	Marks
• A voltaic cell is constructed with a $Cr_2O_7^{2-}/Cr^{3+}$ (in acidic solution) half cell and a Sn/Sn^{2+} half cell. Measurement shows that the Sn electrode is negative. Write the balanced half equations and the overall spontaneous reaction.	**3**

reduction half equation	
oxidation half equation	
overall reaction	

• How many hours will it take to produce 1.00 kg of aluminium metal from a molten Al^{3+} salt, using a current of 100 A?	**3**

	Answer:

- What is the value of the equilibrium constant for the following reaction at 298 K?

$$2Fe^{3+}(aq) + Sn(s) \rightleftharpoons Sn^{2+}(aq) + 2Fe^{2+}(aq)$$

Marks 2

Answer:

Marks 6

- Write the balanced half equations (including states) and the overall spontaneous reaction for a galvanic cell consisting of Ag^{+} | Ag and Sn^{2+} | Sn half cells.

half equation at anode	
half equation at cathode	
overall reaction	

Express the overall reaction in voltaic cell notation.

What is the sign of the cathode?

What voltage would need to be applied to convert this galvanic cell into an electrolytic cell?

	Answer:

3

- The physiological properties of chromium depend on its oxidation state. Consider the half reaction in which Cr(VI) is reduced to Cr(III).

  $CrO_4^{2-}(aq) + 4H_2O(l) + 3e^- \rightarrow Cr(OH)_3(s) + 5OH^-(aq)$ $\quad E^o = -0.13$ V

  Calculate the potential for this half reaction at 25 ^oC, where pH = 7.40 and $[CrO_4^{2-}(aq)] = 1.0 \times 10^{-6}$ M.

Answer:

Marks

- Consider the following reaction at 298 K. **5**

$$Ni^{2+}(aq) + Zn(s) \rightleftharpoons Ni(s) + Zn^{2+}(aq)$$

Calculate ΔG^o for the cell. (Relevant electrode potentials can be found on the data page.)

Answer:

What is the value of the equilibrium constant for the reaction at 298 K?

Answer:

Express the overall reaction in voltaic cell notation.

- Using a current of 2.00 A, how long (in minutes) will it take to plate out all of the silver from 0.250 L of a 1.14×10^{-2} M $Ag^+(aq)$ solution? **2**

- Calculate the standard free-energy change for the following reaction at 298 K.

$$2Au(s) + 3Mg^{2+}(1.0\ M) \rightarrow 2Au^{3+}(1.0\ M) + 3Mg(s)$$

2

Answer:

Marks 6

- The solubility product constant of AgCl is $K_{sp} = 1.8 \times 10^{-10}\ M^2$. Using the relevant electrode potentials found on the data page, calculate the reduction potential at 298 K of a half-cell formed by:
  (a) an Ag electrode immersed in a saturated solution of AgCl.

Answer:

(b) an Ag electrode immersed in a 0.5 M solution of KCl containing some AgCl precipitate.

Answer:

Each of these half-cells is connected to a standard Cu^{2+}(1 M)/Cu(s) half-cell. In which half-cell, (a) or (b), will clear evidence of a reaction be seen? Describe the change(s) observed.

- An aqueous solution of $CuSO_4$ is electrolysed with a current of 1.00 A for 60 minutes. Calculate the mass of the products that are formed at the two electrodes. **4**

- A galvanic cell consists of a Ni^{2+}/Ni half cell with $[Ni^{2+}] = 1.00$ M, and a Ag^{+}/Ag half cell with $[Ag^{+}] = 1.00$ M. Calculate the electromotive force of the cell at 25 °C.

Marks 5

Answer:

Calculate the equilibrium constant of the reaction at 25 °C.

Answer:

Calculate the standard free energy change of the reaction at 25 °C.

Answer:

Is the reaction spontaneous? Give reasons for your answer.

Express the overall reaction in the shorthand voltaic cell notation.

- A galvanic cell is made of a Zn^{2+}/Zn half cell with $[Zn^{2+}] = 2.0$ M and an Ag^{+}/Ag half cell with $[Ag^{+}] = 0.050$ M. Calculate the electromotive force of the cell at 25 °C.

Marks 5

Answer:

Calculate the equilibrium constant of the reaction at 25 °C.

Answer:

Calculate the standard Gibbs free energy of the reaction at 25 °C.

Answer:

Indicate whether the reaction is spontaneous or not. Give a reason for your answer.

Express the overall reaction in the shorthand voltaic cell notation.

- A melt of NaCl is electrolysed for 35 minutes with a current of 3.50 A. Calculate the mass of sodium and volume of chlorine at 40 °C and 1.00 atm that are formed. **4**

Marks 8

- An Ag electrode immersed in a saturated aqueous solution of AgBr has a reduction potential of 0.437 V at 25 °C with respect to the standard hydrogen electrode. Calculate the solubility product of AgBr at 25 °C.

Answer:

A Pd electrode immersed in an aqueous solution containing 0.01 $Pd(NO_3)_2$ M and 1.00 M NaCl has a reduction potential of –0.860 V at 25 °C with respect to the Ag electrode above. Calculate the stability constant of the complex ion, $[PdCl_4]^{2-}$, at 25 °C.

Answer:

	Marks
• A melt containing Cr^{3+} is electrolysed for exactly 1 hour with a current of 0.54 A. Calculate the quantity of chromium that is deposited in this time at the electrode.	**2**
Answer:	
• An Ag electrode immersed in an aqueous solution containing $AgNO_3$ (0.010 M) and NaCN (1.00 M) has a potential of –0.66 V. Calculate the stability constant of the complex ion, $[Ag(CN)_2]^-$.	**4**
Answer:	

• Explain the meaning of the terms ΔG, n, and E_{cell} in the equation $\Delta G = -nFE_{cell}$.	**Marks 3**

Marks 4

- Five strips of different metals were immersed in five different containers with concentrated HCl and the following observations were made.

  1. In the container with the strip of Cu, no change was observed.
  2. In the container with the strip of Sn, no change was observed.
  3. In the container with the strip of Fe, a yellow colour slowly emerged after immersion.
  4. From the container with the strip of Zn, gas started to bubble out.
  5. In the container with the strip of Mg, a vigorous reaction was observed and soon the strip disappeared.

  Write down the reactions involved, if any occur.

Explain these experimental observations.

Explain how cathodic protection can prevent the corrosion of iron.