Electrochemistry I – IV Worksheet
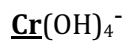
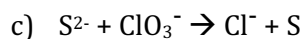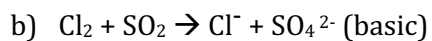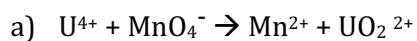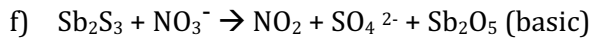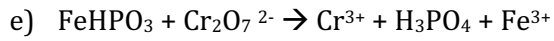1. Calculate the oxidation number of the bolded and underlined element:

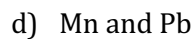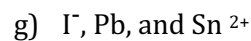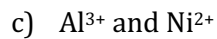$H\underline{\textbf{Cl}}O_3$ $\underline{\textbf{N}}_2H_5^+$ $\underline{\textbf{S}}_8$

$\underline{\textbf{Cr}}(OH)_4^-$ $\underline{\textbf{Sb}}_2O_5$ $H\underline{\textbf{P}}O_3^{2-}$

$\underline{\textbf{Br}}O_3^-$ $K_2\underline{\textbf{U}}O_4$ $\underline{\textbf{C}}_3H_8$
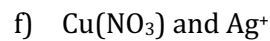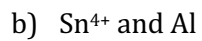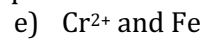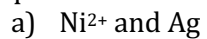
2. Balance the following reactions. Double check your work by calculating oxidation numbers. Identify the reducing agent and oxidizing agent in each:

a) $U^{4+} + MnO_4^- \rightarrow Mn^{2+} + UO_2^{2+}$

b) $Cl_2 + SO_2 \rightarrow Cl^- + SO_4^{2-}$ (basic)

c) $S^{2-} + ClO_3^- \rightarrow Cl^- + S$

d) $HNO_2 \rightarrow HNO_3 + NO$ (basic)

e) $FeHPO_3 + Cr_2O_7{}^{2-} \rightarrow Cr^{3+} + H_3PO_4 + Fe^{3+}$

f) $Sb_2S_3 + NO_3{}^- \rightarrow NO_2 + SO_4{}^{2-} + Sb_2O_5$ (basic)

3. Classify the following combinations as spontaneous, non-spontaneous, or no reaction. If spontaneous or non-spontaneous, write out the complete reaction and calculate the cell potential.
    a) Ni^{2+} and Ag

    b) Sn^{4+} and Al

    c) Al^{3+} and Ni^{2+}

    d) Mn and Pb

    e) Cr^{2+} and Fe

    f) $Cu(NO_3)$ and Ag^+

    g) I^-, Pb, and Sn^{2+}

4. An electrochemical cell is constructed using Ag/Ag^+ and Cu/Cu^{+2} half cells.
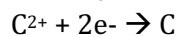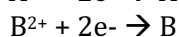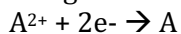   a) Draw the electrochemical cell.

    b) Which electrode will lose mass?

c) Which electrode will gain mass?

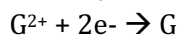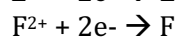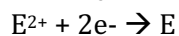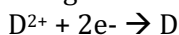d) If 0.875 g of metallic copper is lost, then calculate the number of moles of silver formed.

5. For the following, create an SRP table with the given information:
   a) You have been given the following three half-reactions:
$$A^{2+} + 2e^- \rightarrow A$$
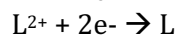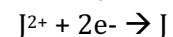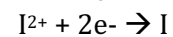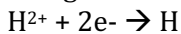$$B^{2+} + 2e^- \rightarrow B$$
$$C^{2+} + 2e^- \rightarrow C$$
   - A^{2+} reacts with C but not with B.

   b) You have been given the following four half-reactions:
$$D^{2+} + 2e^- \rightarrow D$$
$$E^{2+} + 2e^- \rightarrow E$$
$$F^{2+} + 2e^- \rightarrow F$$
$$G^{2+} + 2e^- \rightarrow G$$

   - F^{2+} reacts with D, E and G.
   - No reaction occurs between D^{2+} and any of the metals.
   - G^{2+} only reacts with D.

   c) You have been given the following five half-reactions:
$$H^{2+} + 2e^- \rightarrow H$$
$$I^{2+} + 2e^- \rightarrow I$$
$$J^{2+} + 2e^- \rightarrow J$$
$$K^{2+} + 2e^- \rightarrow K$$
$$L^{2+} + 2e^- \rightarrow L$$

   - K^{2+} only reacted with I and H.
   - L^{2+} did not react with J.
   - I^{2+} reacted with H.

6. Consider the following:
- **A** reacts with **BNO$_{3(aq)}$** and **HCl$_{(aq)}$**.
- **A** does not react with **C(NO$_3$)$_{2(aq)}$**.
- **C** reacts with **HCl$_{(aq)}$**, **BNO$_{3(aq)}$**, **A(NO$_3$)$_{2(aq)}$** and **D(NO$_3$)$_{2(aq)}$**.
- **D** reacts with **BNO$_{3(aq)}$** but not with **HCl$_{(aq)}$**.
- **Cl$^-$** and **NO$_3^-$** are considered to be spectator ions.

If **A**, **B**, **C**, and **D** are four metals, list the **<u>five</u>** reduction **<u>half-reactions</u>** in order of decreasing reduction potential. (watch the ion charges)