statements is correct ?

a) The voltage of the cell will increase

b) The zinc strip will be 16.4 g greater in mass
c) The nickel strip will be 14.7 g greater in mass
d) The nickel strip will be 29.4 g greater in mass

7) What would happen to the voltage of an operating cell with the overall equation $Cu^{2+} + Ni \rightarrow Ni^{2+} + Cu$ if pure water were added to the Ni^{2+}/Ni half cell.

a) The voltage would increase
b) The voltage would decrease
c) The voltage would remain constant
d) The voltage would decrease at first, then slowly increase to the original voltage

8) If the E° for the half-reaction $Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$ were set at zero volts, what would be the E° for the half-reaction $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$?

a) -0.59 V b) -0.34 V c) 0.09 V d) 0.59 V

9) Which of the following half-reactions is involved in an electrolytic process to replate an iron automobile bumper with chromium ?

a) $Cr(s) + 3e^- \rightarrow Cr^{3-}(aq)$
b) $Cr^{3+}(aq) \rightarrow 3e^- + Cr(s)$
c) $Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$
d) $Cr(s) \rightarrow Cr^{3+}(aq) + 3e^-$

10) Which one of the following functions is **NOT** performed by the salt bridge in an electrochemical cell ?

a) It acts as an electrolyte.
b) It completes the circuit.
c) It allows the solution in each half-cell to become electrically charged.
d) It prevents the increase of charge in each half-cell.

11) An electrochemical cell is constructed with a zinc electrode in $Zn(NO_3)_2$ solution and an aluminum electrode in $Al(NO_3)_3$ solution. The two solutions are connected by a salt bridge. Identify the anode and cathode. State the reason for your choice. Support your answer by giving the half-reactions for the anode and cathode. State the cell voltage.

12) Which of the following species is oxidized during the operation of the electrochemical cell $Ca/Ca^{2+}||\ Mn^{2+}/Mn$?

a) $Ca^{2+}(aq)$ b) $Mn^{2+}(aq)$ c) Ca(s) d) Mn(s)

13) Which of the following energy sources will most likely have a PbO_2 electrode ?

a) Dry cell b) Fuel cell
c) Mercury battery d) Automobile battery

14) How many grams of magnesium are deposited when 2.0 faradays (2.0 moles) of charge is used in the electrolysis of molten magnesium chloride ?

a) 12 b) 24 c) 36 d) 48

15) What is the E° for the reaction :

$$Sn^{2+}(aq) + I_2(s) \rightarrow Sn^{4+}(aq) + 2I^-(aq)\ ?$$

a) 0.68 V b) 0.38 V c) -0.38 V d) -0.68 V

16) What is the unit for the rate of charge flow ?

a) Volt b) Joule c) Ampere d) Coulomb

17) Which one of the following will decrease the reduction potential for the half cell :

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)\ ?$$

a) Add NaOH(s) b) Add $H_2SO_4(l)$ c) Decrease $[Mn^{2+}(aq)]$
d) Increase $[\ MnO_4^-(aq)\ ]$

18) Which of the following metals will provide cathodic protection for aluminum against corrosion ?

a) Mg(s) b) Co(s) c) Zn(s) d) Cu(s)

19) Which one of the following converts chemical energy to electrical energy ?

a) Industrial production of aluminum
b) Copper plating by electrolysis
c) Discharging a lead-acid battery
d) Industrial production of chlorine

20) Which half-reaction best describes what is taking place at the cathode during the electrolysis of a 1.0 M NaCl solution ?

a) $Na^+ + e^- \rightarrow Na$ b) $2Cl^- \rightarrow Cl_2(g) + 2e^-$
c) $2H^+(10^{-7}\ M) + 2e^- \rightarrow H_2(g)$
d) $H_2O \rightarrow 1/2\ O_2(g) + 2H^+(10^{-7}\ M) + 2e^-$

21) What is the E° value for the reaction between Pb(s) and $Cl_2(g)$?

a) -1.49 V b) -1.23 V c) 1.23 d) 1.49

22) Electrons in an electrochemical cell move

a) From cathode to anode by means of a wire
b) From anode to cathode by means of a wire
c) From anode to cathode by means of a salt bridge
d) From the oxidizing agent to the reducing agent by means of a wire.

23) The function of a salt bridge in an electrochemical cell is

a) to provide a path for ions to migrate between the two half-cells.
b) to provide a path for anions to migrate towards the cathode.
c) to provide a path for electrons to flow from one electrode to the other.
d) to supply ions for the oxidation and reduction processes at the electrodes.

24) Nickel metal is prepared by electrolysis as follows :

$$Ni^{2+}(aq) + 2Cl^-(aq) \rightarrow Ni(s) + Cl_2(g)$$

What is the minimum voltage necessary for the electrolysis reaction to proceed ?

a) 1.11 V b) 1.61 V c) 2.97 V d) 3.22 V

25) Which metal would provide the best cathodic protection for iron pipes ?

a) Cu b) Sn c) Zn d) Pb

26) The following pairs of metals are placed in solutions of their nitrate salts at standard conditions to make electrochemical cells. Which pair of metals will give the electrochemical cell with the highest voltage ?

a) Ag and Hg b) Ag and Fe c) Ag and Cr d) Ag and Zn

27) An electrochemical cell involves the following half-reactions :

$Ag^+(aq) + e^- <-> Ag(s)$ $E° = 0.80$ V
$Mn^{2+}(aq) + 2e^- <-> Mn(s)$ $E° = -1.18$ V

Which of the following statements is correct after the cell has run for a period of time ?

a) Moles Ag(s) produced = moles Mn(s) used up
b) Moles Ag(s) used up = moles Mn(s) produced
c) Moles Ag(s) produced = 2 times moles Mn(s) used up
d) Moles Ag(s) used up = 2 times moles Mn(s) produced

28) Which of the following occurs when a $Zn/Zn^{2+} || Pb^{2+}/Pb$ electrochemical cell is operating ?

a) Zn^{2+} ions migrate to the Zn electrode
b) Pb^{2+} ions migrate to the Pb electrode
c) Anions migrate from the anode to the cathode
d) Electrons migrate from the anode to the cathode through the salt bridge.

