

NOTE: for this problem set, unless stated otherwise, all standard cell potentials and other standard thermodynamic values are assumed to be reported at 298 K.

1. Consider the demonstration where a piece of copper wire is being immersed in a solution of AgNO_3 .

- a) What is the sign of ΔG° for the demonstration you are observing? Explain.

Negative. Reaction is spontaneous.

- b) Write out a balanced overall reaction for the demonstration, including all phases and stoichiometric coefficients:



- c) In your engineering reference manual you find the following half-reactions:



Determine the standard cell potential associated (E°_{cell}) associated with this reaction.

$$E^\circ_{\text{cell}} = E^\circ_{\text{red}} - E^\circ_{\text{ox}} = 0.80 - 0.34 = 0.46 \text{ V}$$

- d) Calculate the value of ΔG° and K for the demonstration reaction at 298 K.

$$\begin{aligned} \Delta G^\circ &= -n F E^\circ_{\text{cell}} = -2 \times 96485 \text{ C mol}^{-1} \times 0.460 \text{ V} = -88766 \text{ J} \\ &= -89 \text{ kJ} \end{aligned}$$

$$\begin{aligned} \ln K &= -\frac{\Delta G^\circ}{RT} = \frac{88766 \text{ J}}{1 \text{ mol} \times 8.3145 \text{ J mol}^{-1} \text{K}^{-1} \times 298 \text{ K}} = 35.83 \\ K &= e^{35.83} = 3.62 \times 10^{15} \end{aligned}$$

- e) Use your knowledge of thermodynamics to predict what would happen if we were to carry out the opposite experiment – a piece of silver in $\text{Cu}(\text{NO}_3)_2$.

Because dipping Cu in AgNO_3 was a spontaneous process, that means the opposite process should be non-spontaneous.

Note: both this answer and that for part a) make a subtle assumption. Can you see what it is?

Modeling Chemistry Unit 11 Answer Key

Robert R. Redfield



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Journal of Research of the National Bureau of Standards United States. National Bureau of Standards, 1976

Resources in Education, 1999 Report Availability Notice United States. Office of Naval Research. Ocean Science and Technology Division, 1976 **Process Intensification Technologies for Green Chemistry** Kamelia Boodhoo, Adam Harvey, 2013-01-03 The successful implementation of greener chemical processes relies not only on the development of more efficient catalysts for synthetic chemistry but also and as importantly on the development of reactor and separation technologies which can deliver enhanced processing performance in a safe, cost effective and energy efficient manner. Process intensification has emerged as a promising field which can effectively tackle the challenges of significant process enhancement whilst also offering the potential to diminish the environmental impact presented by the chemical industry. Following an introduction to process intensification and the principles of green chemistry, this book presents a number of intensified technologies which have been researched and developed, including case studies to illustrate their application to green chemical processes. Topics covered include Intensified reactor technologies, spinning disc reactors, microreactors, monolith reactors, oscillatory flow reactors, cavitation reactors, Combined reactor separator systems, membrane reactors.

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