Quiz 14

Quizzes are not graded. The questions on this quiz are intended to illustrate the type of test questions that might be based on OFB, Chapter 13. The Nernst equation and selected data from Appendix E will be provided on the exam.

Questions 1 and 2 refer to the cell, $\text{Ga}^{3+} \mid \text{Ga}^{3+} :: \text{Cd}^{2+} \mid \text{Cd}$.

1. If this cell were constructed, what would be the value of $\Delta \varepsilon^0$ and which half-cell would function as the anode?

   a. $\Delta \varepsilon^0 = 0.146 \text{ V}$; the $\text{Cd}^{2+} \mid \text{Cd}$ half-cell acts as the anode.
   
   b. $\Delta \varepsilon^0 = 0.603 \text{ V}$; the $\text{Cd}^{2+} \mid \text{Cd}$ half-cell acts as the anode.
   
   c. $\Delta \varepsilon^0 = 0.146 \text{ V}$; the $\text{Ga}^{3+} \mid \text{Ga}$ half-cell acts as the anode.
   
   d. $\Delta \varepsilon^0 = 0.952 \text{ V}$; the $\text{Cd}^{2+} \mid \text{Cd}$ half-cell acts as the anode.

   

$3\text{Cd}^{2+} + 2\text{Ga} \rightarrow 2\text{Ga}^{3+} + 3\text{Cd}$

\[ \Delta \varepsilon^0 = 0 \]

2. What is the value of $\Delta \varepsilon$ for a cell of this type if it is constructed with $[\text{Ga}^{3+}] = 0.30 \text{ M}$ and $[\text{Cd}^{2+}] = 1 \times 10^{-8} \text{ M}$ and which half-cell functions as the anode?

   a. $\Delta \varepsilon = 0.08 \text{ V}$; the $\text{Cd}^{2+} \mid \text{Cd}$ half-cell acts as the anode.
   
   b. $\Delta \varepsilon = 0.30 \text{ V}$; the $\text{Cd}^{2+} \mid \text{Cd}$ half-cell acts as the anode.
   
   c. $\Delta \varepsilon = 0.725 \text{ V}$; the $\text{Ga}^{3+} \mid \text{Ga}$ half-cell acts as the anode.
   
   d. $\Delta \varepsilon = 0$ (concentration cell)

   \[ \Delta \varepsilon = 0.146 \text{ V} - \frac{0.059 \text{ V}}{0} \ln \left( \frac{[\text{Ga}^{3+}]}{[\text{Cd}^{2+}]} \right) = -0.08 \text{ V} \]

3. Which stress would increase the value of $\Delta \varepsilon$ for the half-reaction: $\text{O}_2 (g) + 4 \text{H}^+ (aq) + 4 \text{e}^- \rightarrow 2\text{H}_2\text{O} (l)$

   a. increasing the pH from 0 to 7
   
   b. lowering $P_{\text{O}_2}$ from 1 atm to 0.2 atm
   
   c. raising $[\text{H}^+]$ from 1 M to 12 M
   
   d. doing the reduction in basic solution

   \[ \Delta \varepsilon \text{ increases when it becomes favorable to use } \text{H}^+ \text{ (shift right)} \]
4. Will Cu\(^+\) ions (in aqueous solution) tend to disproportionate?

a. Yes. The disproportionation reaction is spontaneous in standard solution and is likely to be spontaneous in non-standard solutions.

b. No. The disproportionation reaction is not spontaneous in standard solution and is not likely to be spontaneous in non-standard solutions.

c. Maybe. The disproportionation reaction is spontaneous in standard solution but is not likely to be spontaneous in non-standard solutions.

d. Maybe. The disproportionation reaction is not spontaneous in standard solution but is likely to be spontaneous in non-standard solutions.

\[
\begin{align*}
\text{Cu}^+ + \text{e}^- & \rightarrow \text{Cu} \quad E^0 = 0.521 \text{V} \\
\text{Cu}^{2+} + \text{e}^- & \rightarrow \text{Cu} \quad E^0 = 0.153 \text{V}
\end{align*}
\]

5. Which statement is true?

a. The anode reaction in the electrolysis of molten sodium chloride is Na\(^+\) + e\(^-\) → Na.

b. In the reaction: Zn + 2H\(^+\) → ZnCl\(_2\) + H\(_2\), the zinc acts as an oxidizing agent.

b. In the reaction: Zn + 2H\(^+\) → ZnCl\(_2\) + H\(_2\), the zinc acts as a reducing agent.

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c. The reaction: 3 H\(_2\)O + 3 Cl\(_2\) → ClO\(_3\)\(^-\) + 5 Cl\(^-\) + 6 H\(^+\) is a disproportionation.

a. The perchlorate ion is a strong reducing agent.

\[
\begin{align*}
\text{ClO}_4^- + 7 \text{H}^+ & \rightarrow \text{HClO}_4 \\
\text{ClO}_4^- & \text{is the highest possible oxo acid of Cl.} \\
\text{ClO}_4^- & \text{can't be oxidized.}
\end{align*}
\]

5. Which metal could serve as a sacrificial anode for the protection of iron?

a. tin

b. manganese

c. lead

d. copper

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\[
\begin{align*}
\text{Fe}^\text{II} & | \text{Fe}^\text{III} \\
\text{E}^0 & = -0.76 \text{V}
\end{align*}
\]

6. Which is the best reducing agent?

a. zinc

b. Zn\(^{2+}\)

c. barium

d. MnO\(_4\)\(^-\)

\[
\begin{align*}
\text{Zn}^\text{2+} & | \text{Zn} \\
\text{E}^0 & = -0.76 \text{V}
\end{align*}
\]

\[
\begin{align*}
\text{Ba}^\text{2+} & | \text{Ba} \\
\text{E}^0 & = -2.912 \text{V}
\end{align*}
\]