29) What would be the maximum voltage obtained using the half-cells Co/Co^{2+} and Zn/Zn^{2+} at standard conditions ?

a) -1.04 V b) -0.48 V c) 0.48 V d) 1.04 V

30) A particular reaction has a predicted E° value of - 1.35 V. This indicates that the reaction would

a) occur rapidly b) produce energy c) go to completion d) be non-spontaneous

31) Corrosion of a metal means that the metal

a) acts as a cathode b) undergoes oxidation
c) undergoes reduction d) acts as an oxidizing agent

32) If two cells form the electrochemical cell Cr/Cr^{3+} || Ag/Ag^{+}, the silver electrode :

a) is the site of oxidation b) loses mass
c) is undergoing reduction d) is the reducing agent

33) The electrolysis of a solution of strontium iodide will cause the formation at the anode of

a) strontium b) iodine c) hydrogen gas d) oxygen gas

34) The electrolysis of aqueous NaCl using electrodes of Cu will result in the formation at the anode of

a) H_2 b) O_2 c) Cl_2 d) Cu^{2+}

35) In the electrochemical cell Fe/Fe^{2+} || Au^{3+}/Au using all nitrate solutions and the salt bridge of $NaNO_3(aq)$, as the reaction proceeds, identify the species leaving the anode.

a) Fe^{2+} b) Na^{+} c) Au^{3+} d) NO_3^{-}

36) The electrochemical cell Ni/Ni^{2+} || Cu/Cu^{2+} is set up. Identify the cathode reaction.

a) $Cu \rightarrow Cu^{2+} + 2e^{-}$ b) $Cu^{2+} + 2e^{-} \rightarrow Cu$
c) $Ni \rightarrow Ni^{2+} + 2e^{-}$ d) $Ni^{2+} + 2e^{-} \rightarrow Ni$

37) The main characteristic of the two species undergoing a redox titration reaction must be

a) a change in mass b) a change in concentration

c) a change in color d) a change in oxidation number

38) A piece of zinc is to be chromium plated. The anode must be the element

a) copper b) zinc c) chromium d) carbon

39) An electrochemical cell Fe/Fe^{2+} || Pb/Pb^{2+} is constructed. The anode is

a) Pb and the charge is + b) Pb and the charge is -
c) Fe and the charge is + d) Fe and the charge is -

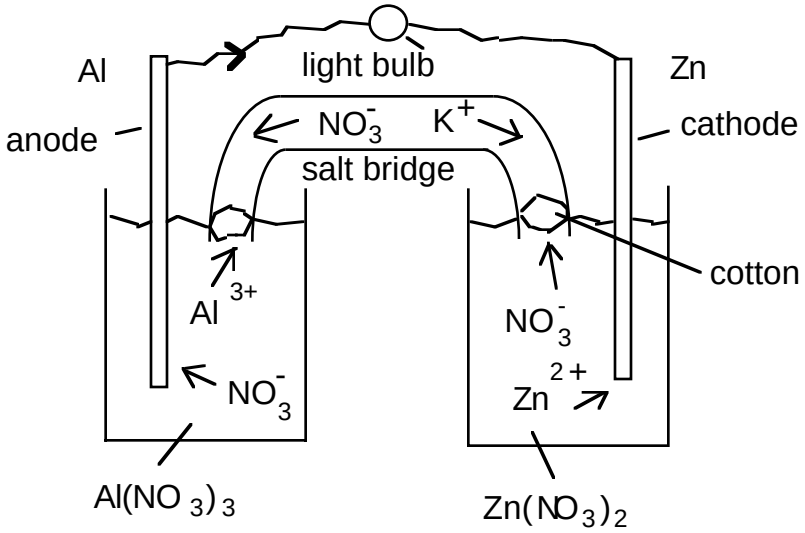
40) Which of the following could be used to cathode protect a chromium mug?

a) Pb b) Sn c) Co d) Mn

41) What are the requirements for rusting to occur ? The presence of

a) O_2 and Fe b) H_2O and Fe c) O_2 and H_2O d) O_2, H_2O, Fe

Answers : 1) a, 2) d, 3) b, 4) d, 5) b, 6) c, 7) a, (this question is beyond the current scope of Chem 12, see the Nernst equation, also Hebden, Chemistry, Theory and Problems, Book 2, 1980), 8) d, 9) c, 10) c, 11)



11) continued, The anode is Al. It is more easily oxidized than zinc. The anode half-reaction is $Al \rightarrow Al^{3+} + 3e^-$. The cathode half-reaction is $Zn^{2+} + 2e^- \rightarrow Zn$. The cell voltage is 0.90V.

12) c, 13) d, 14) b, 15) b, 16) c, 17) a, 18) a, 19) c, 20) c, 21) d, 22) b, 23) a, 24) b, 25) c, 26) d, 27) c, 28) b, 29) c, 30) d, 31) b, 32) c, 33) b, 34) c, 35) a, 36) b, 37) d, 38) c, 39) d, 40) d, 41) d.