Name: KEY

Chemistry 30
Electrochemistry Review

Use the following information to answer the next question.

At the Wascana Gas Plant in Balzac, Alberta, environmental and economic concerns have resulted in the development of an efficient process for the removal of sulphur from sour gas, which is a mixture of hydrocarbons and $H_2S_{(g)}$. In the first step of the process, one-third of the $H_2S_{(g)}$ reacts with $O_{2(g)}$ to produce $SO_{2(g)}$. In the second step of the process, the $SO_{2(g)}$ produced reacts with the remaining $H_2S_{(g)}$ to form elemental sulphur and water.

Step I $\quad 2\ H_2S(g) + 3\ O_2(g) \rightarrow 2\ H_2O(g) + 2\ SO_2(g)$

Step II $\quad 2\ H_2S(g) + 2\ SO_2(g) \rightarrow 2\ H_2O(g) + 3\ S(s)$

Overall Equation: $\quad \overset{+1\ -2}{2\ H_2S}(g) + \overset{0}{O_2}(g) \rightarrow \overset{+1\ -2}{2\ H_2O}(g) + 2\ \overset{0}{S}(s)$

lose e^- = oxidized

$-2 \quad 0$

1. As $H_2S(g)$ forms S(s), the oxidation number of sulphur
   - **A.** changes from 0 to −2 and sulphur is reduced
   - **B.** changes from −2 to 0 and sulphur is oxidized
   - **C.** decreases by 2 and hydrogen sulphide acts as the reducing agent
   - **D.** stays the same because the sulphur is neither oxidized nor reduced

Use the following information to answer the next question.

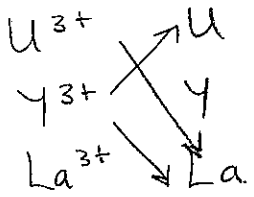
$$U^{3+}(aq) + La(s) \rightarrow La^{3+}(aq) + U(s)$$

$$Y^{3+}(aq) + U(s) \rightarrow \text{no reaction}$$

$$Y^{3+}(aq) + La(s) \rightarrow La^{3+}(aq) + Y(s)$$

2. The oxidizing agents above, listed from strongest to weakest, are
   - **A.** $U^{3+}(aq)$, $La^{3+}(aq)$, $Y^{3+}(aq)$
   - **B.** $U^{3+}(aq)$, $Y^{3+}(aq)$, $La^{3+}(aq)$
   - **C.** $Y^{3+}(aq)$, $U^{3+}(aq)$, $La^{3+}(aq)$
   - **D.** U(s), Y(s), La(s)

SOA



Use the following information to answer the next question.

A farmer noticed a white substance around the scratches on his zinc-coated steel grain bins. His daughter, who had just completed Chemistry 30, correctly told him that the zinc was being oxidized.

3. In the process of being oxidized, the zinc
   - **A.** gained electrons to produce more Zn(s)
   - **B.** lost electrons and became $Zn^{2+}(aq)$
   - **C.** gained protons to produce $Zn^{2+}(aq)$
   - **D.** lost protons and became Zn(s)

$Zn(s) \rightarrow Zn^{2+} + 2e^-$

4. The oxidation number of chromium in $Na_2Cr_3O_{10}(s)$ is
   - **A.** +6
   - **B.** +18
   - **C.** +1
   - **D.** +3

$\overset{+1}{Na_2}\overset{x}{Cr_3}\overset{-2}{O_{10}}$

$(+2) + 3(x) + (-20) = 0$

$\frac{3x}{3} = \frac{18}{3}$

$x = 6$

Use the following information to answer the next question.

A student used an acidified 6.31×10^{-2} mol/L $KMnO_4(aq)$ solution to titrate 25.0 mL samples of $Fe^{2+}(aq)$ solution of unknown concentration. In the reactions, the $Fe^{2+}(aq)$ ion was oxidized to the $Fe^{3+}(aq)$ ion. The student completed five trials and summarized the data in a table.

