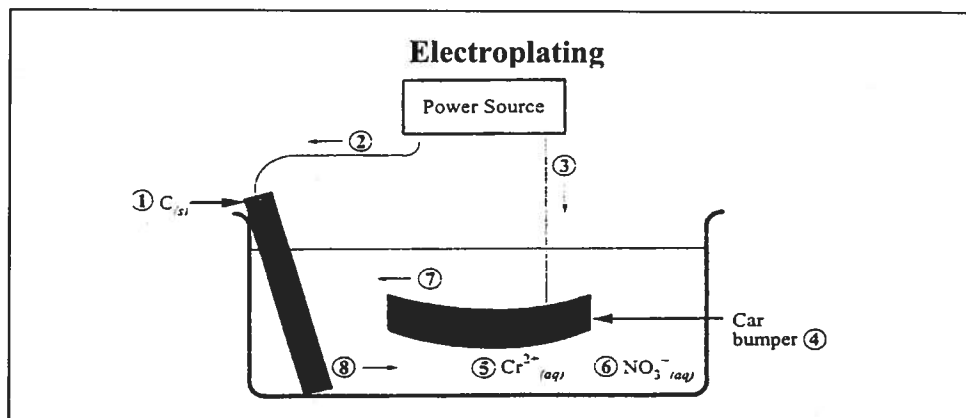
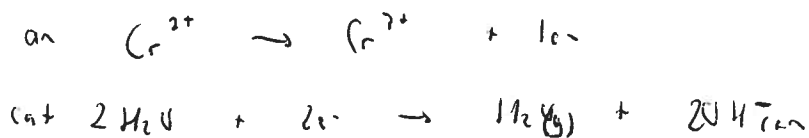


KEY

Use the following information to answer the next question.



1. Write the half reactions occurring at the cathode and anode of this cell.



2. Calculate the cell potential.

$E_{cell} = E_{cat} - E_{an} = -0.83V - -0.41V = -0.42V$

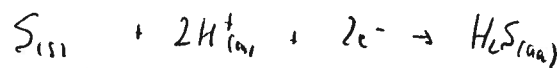
Numerical Response

1. Use the numbers that identify the parts of the electroplating cell in the diagram above to complete the statements below.

- The cathode is identified by 4 (Record in the first column)
- The electron movement is identified by 3 (Record in the second column)
- The cation movement is identified by 8 (Record in the third column)
- The anion is identified by 6 (Record in the fourth column)

3. The voltage of an electrochemical cell is +0.20 V. If one of the half-reactions is the reduction of $Cu^{2+}(aq)$, the write the other half-reaction that occurs.

$E_{cell} = E_{cat} - E_{an}$
 $+0.20V = +0.34V - E_{an}$
 $E_{an} = +0.14V$



Use the following information to answer the next question.

A chromium electroplating cell needs to operate at a current of 2000 A to plate 112 g of chromium onto a car bumper.

Numerical Response

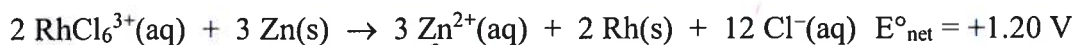
2. In order to plate the bumper, the cell must operate for 3.46 min.

(Record your **three-digit answer** in the numerical-response section on the answer sheet)

$$\begin{array}{l}
 \text{Cr}^{2+} + 2e^- \rightarrow \text{Cr(s)} \\
 n = 4.307 \dots \text{mol} \quad \times 2 \\
 I = 2000 \text{ A} \quad \quad \quad m = 112 \text{ g} \\
 \quad \quad \quad \quad \quad \quad \quad M = 52.00 \text{ g/mol} \\
 \quad \quad \quad \quad \quad \quad \quad n = 2.153 \dots \text{mol}
 \end{array}$$

$n_e = \frac{It}{F}$
 $t = 207.846 \text{ sec.}$
 $t = 3.4641 \dots \text{min.}$

Use the following information to answer the next question.



Numerical Response

3. The standard electrode potential for the half-reaction $\text{RhCl}_6^{3+}(\text{aq}) + 3e^- \rightarrow \text{Rh}(\text{s}) + 6\text{Cl}^{-}(\text{aq})$ is \pm 0.44 V.

