

Answer on Question#71737 – Chemistry – General chemistry

Question:

A $\text{Cr(s)}|\text{Cr}^{3+}(\text{aq})||\text{Fe}^{3+}(\text{aq})|\text{Fe(s)}$ galvanic cell has a standard cell potential of 0.700 V. Calculate the Gibbs free energy change at 25 °C when 2.20 g of iron is deposited. Assume the concentrations in the cell remain at the standard state values of 1 M through the entire deposition process.

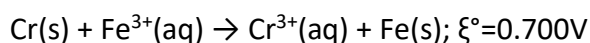
$\Delta G = ? \text{ J}$

Calculate the maximum amount of work done by the cell on its surroundings.

$w_{\text{max}} = ? \text{ J}$

Solution:

There is a reaction:



$$\Delta G^{\circ} = -nF \xi^{\circ},$$

Where

$$n \text{ is number of moles of electrons: } n = 3 \times \frac{2.20\text{g}}{55.86\frac{\text{g}}{\text{mol}}} = 0.118 \text{ mol};$$

$$F \text{ is the Faraday constant: } F = 96485 \frac{\text{C}}{\text{mol}};$$

$$\xi^{\circ} \text{ is the standard cell potential: } \xi^{\circ} = 0.700\text{V} = 0.700 \frac{\text{J}}{\text{C}}$$

$$\Delta G^{\circ} = -0.118 \text{ mol} \times 96485 \frac{\text{C}}{\text{mol}} \times 0.700 \frac{\text{J}}{\text{C}} = -7.97 \times 10^3 \text{ J}$$

For a galvanic cell,

$$w_{\text{max}} = \Delta G^{\circ} = -7.97 \times 10^3 \text{ J}$$

Answer:

$$-7.97 \times 10^3 \text{ J}$$

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