Trial Number	1	2	3	4	5
Final Buret Reading (mL)	17.55	35.65	26.40	42.65	16.85
Initial Buret Reading (mL)	0.30	17.55	10.05	26.40	0.55
Final Colour	purple	purple	pink	pink	pink
	17.25	18.1	16.35	16.25	16.3

$\frac{16.35 + 16.25 + 16.3}{3} = 16.3\text{mL}$

5. According to the student's data, the concentration of $Fe^{2+}(aq)$ is
   - **A.** 0.206 mol/L
   - **B.** 0.218 mol/L
   - **C.** 0.213 mol/L
   - **D.** 0.223 mol/L

$5(Fe^{2+} \rightarrow Fe^{3+} + 1e^-)$

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

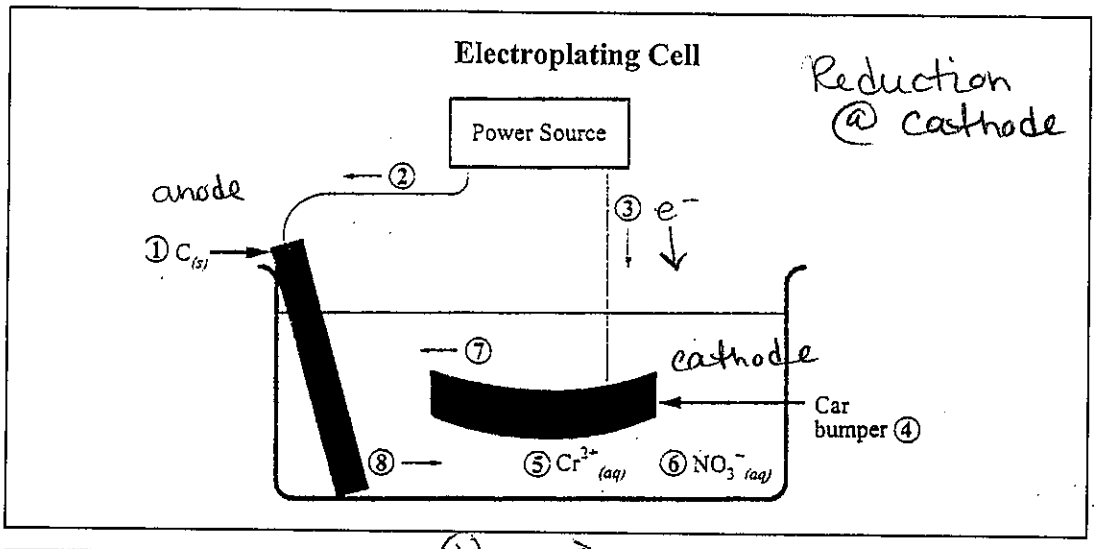
25.0mL $6.31 \times 10^{-2}\text{mol/L}$

$C = ?$ 16.3mL

$\frac{16.3\text{mL} \times 6.31 \times 10^{-2}\text{mol/L}}{2} \times \frac{5\text{mol } Fe^{2+}}{1\text{mol } MnO_4^-} \times \frac{1}{25.0\text{mL}}$

$= 0.2057 = 0.206\text{mol/L}$

Use the following information to answer the next question.



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)

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

Use the following information to answer the next question.

The following are materials used by Chemistry 30 students in laboratory work.

(1) electrodes	5 thermometer
2 insulated containers	(6) electrolytes
3 pH paper	(7) external circuit
(4) porous boundary	8 buret

Numerical Response

2. The materials necessary to construct and operational voltaic cell are, in numerical order, ___1___, ___4___, ___6___, and ___7___.

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

Use the following information to answer the next three questions.

Restorers of antique cars often refinish chrome-plated parts by electroplating them. The part is attached to one electrode of an electrolytic cell in which the other electrode is lead. The electrolyte is a solution of dichromic acid, $H_2Cr_2O_7(aq)$.

6. The plating of chromium metal will take place at the
   A. anode where oxidation occurs
   B. anode where reduction occurs
   C. cathode where oxidation occurs
   D. cathode where reduction occurs

$Cr^{2+} + 2e^- \rightarrow Cr(s)$

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$

$Pb(s) \rightleftharpoons Pb^{2+} + 2e^-$

7. During the operation of this cell,
   A. Pb(s) is reduced
   B. $H_2Cr_2O_7(aq)$ is oxidized
   C. the pH of the solution increases
   D. the total energy of the system decreases

8. A metal that will react spontaneously with $Cr^{3+}(aq)$ in a chromium-plating solution is
   A. aluminum
   B. cadmium
   C. lead
   D. tin

$Cr^{3+} \rightarrow Pb(s)$, $Sn(s)$, $Cd(s)$

$Cr^{3+} \rightarrow Al(s)$

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9. The voltage of an electrochemical cell is +0.20 V. If one of the half-reactions is the cathode reduction of $Cu^{2+}(aq)$, then the other half-reaction that occurs could be
   A. $2\,I^-(aq) \rightarrow I_2(s) + 2\,e^-$
   B. $S(s) + 2\,H^+(aq) + 2\,e^- \rightarrow H_2S(aq)$
   C. $H_2S(aq) \rightarrow S(s) + 2\,H^+(aq) + 2\,e^-$
   D. $I_2(s) + 2\,e^- \rightarrow 2\,I^-(aq)$

The answer should be C - not B - need oxidation.

