Answer on Question#71737 – Chemistry – General chemistry

Question:

A Cr(s)|Cr3 (aq)||Fe3 (aq)|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=? J

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

wmax=? J

Solution:

There is a reaction:

Cr(s) + Fe^{3+}(aq) → Cr^{3+}(aq) + Fe(s); ξ°=0.700V

ΔG° = -nF ξ°,

Where

n 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 is the Faraday constant: $F = 96\,485\,\frac{\text{C}}{\text{mol}};$

ξ° is the standard cell potential: $\xi° = 0.700\text{V} = 0.700\,\frac{\text{J}}{\text{C}}$

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

For a galvanic cell,

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

Answer:

-7.97×10^3 J

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