QUESTION

For cathodic protection used to prevent corrosion of iron to be effective which of the following must be true?

A. The anode used must be a better oxidizing agent than iron.
B. The sacrificial anode used must react with oxygen to protect the iron from reacting with oxygen.
C. Iron must have a higher reduction potential than the metal used as the anode.
D. In cathodic protection systems a metal is attached or connected to iron in such a way that electrons flow away from the iron to the ground through the metal.
E. The anode must be free of oxygen and water.

ANSWER

C.

To cathodically protect iron from corrosion is to provide another metal, in contact with the iron sample, to oxidize in place of iron.

Thus the other metal sacrifices itself in place of the iron. Only a metal that is a better reducing agent than iron can do this. (A higher reduction potential.)

QUESTION

Voltaic cells and electrolytic cells are based on thermodynamic principles. Which statement about these cells is <u>correct</u>?

A) The mass of the anode increases in a voltaic cell as the cell discharges.

B) Reduction occurs at the anode only in the electrolytic cell.

C) In a voltaic cell, electrons travel from the cathode to the anode in solution.

D) The free energy change ΔG is greater than zero for the electrolytic cell.

ANSWER

Voltaic cells and electrolytic cells are based on thermodynamic principles. Which statement about these cells is <u>correct</u>?

A) The mass of the anode increases in a voltaic cell as the cell discharges.

B) Reduction occurs at the anode only in the electrolytic cell.

C) In a voltaic cell, electrons travel from the cathode to the anode in solution.

D) The free energy change ΔG is greater than zero for the electrolytic cell.

QUESTION

How many grams of Cr would plate out from a solution of $Cr(NO_3)_3$ when 1.93×10^5 coulombs of charge are passed through the solution? The atomic mass of Cr is 52.0 g/mol, and 1 Faraday is equal to 9.65×10^4 C/mol e^-.

A) 17.3 g B) 34.7 g C) 52.0 g D) 104 g

ANSWER

How many grams of Cr would plate out from a solution of $Cr(NO_3)_3$ when 1.93×10^5 coulombs of charge are passed through the solution? The atomic mass of Cr is 52.0 g/mol, and 1 Faraday is equal to 9.65×10^4 C/mol e^-.

A) 17.3 g B) 34.7 g C) 52.0 g D) 104 g

$$Cr^{3+}_{(aq)} + 3\ e^- \longrightarrow Cr_{(s)}$$

$$1.93 \times 10^5 \text{C} \times \frac{1 \text{ mol } e^-}{9.65 \times 10^4 \text{ C}} \times \frac{1 \text{ mol Cr}}{3 \text{ mol } e^-} \times \frac{52.0 \text{ g Cr}}{1 \text{ mol Cr}} =$$

QUESTION

Gold (atomic mass = 197) is plated from a solution of chlorauric acid, $HAuCl_4$; it deposits on the cathode. Calculate the time it takes to deposit 0.50 gram of gold, passing a current of 0.10 amperes. (1 faraday = 96,485 coulombs)

A) 41 minutes
B) 2.0 hours
C) 1.0 hour
D) 6.0 hours
E) none of these

ANSWER

B) 2.0 hours

Chlorauric acid is one of the few stable gold-containing compounds known. Even gold that is dissolved in seawater tends to maintain its elemental form.

ANSWER

$$AuCl_4^{1-}{}_{(aq)} + 3\,e^- \longrightarrow Au_{(s)} + 4\,Cl^{1-}{}_{(aq)}$$

$$0.50\text{ g Au} \times \frac{1\text{ mol Au}}{197\text{ g Au}} \times \frac{3\text{ mol e}^-}{1\text{ mol Au}} = 0.0076\text{ mol e}^-$$

Calculating charge transfer:

$$\text{Charge (C)} = 0.0076\text{ mol e}^- \times \frac{9.65 \times 10^4\text{ C}}{1\text{ mol e}^-} = 4.8 \times 10^3\text{ C}$$

Calculating the time:

$$\text{Current (A)} = \frac{\text{charge (C)}}{\text{time (s)}} \qquad \textbf{0.10 A} = 0.10\text{ C/s}$$

$$\text{Time} = \frac{\text{charge (C)}}{\text{Current (C/s)}} = \frac{4.8 \times 10^3\text{ C}}{0.10\text{ C/s}} \times \frac{1\text{ min}}{60\text{ s}} \times \frac{1\text{ hr}}{60\text{ min}} = 2\text{ hrs}$$

QUESTION

An antique automobile bumper is to be chrome plated. The bumper, which is dipped into an acidic $Cr_2O_7^{2-}$ solution, serves as a cathode of an electrolytic cell. The atomic mass of Cr is 51.996; 1 faraday = 96,485 coulombs. If oxidation of H_2O occurs at the anode, how many moles of oxygen gas will evolve for every 1.00×10^2 grams of Cr(s) deposited?

A) 2.88
B) 0.48
C) 11.5
D) 7.7
E) 1.44

ANSWER

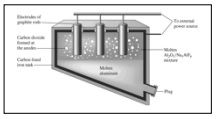
A) 2.88 mol

$$Cr_2O_7^{2-}{}_{(aq)} + 12\,e^- + 14H^+{}_{(aq)} \longrightarrow 2\,Cr_{(s)} + 7H_2O_{(l)}$$

$$2H_2O_{(l)} \longrightarrow 4H^+{}_{(aq)} + O_{2(g)} + 4\,e^-$$

$$\text{mol } O_{2\,(g)} = 1.00 \times 10^2\text{g Cr} \times \frac{1\text{ mol Cr}}{51.996\text{ g Cr}} \times \frac{6\text{ mol e}^-}{1\text{ mol Cr}} \times \frac{\text{mol } O_{2\,(g)}}{4\text{ mol e}^-}$$

QUESTION



The extraction of aluminum from a mixture of molten Al_2O_3/Na_3AlF_6 (cryolite) is superior to the extraction from a solution of aluminum ions in water because…

A. carbon dioxide bubbles can continuously provide agitation that effectively stirs the molten solution.
B. attempts at reducing Al^{3+} from water are hampered because Al^{3+} is a better oxidizing agent than water.
C. the process involves lower temperatures (therefore less energy) due to the ease of oxidation of aluminum in the presence of cryolite.
D. water is easier to oxidize than aluminum, so it would react first at a lower voltage.

ANSWER

B. provides the basis for the superiority of the Hall-Heroult process. The $E°$ value for the reduction of Al^{3+} is 0.83 volts lower than the reduction of water. Therefore, water will be reduced before Al^{3+} in aqueous solutions.

2011: $1.15/lb

CUT IN THE PRICE OF ALUMINUM.

PITTSBURG, Penn., Oct. 24.—The Pittsburg Reduction Company has made a surprising cut in the prices of aluminum in the form of ingots. It announces 1,000-pound lots at $2 per pound, 500-pound lots at $2 25 per pound, 100-pound lots at $2 50 per pound, 50-pound lots at $3 per pound, and small lots at $4 per pound. The lowest quotations heretofore on aluminum have been $4 per pound, and within a short time as much as $6.

This new and peculiar metal can be drawn into wire, rolled into sheets from .0004 inch thickness and upward, and beaten to almost the thinness of gold leaf under the hammer. It is believed by experts that the time is rapidly approaching when aluminum will be sold at a price to permit of its general use.

The New York Times
Published: October 25, 1889

The Price of Aluminum over the Past Century

Date	Price of Aluminum ($/lb)*
1855	100,000
1885	100
1890	2
1895	0.50
1970	0.30
1980	0.80
1990	0.74

US Patent 400,766; filed July 9, 1886; patented April 2, 1889