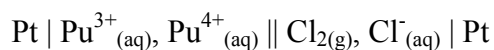


Exam Review Questions: Electrochemistry

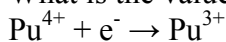
1. Consider a voltaic cell based on the following cell diagram:



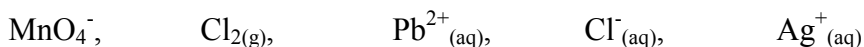
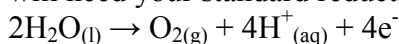
Given that the standard cell emf is 0.35V, and that the standard reduction potential of chlorine is 1.36V:



What is the value of the standard reduction potential $E^{\circ}_{\text{Pu}^{4+}/\text{Pu}^{3+}}$



2. Which of the following substances can oxidize H_2O to $\text{O}_{2(\text{g})}$ under standard state conditions (hint: You will need your standard reduction potential table)?



3. A metal object is to be gold-plated by an electrolytic procedure using aqueous AuCl_3 electrolyte and Au anode. Calculate the number of moles of gold deposited in 3.0min by a constant current of 10.A.

4. How many coulombs of electrical charge would be required to electroplate 35.0 grams of chromium by passing an electrical current through a solution containing CrCl_3 ?

5. For the reaction $2\text{Cr}^{2+} + \text{Cl}_{2(\text{g})} \rightarrow 2\text{Cr}^{3+} + 2\text{Cl}^{-}$, the value of E°_{cell} is 1.78V. Determine the value of E°_{cell} for the related reaction $\text{Cr}^{3+} + \text{Cl}^{-} \rightarrow \text{Cr}^{2+} + \frac{1}{2} \text{Cl}_{2(\text{g})}$.

6. An electrochemical cell is formed from aluminum and zinc and solutions containing their ions. Determine:

- The oxidation half reaction
- The reduction half reaction
- The net ionic equation
- The cell potential

7. Calculate the amount of time (in minutes) required to plate .750g of copper onto the surface of an object if a current of 525mA flows through an electrolytic circuit. Assume that the ion form of copper is Cu^{2+} . The molar mass of copper is 63.55g/mol.

Answers: (NOTE: There may be slight differences in cell potential depending on which reduction potential table is used.)

1.
 $0.35\text{V} = (X_{\text{ox}}) + 1.36\text{V} \quad X_{\text{ox}} = -1.01\text{V}$
Pu_(4+/3+) = 1.01V

2.
Look at the relative positions on the reduction potential table. Both chlorine gas and the permanganate ion have higher reduction potentials than $\text{O}_{2(\text{g})} + 4\text{H}^+_{(\text{aq})} + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}_{(\text{l})}$ and so will drive this reaction in the opposite direction.

Answer: MnO₄⁻ and Cl_{2(g)}

3. $(10.0\text{C/s})(3.0\text{min})(60\text{s/min})(1\text{mol e}^-/96,480\text{C})(1\text{mol Al}/3\text{mol e}^-)$
= 6.2x10⁻³ mol

4.
 $\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}$
 $35.0\text{g Cr} (1\text{mol Cr} / 52.00\text{g Cr})(3\text{mol e}^- / 1\text{mol Cr})(96,480\text{C} / 1\text{mol e}^-)$
= 1.95x10⁵ C

5. The change in coefficients don't affect the cell potential but the reaction is reversed = **-1.78V**

6.
a. **Al → Al³⁺ + 3e⁻**
b. **Zn²⁺ + 2e⁻ → Zn**
c. **2Al + 3Zn²⁺ → 2Al³⁺ + 3Zn**
d. $E^\circ_{\text{cell}} = 1.66 + (-0.76\text{V}) = \mathbf{.900\text{V}}$

7. $.750\text{g} / 63.55\text{g/mol} = .0118\text{mol Cu}$
 $.0118\text{mol Cu} (2\text{mol e}^- / 1\text{mol Cu}) = .0236\text{mol e}^-$
 $.0236\text{mol e}^- (96,480\text{C/mol e}^-) = 2,277.26 \text{ C}$
 $2,277.26\text{C} (1\text{s} / .525\text{C}) = 4337.64 \text{ s}$
 $4337.64\text{s} (1\text{min} / 60\text{s}) = 72.294\text{min} = \mathbf{72.3\text{min}}$