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$+0.20 = +0.34 - x$

$x = 0.14V$

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.

$Cr^{2+} + 2e^- \rightarrow Cr(s)$

Numerical Response

3. In order to plate the bumper, the number of moles of chromium(II) ions that must react in the cell is 2.15 mol.

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

$112\,g\,Cr \times \frac{mol}{52.00\,g} \times \frac{1\,mol\,Cr^{2+}}{1\,mol\,Cr(s)} = 2.15\,mol$

*Use your recorded answer for **Numerical Response 3** to answer **Numerical Response 4*.***

Numerical Response

4. 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)

***You can still receive marks for this question even if the previous question was answered incorrectly.**

$112\,g\,Cr \times \frac{mol}{52.00\,g} \times \frac{2\,mole^-}{1\,mol\,Cr(s)} \times \frac{9.65\times10^4\,C}{mole^-} \times \frac{s}{2000\,C} \times \frac{min}{60\,s} = 3.46\,min$

Use the following information to answer the next question.

Some car manufacturers have designed an anticorrosion system that sends a weak electric current from the battery to the frame of the car. The current provides a source of electrons, which reduces corrosion of the steel frame.

10. Which of the following methods could **not** be used as an alternative to the method of corrosion prevention described above?

A. Galvanize the steel frame with zinc. ✓

B. Coat the steel frame with inert plastic polymers. ✓

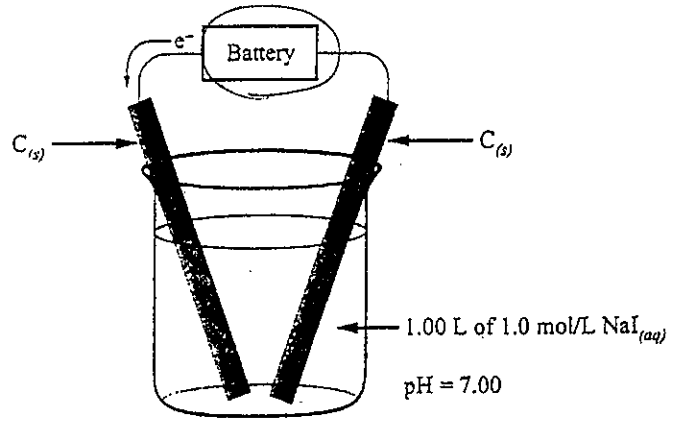
C. Use a paint that prevents contact of the steel frame with the environment. ✓

D. Bolt sacrificial anodes made of copper to the steel frame.

↑ would not be a SRA than the steel frame ∴ wouldn't act as a sacrificial anode

Use the following information to answer the next question.

Electrochemical Cell



The diagram above provides a representation of the process of electrolysis.

11. Which of the following statements describes what happens during the operation of this cell?

A. Chemical energy is converted to electrical energy. (voltaic) ✗

B. Electrical energy is converted to chemical energy.

C. Electrons flow toward the anode.

D. Plating takes place at the anode.

Use the following information to answer the next question.

$2\ RhCl_6^{3+}(aq) + 3\ Zn(s) \rightarrow 3\ Zn^{2+}(aq) + 2\ Rh(s) + 12\ Cl^-(aq)\quad E°_{net} = +1.20\ V$

Numerical Response

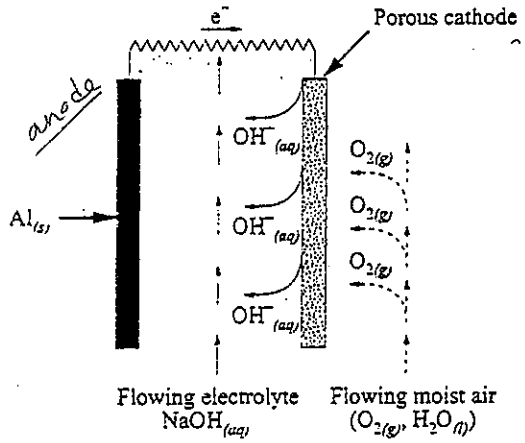
5. The standard electrode potential for the half-reaction $RhCl_6^{3+}(aq) + 3\ e^- \rightarrow Rh(s) + 6\ Cl^-(aq)$ is +/- 0.44 V.

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

Use the following information to answer the next four questions.

