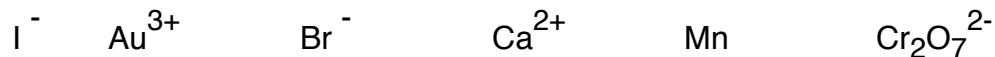
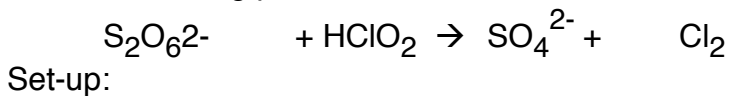


**FOR ALL PROBLEMS, YOU MUST SHOW YOUR CALCULATION CLEARLY**1) Consider **ONLY** the following species at standard condition:

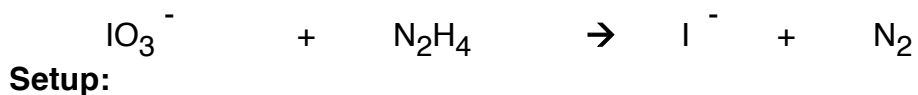
in answering the following questions:

a) Which is the strongest reducing agent? \_\_\_\_\_

b) Which is the strongest oxidizing agent? \_\_\_\_\_

c) List all species that can be oxidized by  $\text{Ca}^{2+}$ . \_\_\_\_\_d) List all species that can be reduced by  $\text{Br}^-$ . \_\_\_\_\_2) Balance the following equation by the **ion-electron** method **ONLY**. The reaction is taking place in **acidic** solution. You must show all steps clearly.

3) Balance the following equation taking place in **acidic** solution . You may add  $H^+$ ,  $OH^-$ ,  $H_2O$  as needed to balance the equation. You must show your work.

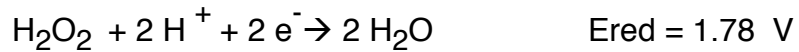


4) How many hours will it take to plate out 3.70 kg of tin from an aqueous solution of tin(IV)sulfate using a current of 80.0 A? (molar mass of tin is 118.7g/mole, 1 Faraday = 96500 coulomb).

Setup:

Answer\_\_\_\_\_

5) A Galvanic cell that measures 0.32 V is utilizing the half reactions given below:



The  $\text{Co}^{3+}/\text{Co}^{2+}$  half cell is connected to the **positive** terminal of the voltmeter.

a) Write the half reaction taking place at the **cathode**:

b) Write the half reaction taking place at the **anode**:

c) Write the overall cell reaction:

d) Calculate the molar concentration of  $\text{Co}^{3+}$  if the concentration of other species in the solution is 0.010 M **each**.

Setup:

Answer \_\_\_\_\_

6) Two Cr / Cr<sup>3+</sup> half cells are connected to make a single Galvanic cell. In one of the half cells, the [Cr<sup>3+</sup>] = 0.100 M, but the [Cr<sup>3+</sup>] concentration in the other half cell is not known. The measured voltage delivered by the combination is 0.0335 V, and the electrode in the known concentration is **positive**.

a) Write the reaction taking place at the **anode**:

b) Write the reaction taking place at the **cathode**:

c) Write the overall cell reaction:

d) Without making further calculations, predict from your assignment of the reactions taking place at each electrode above, if the unknown concentration of [Cr<sup>3+</sup>] is greater than, equal to, or less than 0.100 M. Answer \_\_\_\_\_.

Explain how did you arrive at your answer given above.

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e) Now, calculate the **unknown** concentration of [Cr<sup>3+</sup>]. Show your work clearly.  
Setup:

Answer: \_\_\_\_\_

7) A cell was constructed using the standard hydrogen electrode in one compartment and a nickel electrode in a 0.22 M  $\text{Na}_2\text{CO}_3$  solution in contact with undissolved  $\text{NiCO}_3(\text{s})$ . The potential of the cell was measured to be 0.400 V, with the nickel electrode as the **negative** electrode .

a) Sketch the above cell and label the electrodes and all cell components.

b) Write the reaction taking place at the **anode**.

c) Write the reaction taking place at the **cathode**.

d) Write the cell reaction.

e) Calculate the solubility product constant for  $\text{NiCO}_3(\text{s})$

Setup:

Answer \_\_\_\_\_

8) A Galvanic cell is made of  $\text{Zn} / \text{Zn}^{2+}$  and  $\text{Cr} / \text{Cr}^{3+}$  half reactions. The concentration of  $\text{Zn}^{2+}$  is 0.132 M **at equilibrium**. What is the **equilibrium** concentration of  $\text{Cr}^{3+}$ ?

Setup:

Answer\_\_\_\_\_