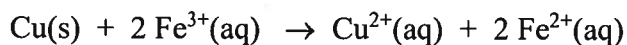
(Record your **three-digit answer** in the numerical-response section on the answer sheet)

$$1.20 \text{ V} = ? - (-0.76 \text{ V})$$

$$? = +0.44 \text{ V}$$

Use the following information to answer the next two questions.

Electronic hobbyists often “etch” circuit boards. In this process, unwanted copper foil is removed from a copper-clad plastic circuit board by immersing the board in a bath of iron(III) chloride solution. The equation for the net reaction is



4. In the reaction above, in which the unwanted copper foil is removed,
- A. copper ions are reduced
 B. copper atoms are oxidized
 C. iron(II) ions act as the oxidizing agent
 D. iron(III) ions act as the reducing agent
5. Which of the following statements and corresponding net voltages are correct for this reaction?
- A. It is a spontaneous reaction with an $E^\circ_{\text{net}} = +0.43 \text{ V}$.
 B. It is a spontaneous reaction with an $E^\circ_{\text{net}} = +1.11 \text{ V}$.
 C. A power supply is required because the $E^\circ_{\text{net}} = -0.43 \text{ V}$.
 D. A power supply is required because the $E^\circ_{\text{net}} = -1.11 \text{ V}$.

Use the following information to answer the next question.

In a laboratory, a student obtained the following results when testing, under standard conditions, reactions between various metals and their corresponding ions.

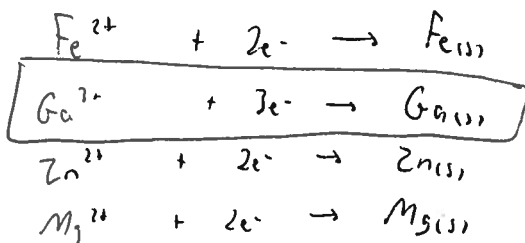
	Ga(s)	Fe(s)	Zn(s)	Mg(s)
Ga ³⁺ (aq)	–	×	✓	✓
Fe ²⁺ (aq)	✓	–	✓	✓
Zn ²⁺ (aq)	×	×	–	✓
Mg ²⁺ (aq)	×	×	×	–

× denotes no reaction

✓ denotes a reaction

– denotes not tested

6. Create a table of reduction reactions based on the evidence in the chart above.



between iron + zinc on the table

7. The reduction potential of Ga³⁺(aq) could be

A. -0.53 V

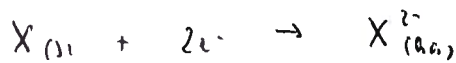
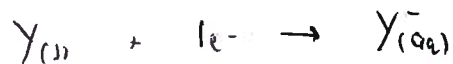
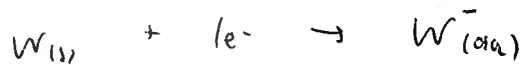
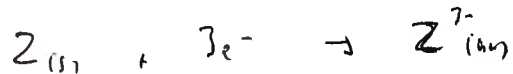
B. -1.41 V

C. +1.21 V

D. +1.92 V

8. Using the data from the following table, write a reduction half reactions table of decreasing strength.

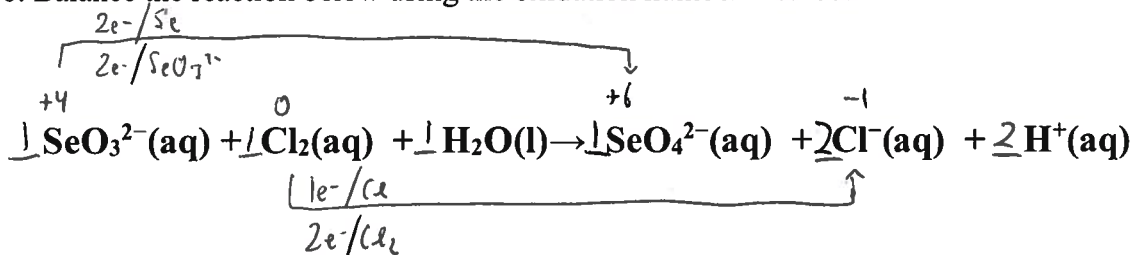
	$W^-(aq)$	$X^{2-}(aq)$	$Y^-(aq)$	$Z^{3-}(aq)$
W(s)	NR	✓	✓	NR
X(s)	NR	NR	NR	NR
Y(s)	NR	✓	NR	NR
Z(s)	✓	✓	✓	NR