Concern about increased air pollution and the increasing use of non-renewable resources has accelerated research into alternatives to the internal combustion engine. One alternative is a battery-powered electric motor. Several "new" efficient batteries are being tested. The diagram below represents one of these batteries.

Aluminum-Air Battery



12. In this aluminum-air battery, the $O_2(g)$ acts as the

A. reducing agent and gains electrons

B. reducing agent and loses electrons

C. oxidizing agent and gains electrons

D. oxidizing agent and loses electrons

OA

$O_{2(g)} + 2H_2O_{(l)} + 4e^- \rightarrow 4OH^-$ 0.40

(reduced)

$Al_{(s)} \rightarrow Al^{3+} + 3e^-$ −1.66

13. The reduction half-reaction for this aluminum-air battery is

A. $2\ H_2O(l) + 2\ e^- \rightarrow H_2(g) + 2\ OH^-(aq)$

B. $Na^+(aq) + e^- \rightarrow Na(s)$

C. $O_2(g) + 4\ H^+(aq) + 4\ e^- \rightarrow 2\ H_2O(l)$

D. $O_2(g) + 2\ H_2O(l) + 4\ e^- \rightarrow 4\ OH^-(aq)$

*Use the answer selected for **Multiple Choice 15** to answer **Multiple Choice 16.****

14. The standard voltage produced by this aluminum-air cell is

A. +2.36 V

B. +2.06 V

C. +0.83 V

D. −1.05 V

$E^\circ cell = E^\circ cath - E^\circ anode$

$= 0.40 - (-1.66)$

$= 2.06V$

***You can receive marks for this question even if the previous question was answered incorrectly.**

*Use your recorded answer for **Multiple Choice 14** to answer **Numerical Response 6.****

Numerical Response

6. When three aluminum-air cells are connected in series, the net voltage generated by the battery is +/– 6.18 V.

2.06 × 3 = 6.18

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

***You can receive marks for this question even if the previous question was answered incorrectly.**

Use the following information to answer the next three questions.

At the Banff Wastewater Treatment plant, bacteria are used to treat organic "sludge" $(CH_2O)_{n(s)}$ in a process called autothermal thermophilic aerobic digestion (ATAD). The digestion of the sludge can be represented by the equation

0 +1 -2 +4 -2

$$(CH_2O)_n(s) + n\,O_2(g) \xrightarrow{\text{bacteria}} n\,CO_2(g) + n\,H_2O(l) + \text{energy}$$

exo

15. At the treatment plant, the enzymes in the bacteria act as

A. buffers

B. reducing agents

C. oxidizing agents

D. biological catalysts

16. The ATAD process is

A. a reduction

B. exothermic

C. endothermic

D. an acid-base reaction

17. During the digestion process, the carbon in the sludge is

A. reduced

B. oxidized

C. amphoteric

D. precipitated

0 —oxidized→ +4

C ⟶ C

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

$$\overset{0}{Cu(s)} + 2\,Fe^{3+}(aq) \rightarrow \overset{+2}{Cu^{2+}}(aq) + 2\,Fe^{2+}(aq)$$

18. 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

oxidized

0 ⟶ +2

19. Which of the following statements and corresponding net voltages are correct for this reaction?

A. It is a spontaneous reaction with an $E°_{net} = +0.43$ V.

B. It is a spontaneous reaction with an $E°_{net} = +1.11$ V.

C. A power supply is required because the $E°_{net} = -0.43$ V.

D. A power supply is required because the $E°_{net} = -1.11$ V.

cath $Fe^{3+} + 1e^- \rightarrow Fe^{2+}$ 0.77V

anode $Cu(s) \rightarrow Cu^{2+} + 2e^-$ 0.34V

0.43V

Use the following information to answer the next question.

ICCP (Impressed Current Cathodic Protection) is a corrosion prevention technique that is used to protect buried metal structures. A low-voltage current (electron flow) is applied to the buried metal structure such that only reduction reactions can occur at its surface.

Numerical Response

7. The ground water surrounding the buried metal structure may contain the following ions.

1	$Pb^{2+}(aq)$
2	$Fe^{2+}(aq)$
3	$Fe^{3+}(aq)$
4	$Cd^{2+}(aq)$

SOA

Fe^{3+}

Pb^{2+}

Cd^{2+}

Fe^{2+}

The order in which these ions are reduced on the surface of the metal structure is 3, 1, 4 and 2.

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

Use the following information to answer the next three questions.

