Chapter 12 Review

1. Chlorine is bubbled through an aqueous solution of sodium bromide.

Species List: Cl₂(g), Na⁺(aq), Br⁻(aq)
Reduction half reaction: Cl₂(g) + 2e⁻ → 2 Cl⁻(aq)
Oxidation half reaction: 2 Br⁻(aq) → 2e⁻ + Br₂(l)
Net redox reaction: Cl₂(g) + 2 Br⁻(aq) → 2 Cl⁻(aq) + Br₂(l)
Is the reaction spontaneous? Explain why or why not. Yes
Describe a diagnostic test to identify one of the products.
React a sample of the product solution with silver ions to produce a precipitate.

2. Aluminum is exposed to moist air.

Species List: Al(s), H₂O(l), O₂(g)
Reduction half reaction: 2 H₂O(l) + O₂(g) + 4e⁻ → 4OH⁻(aq)
Oxidation half reaction: Al(s) → 3e⁻ + Al³⁺(aq)
Net redox reaction: 6H₂O(l) + 3O₂(g) + 2Al(s) → 12 OH⁻(aq) + 4 Al³⁺(aq)
Is the reaction spontaneous? Explain why or why not. Yes
Describe a diagnostic test to identify one of the products.
Litmus test for the OH ions should indicate a base

3. Water is poured onto a gold ring.

Species List: H₂O(l), Au(s)
Reduction half reaction: 2 H₂O(l) + 2e⁻ → H₂(g) + 2OH⁻(aq)
Oxidation half reaction: Au(s) → Au³⁺(aq) + 3e⁻
Net redox reaction: 6 H₂O(l) + 2Au(s) → 3H₂(g) + 6OH⁻(aq) + 2Au³⁺(aq)
Is the reaction spontaneous? Explain why or why not. No

Use the following information to answer the question #4.

Q²⁺(aq) + 2R (s) ----> Q (s) + 2R⁺(aq)
Q²⁺(aq) + E (s) ----> no reaction
2P⁺(aq) + E (s) ----> 2P (s) + E²⁺(aq)

4a) Construct a redox table for the above four species.

  P⁺(aq) + e⁻ → P(s)
  E²⁺(aq) + 2e⁻ → E(s)
  Q²⁺(aq) + 2e⁻ → Q(s)
  R⁺(aq) + e⁻ → R(s)

4b) Numerical Response:

  The order of oxidizing agents, from strongest to weakest is:
  P⁺(aq) , E²⁺(aq) , Q²⁺(aq) , R⁺(aq)
Use the following hypothetical reaction to answer the next question:

\[ \text{Q}_2(\text{g}) + 2\text{R}^- (\text{aq}) \rightarrow \text{R}_2(\text{l}) + 2\text{Q}^- (\text{aq}) \]

5. a) Write the half reaction for the species that gains electrons. Is this oxidation or reduction? How do you know?

\[ \text{Q}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Q}^- (\text{aq}) \quad \text{RIG} \]

b) Identify the oxidizing agent: ____ \text{Q}_2(\text{g}) ____

Identify the reducing agent: ____ \text{R}^- (\text{aq}) ____

c) Identify the species that has the greatest strength of attraction of electrons: ____ \text{Q}_2(\text{g}) ____

d) Identify the species that has the least strength of attraction of electrons: ____ \text{R}^- (\text{aq}) ____

6. Prove that the following is an acidic disproportionation reaction by providing both half reactions.

\[ \text{Cl}_2 \rightarrow \text{HOCl} + \text{Cl}^- \]

Red: \( \text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^- (\text{aq}) \)

Ox: \( \text{Cl}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HOCl} (\text{aq}) + 2\text{H}^+ (\text{aq}) + 2\text{e}^- \)

7. Balance the following redox reaction that is reacting in an acidic solution.

\[ \text{CH}_3\text{NO}_2 + \text{Ti}^{3+} \rightarrow \text{CH}_3\text{NH}_2 + \text{Ti}^{4+} \]

\( \text{CH}_3\text{NO}_2 + 6\text{e}^- \rightarrow \text{CH}_3\text{NH}_2 \)

6 \text{Ti}^{3+} \rightarrow 6 \text{Ti}^{4+} + 6\text{e}^- \)

\[ 6\text{H}^+ + 6\text{Ti}^{3+} + \text{CH}_3\text{NO}_2 \rightarrow \text{CH}_3\text{NH}_2 + 6 \text{Ti}^{4+} + 2\text{H}_2\text{O}(\text{l}) \]

8. A redox titration was completed by titrating 10.0 mL of aqueous tin (II) nitrate with acidified 0.0955 mol/L potassium dichromate solution. If, on average, 12.4 mL of potassium dichromate solution were required for complete reaction what is the molar concentration of the tin (II) nitrate solution? (0.355 mol/L)

\[ 2\text{MnO}_4^- (\text{aq}) + 16\text{H}^+ (\text{aq}) + 5 \text{Sn}^{2+} (\text{aq}) \rightarrow 2\text{Mn}^{2+} (\text{aq}) + 5 \text{Sn}^{4+} (\text{aq}) + 8\text{H}_2\text{O}(\text{l}) \]