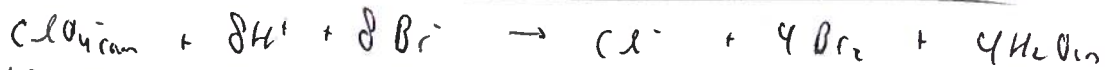
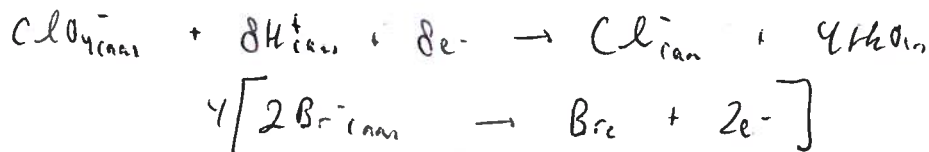
9. In the redox reaction $M + N \rightarrow P + Q$, which statement is false?

- a. If M is the reducing agent, then N is reduced.
- b. If M is oxidized, then N is the oxidizing agent
- c. If M is oxidized, then N is reduced.
- d. If M is the reducing agent, then N is oxidized.

10. Balance the reaction below using the oxidation number method.



11. What mass of bromine will be produced if a potassium bromide solution reacts with 50.0 mL of a 1.20 mol/L solution of acidified $NaClO_4(aq)$?



$$c = 1.20 \text{ mol/L}$$

$$v = 0.050 \text{ L}$$

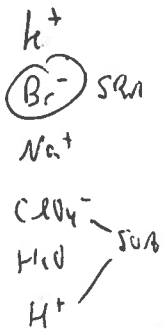
$$n = cv$$

$$n = 0.060 \text{ mol}$$

$$\times \frac{4}{8} \rightarrow \begin{array}{l} m = ?? \\ n = 0.24 \text{ mol} \end{array}$$

$$M = 159.80 \text{ g/mol}$$

$$m = 38.352 \text{ g}$$

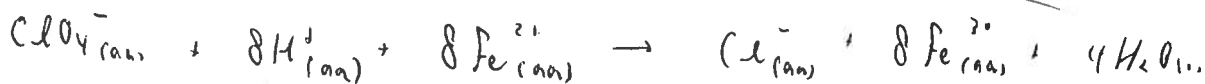
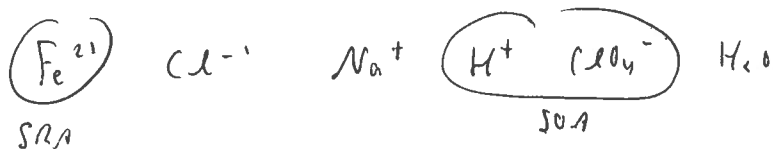


12.

Problem: What is the concentration of a sodium perchlorate solution?

Evidence: Volume of acidified $\text{NaClO}_4(\text{aq})$ titrated with 10.00 mL of acidic 0.0500 mol/L iron (II) chloride

Trial	1	2	3	4
Final Buret Reading (mL)	18.4	35.2	17.3	34.1
Initial Buret Reading (mL)	1.0	18.4	0.6	17.3
Volume of $\text{NaClO}_4(\text{aq})$ (mL)	17.4	16.8	16.7	16.8
Endpoint Colour	Dark pink	Light pink	Light pink	Light pink



$$n = 0.0005 \text{ mol}$$

$$v = 0.016766 \text{ L}$$

$$C = 0.003727 \text{ mol/L}$$

$$v = 0.01000 \text{ L}$$

$$C = 0.0500 \text{ mol/L}$$

$$n = 0.000500 \text{ mol}$$

$$C = 0.00373 \text{ mol/L}$$

$$3.73 \text{ mmol/L}$$

13. a. An electrochemical cell is created using standard lead and bromine half-cells. Draw the cell. Determine which half-cell will undergo oxidation and which will undergo reduction, identify anode and cathode, and calculate the voltage for the cell.

b. If the mass of the lead electrode changes by 5.0 g, what will be the change in the mass of bromine in the other half cell, and will its mass increase or decrease?