WORKSHEET 4

ELECTROLYSIS

Syllabus reference 9.6.3

1 Complete the following. Factors that determine the products of an electrolysis reaction are the:

a chemical nature of the electrolyte in the solution

b Concentration of the ions present

c Nature of the electrodes.

For questions 2–8 circle the letter corresponding to the most correct answer.

2 Which of the following best identifies the anode in an electrolytic cell? It is the electrode at which:
A anions are discharged
B no gas can be evolved
C hydroxide ions are produced
D oxidation occurs

3 Consider the electrolysis of a concentrated aqueous solution of sodium chloride using inert electrodes. Which of the following equations represents the reaction at the positive electrode?
A $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$
B $Na^+ + e^- \rightarrow Na$
C $2Cl^- \rightarrow Cl_2 + 2e^-$
D $Cl_2 + 2e^- \rightarrow 2Cl^-$

4 When a dilute solution of hydrochloric acid undergoes electrolysis using inert electrodes:
A oxygen is produced at the anode and chloride ions are oxidised
B oxygen is produced at the cathode and chloride ions are oxidised
C oxygen is produced at the anode and hydrogen ions are reduced
D hydrogen is produced at the anode and chloride ions are oxidised

5 The production of pure copper in commercial quantities involves electrolysis of a copper sulfate solution using copper electrodes. During this process:
A copper metal is deposited on the positive electrode
B hydrogen gas is given off at the negative electrode
C copper ions migrate towards the anode
D the mass of the anode decreases

6 For an electrolytic cell the cathode is:
A negative and the site of oxidation
B positive and the site of oxidation
C negative and the site of reduction
D positive and the site of reduction

7 Which of the following does *not* affect the rate of an electrolytic reaction?

A inert electrodes
B voltage applied
C concentration of ions in the electrolyte
D distance between electrodes

8 If 500 electrons per second are being released at one electrode of an electrolytic cell, the number of electrons per second being used up at the other electrode is:

A at least 500
B exactly 500
C greater than 500
D dependent on the chemicals used

9 For the electrolysis of a neutral nickel(II) chloride aqueous solution using inert platinum electrodes, predict the electrode reactions. Give the electrode half-reactions and the overall cell reaction.

Depending on concentration:

Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$ or $2H_2O \rightarrow O_2 + 4H^+ + 4e$

Cathode: $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Overall: $2H_2O + 2Cl^- \rightarrow H_2(g) + 2OH^- + Cl_2(g)$ or $2H_2O(l) \rightarrow O_2(g) + 2H_2(g)$

10 For the electrolysis of a 1.00 mol/L aqueous solution of potassium sulfate using inert electrodes, predict the products at the anode and cathode and write the overall equation.

Anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Cathode: $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Overall: $2H_2O(l) \rightarrow O_2(g) + 2H_2(g)$

11 Predict the anode and cathode reactions for the electrolysis of copper bromide solution with copper electrodes.

Anode: $Cu \rightarrow Cu^{2+} + 2e^-$

Cathode: $Cu^{2+} + 2e^- \rightarrow Cu(s)$

12 A neutral solution of $Pb(NO_3)_2$ is electrolysed using copper electrodes. Referring to the table of electrode potentials in your textbook, write the half-cell and overall cell reactions.

Anode: $Cu(s) \rightarrow Cu^{2+} + 2e^-$

Cathode: $Pb^{2+} + 2e^- \rightarrow Pb(s)$

Overall: $Cu(s) + Pb^{2+} \rightarrow Cu^{2+} + Pb(s)$

13 Write a statement explaining the relationship between the rate of product formation and the current that passes through an electrolysis cell.

The higher the current, the greater the rate of product formation.

14 Classify each of the following statements as true or false. For those statements that are false rewrite them so they are true.

a The higher the voltage the lower the current.

FALSE The higher the voltage the HIGHER the current.

b The higher the conductance, the lower the resistance and the greater the current.

TRUE

c Increasing the concentration of ions in solution increases the conductance.

TRUE

d The greater the surface area of the electrodes, the lower the electrical conductance.

FALSE The greater surface area of the electrodes the GREATER the electrical conductance.

e Changing the distance between electrodes has no effect on conductance.

FALSE Changing the distance between electrodes AFFECTS THE conductance.