A student dipped 12.50 g strips of four different metals, Ag(s), Cu(s), Pb(s), and Mg(s), into a beaker containing 250 mL of 1.00 mol/L HCl(aq) in order to determine an activity series. One of the metals reacted immediately and vigorously with the acid.

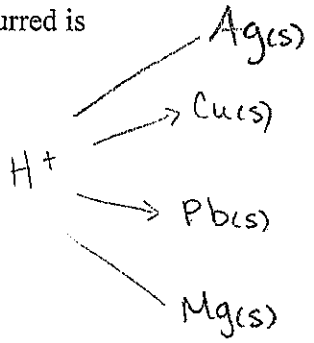
20. The balanced net-ionic equation for the first reaction that occurred is

A. $2\,Ag(s) + 2\,H^+(aq) \rightarrow H_2(g) + 2\,Ag^+(aq)$

B. $Cu(s) + 2\,H^+(aq) \rightarrow H_2(g) + Cu^{2+}(aq)$

C. $Pb(s) + 2\,H^+(aq) \rightarrow H_2(g) + Pb^{2+}(aq)$

D. $Mg(s) + 2\,H^+(aq) \rightarrow H_2(g) + Mg^{2+}(aq)$



*Use your recorded answer for **Multiple Choice 20** to answer **Numerical Response 8.****

Numerical Response

$E°_{cell} = E°_{cath} - E°_{anode}$

$0.00 - (-2.37V)$

8. The electrical potential for this reaction is +/– 2.37 V.

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

***You can receive marks for this question even if the previous question was answered incorrectly.**

*Use your recorded answer for **Multiple Choice 20** to answer **Numerical Response 9.****

Numerical Response

9. The mass of metal that reacted with the hydrochloric acid is 3.04 g.

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

***You can receive marks for this question even if the previous question was answered incorrectly.**

$Mg(s) + 2H^+ \rightarrow H_2(g) + Mg^{2+}(aq)$

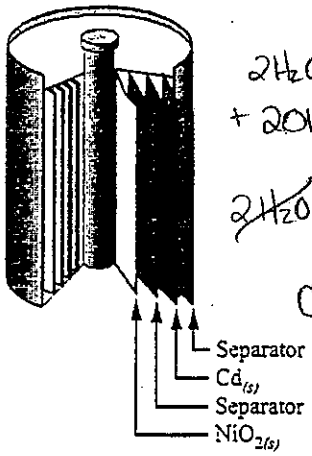
$m = ?$; $0.250\,L$; $1.00\,mol/L$

$$0.250\,\cancel{L} \times \frac{1.00\,mol}{\cancel{L}} \times \frac{1\,mol\,Mg}{2\,mol\,H^+} \times \frac{24.31\,g}{mol} = 3.03875\,g$$

$= 3.04\,g$

Use the following information to answer the next two questions.

Voltaic cells are used as portable sources of electrical energy. One common cell is the rechargeable nickel-cadmium cell.



$2H_2O + Cd_{(s)} \rightarrow Cd(OH)_2 + 2H^+ + 2e^- + 2OH^-$

$2H_2O + 2OH^- + Cd_{(s)} \rightarrow Cd(OH)_2 + 2H_2O + 2e^-$

$Cd_{(s)} + 2OH^- \rightarrow Cd(OH)_2 + 2e^-$

The equation representing the discharge of this cell is

OA RA

$$NiO_2(s) + Cd(s) + 2\,H_2O(l) \rightarrow Cd(OH)_2(s) + Ni(OH)_2(s)$$

Balancing in basic solutions

21. The oxidation half-reaction for the discharge of this cell is

* **A.** $Cd(s) + 2\,OH^-(aq) \rightarrow Cd(OH)_2(s) + 2\,e^-$

* Not in curriculum anymore

B. $NiO_2(s) + 2\,H_2O(l) + 2\,e^- \rightarrow Ni(OH)_2(s) + 2\,OH^-(aq)$

C. $NiO_2(s) + 2\,H_2O(l) \rightarrow Ni(OH)_2(s) + 2\,OH^-(aq) + 2\,e^-$

D. $Cd(s) + 2\,OH^-(aq) + 2\,e^- \rightarrow Cd(OH)_2(s)$

* **22.** In this system, the strongest oxidizing agent is

A. $NiO_2(s)$

B. $Cd(s)$

C. $Cd(OH)_2(s)$

D. $H_2O(l)$

$2OH^- \rightarrow 2e^- + 2H^+ + NiO_2 \rightarrow Ni(OH)_2 + 2OH^-$

$NiO_2 + 2H_2O + 2e^- \rightarrow Ni(OH)_2 + 2OH^-$

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23. If the electrochemical cell $Cd(s) / Cd^{2+}(aq)//Ag^+(s) /Ag(s)$ produces a 6.00 A current for 2.00 h, the mass change of the anode will be a

A. 25.2 g decrease

B. 2.25 g increase

C. 48.3 g decrease

D. 48.3 g increase

anode $Cd_{(s)} \rightarrow Cd^{2+} + 2e^-$

$m = ?$ 6.00A 2h

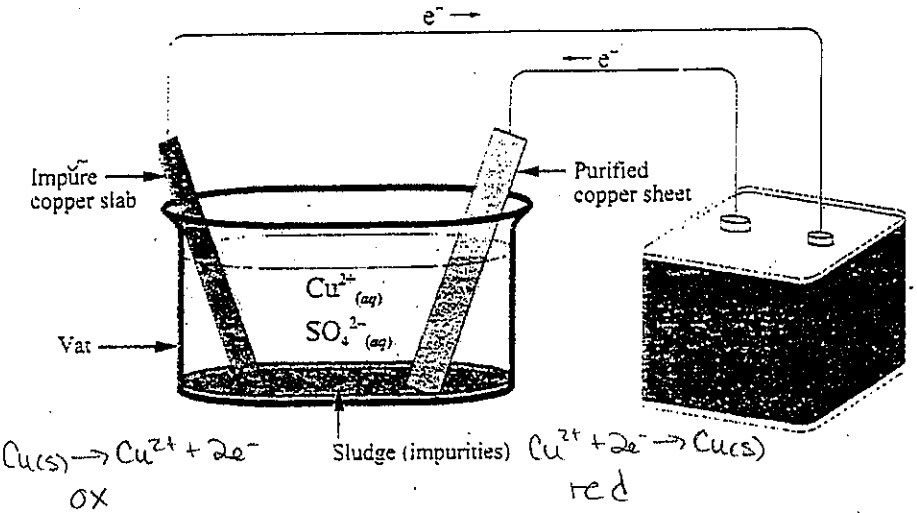
$$2h \times \frac{3600s}{hr} \times \frac{6.00C}{s} \times \frac{mole^-}{9.65\times10^4 C} \times \frac{1mol\,Cd}{2mole^-} \times \frac{112.41g}{mol}$$

$= 25.2g$ decrease

Use the following information to answer the next question.

Copper can be refined (purified) using an apparatus like the one shown below, which is a small-scale version of an industrial apparatus.

Electrorefining



$Cu_{(s)} \rightarrow Cu^{2+} + 2e^-$ ox

$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$ red

24. In this electrochemical cell, the purified copper sheet acts at the

A. anode and is the site where $SO_4^{2-}(aq)$ ions are oxidized

B. cathode and is the site where $SO_4^{2-}(aq)$ ions are reduced

C. anode and is the site where $Cu^{2+}(aq)$ ions are oxidized

D. cathode and is the site where $Cu^{2+}(aq)$ ions are reduced

Numerical Response

10. If the direct current power supply produces a steady 3.50 A current, then the time required to deposit 0.100 g of purified copper is 86.8 s.

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

$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

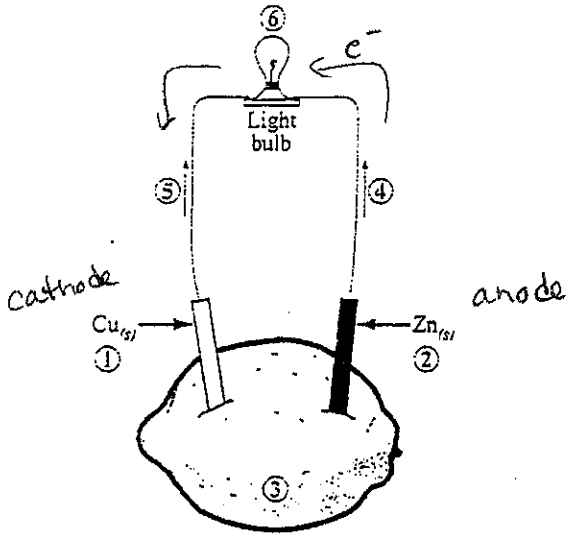
3.50A 0.100g

t = ?

$$0.100\,g\,Cu \times \frac{mol}{63.55\,g} \times \frac{2\,mol\,e^-}{1\,mol\,Cu} \times \frac{9.65\times10^4\,C}{mol\,e^-} \times \frac{s}{3.50\,C} = 86.77 = 86.8\,s$$

Use the following information to answer the next question.

A voltaic cell capable of lighting a small light bulb can be made by placing copper and zinc strips in a lemon.



Numerical Response

11. Identify the part of the voltaic cell, as numbered above, that corresponds to each of the descriptors listed below.

Anode ___2___ (Record in the **first** column)

Cathode ___1___ (Record in the **second** column)

Electron flow ___4___ (Record in the **third** column)

Electrolyte ___3___ (Record in the **fourth** column)

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

Use the following information to answer the next question.

A particular voltaic cell is represented by

$$Ag(s) / Ag^+(aq) // Cr_2O_7^{2-}(aq), Cr^{3+}(aq), H^+(aq) / C(s)$$

25. The net ionic equation for this voltaic cell is

A. $6\ Ag(s) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow 6\ Ag^+(aq) + 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

B. $6\ Ag^+(aq) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow 6\ Ag(s) + 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

C. $Ag(s) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow Ag^+(aq) + 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

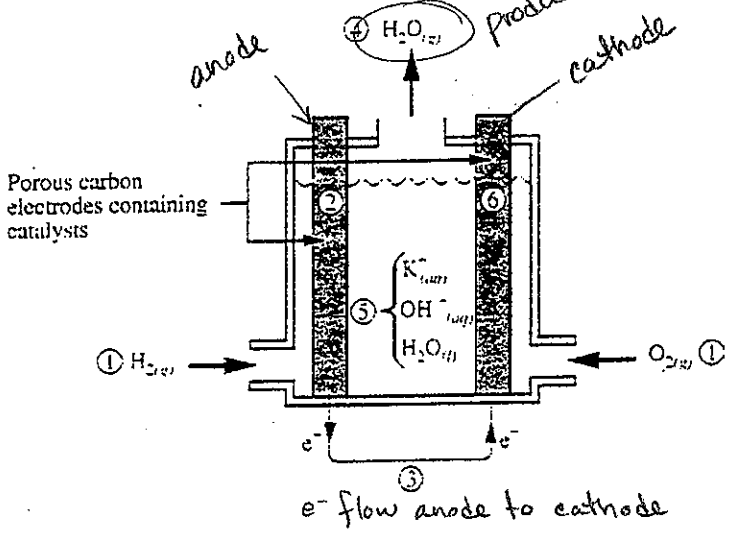
D. $Ag^+(aq) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow Ag(s) + 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$6(Ag_{(s)} \rightarrow Ag^+ + 1e^-)$

Use the following information to answer the next two questions.

Hydrogen-oxygen fuel cells have been used for years in spacecraft and more recently in small-scale power plants to generate electricity. Now, some governments and companies are working together to perfect this type of fuel cell for automobile use, and experiments are currently being conducted with operational prototypes. A diagram of a hydrogen-oxygen fuel cell is shown below.



Numerical Response

12. In the diagram above, the anode, the cathode, the electrolyte, and a product of the reaction are labelled, respectively, 2, 6, 5, and 4.

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

Use the following information to answer the next question.

The sodium metal in television picture tubes reacts with oxygen that would otherwise oxidize the tungsten and phosphorus found in the tubes. Tungsten and phosphorus are vital to the function of picture tubes.

Numerical Response

13. The mass of sodium that will react when 0.350 mol of electrons is transferred is 8.05 g.

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

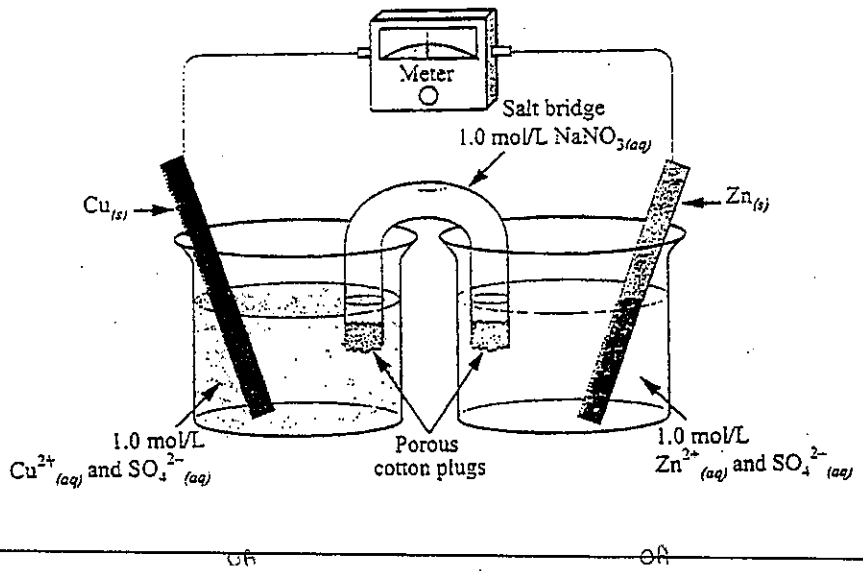
$Na^+ + 1e^- \rightarrow Na_{(s)}$

0.350mol m = ?

$0.350\text{mol} \times \frac{1\text{mol Na(s)}}{1\text{mol } e^-} \times \frac{22.99\text{g}}{\text{mol}} = 8.05\text{g}$

Use the following information to answer the next question.

An Electrochemical Cell



OA OA
Na^+, NO_3^-, Cu^{2+}, SO_4^{2-}, Zn^{2+}, $H_2O_{(l)}$, $Cu_{(s)}$, $Zn_{(s)}$
SOA RA SRA
OA

Numerical Response

14. A student attempted to replicate a traditional Daniell Cell by setting up the electrochemical cell shown above. Under standard conditions, the electrical potential of the cell should be +/- 1.10 V.

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

$Cu^{2+} + 2e^- \rightleftharpoons Cu_{(s)}$ 0.34V

$Zn_{(s)} \rightleftharpoons Zn^{2+} + 2e^-$ -0.76V

1.10V

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

Numerical Response

15. Under standard conditions, hydrogen gas reacts with $Au^{3+}(aq)$ ions to produce Au(s). The net cell potential for the reaction is +/- 1.50 V.

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

$Au^{3+} + 3e^- \rightleftharpoons Au_{(s)}$ 1.50V

$H_{2(g)} \rightleftharpoons 2H^+ + 2e^-$ 0.00

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

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.

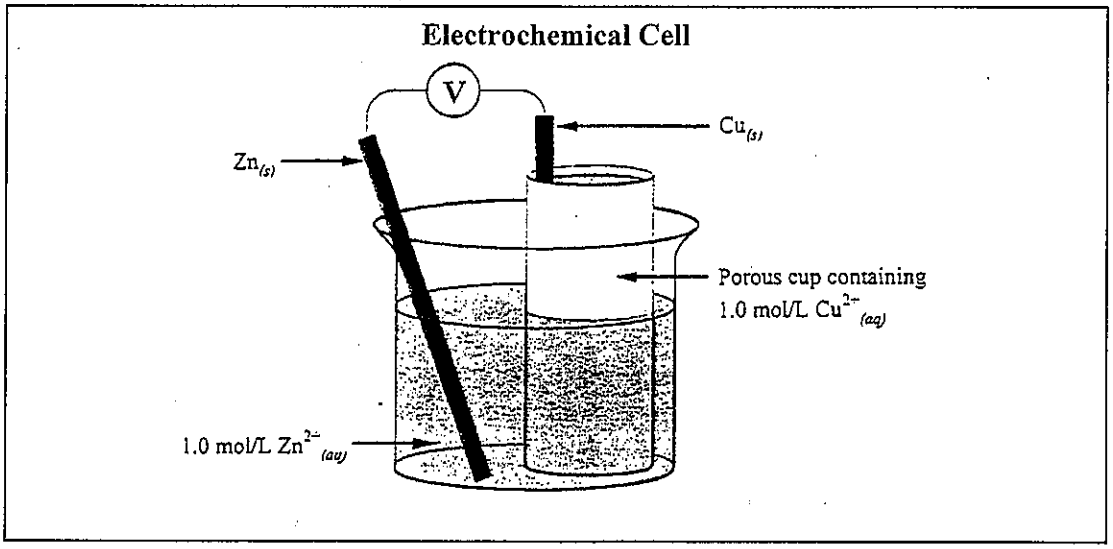
	Ga(s)	Fe(s)	Zn(s)	Mg(s)
$Ga^{3+}(aq)$	–	×	✓	✓
$Fe^{2+}(aq)$	✓	–	✓	✓
$Zn^{2+}(aq)$	×	×	–	✓
$Mg^{2+}(aq)$	×	×	×	–

× denotes no reaction
✓ denotes a reaction
– denotes not tested

26. The reduction potential of $Ga^{3+}(aq)$ could be

A. −0.53 V
B. −1.41 V
C. +1.21 V
D. +1.92 V

Use the following information to answer the next question.



27. For this cell, the potential is

A. +1.10 V
B. +0.42 V
C. −0.42 V
D. −1.10 V