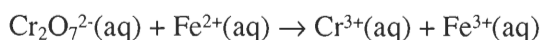


## Take home 3

## Multiple Choice

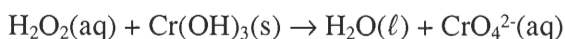
Identify the letter of the choice that best completes the statement or answers the question. Then write a *SHORT* explanation or show the calculations to justify your answer. Also record your answers on a Green Scanton. This assignment is due at the time of the final Tuesday December 14th 9:00 a.m.

- \_\_\_\_\_ 1. Write a balanced chemical equation for the following reaction in an acidic solution.



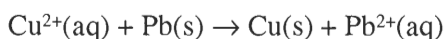
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + \text{Fe}^{3+}(\text{aq})$
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + 7 \text{H}^+(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + \text{Fe}^{3+}(\text{aq}) + 7 \text{OH}^-(\text{aq})$
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 6 \text{Fe}^{2+}(\text{aq}) + 7 \text{H}^+(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + 6 \text{Fe}^{3+}(\text{aq}) + 7 \text{OH}^-(\text{aq})$
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + 14 \text{H}^+(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + \text{Fe}^{3+}(\text{aq}) + 7 \text{H}_2\text{O}(\ell)$
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 6 \text{Fe}^{2+}(\text{aq}) + 14 \text{H}^+(\text{aq}) \rightarrow 6 \text{Fe}^{3+}(\text{aq}) + 2 \text{Cr}^{3+}(\text{aq}) + 7 \text{H}_2\text{O}(\ell)$

- \_\_\_\_\_ 2. Write a balanced chemical equation for the following reaction in a basic solution.



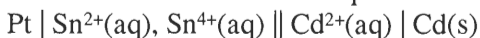
- $2 \text{H}_2\text{O}_2(\text{aq}) + 3 \text{Cr}(\text{OH})_3(\text{s}) \rightarrow \text{H}_2\text{O}(\ell) + 3 \text{CrO}_4^{2-}(\text{aq}) + 11/2 \text{H}^+(\text{aq})$
- $2 \text{H}_2\text{O}_2(\text{aq}) + \text{Cr}(\text{OH})_3(\text{s}) \rightarrow \text{H}_2\text{O}(\ell) + \text{CrO}_4^{2-}(\text{aq}) + 2 \text{OH}^-(\text{aq})$
- $\text{H}_2\text{O}_2(\text{aq}) + 2 \text{Cr}(\text{OH})_3(\text{s}) \rightarrow \text{H}_2\text{O}^*(\ell) + 2 \text{CrO}_4^{2-}(\text{aq}) + 4 \text{H}_2\text{O}(\ell)$
- $3 \text{H}_2\text{O}_2(\text{aq}) + 2 \text{Cr}(\text{OH})_3(\text{s}) + 4 \text{OH}^-(\text{aq}) \rightarrow 2 \text{CrO}_4^{2-}(\text{aq}) + 8 \text{H}_2\text{O}(\ell)$
- $4 \text{H}_2\text{O}_2(\text{aq}) + 2 \text{Cr}(\text{OH})_3(\text{s}) \rightarrow 2 \text{H}_2\text{O}(\ell) + 2 \text{CrO}_4^{2-}(\text{aq}) + 4 \text{OH}^-(\text{aq})$

- \_\_\_\_\_ 3. What is the correct cell notation for the reaction below?



- $\text{Pb} \mid \text{Pb}^{2+}(\text{aq}) \parallel \text{Cu}^{2+}(\text{aq}) \mid \text{Cu}$
- $\text{Pb} \mid \text{Cu}^{2+}(\text{aq}) \parallel \text{Pb}^{2+}(\text{aq}) \mid \text{Cu}$
- $\text{Pb} \mid \text{Cu}(\text{s}) \parallel \text{Pb}^{2+}(\text{aq}) \mid \text{Cu}^{2+}$
- $\text{Cu} \mid \text{Pb}^{2+}(\text{aq}) \parallel \text{Cu}^{2+}(\text{aq}) \mid \text{Pb}$
- $\text{Cu} \mid \text{Cu}^{2+}(\text{aq}) \parallel \text{Pb}^{2+}(\text{aq}) \mid \text{Pb}$

- \_\_\_\_\_ 4. Write a balanced chemical equation for the overall reaction represented by the cell notation below.



- $\text{Cd}^{2+}(\text{aq}) + \text{Sn}^{4+}(\text{aq}) \rightarrow \text{Cd}(\text{s}) + \text{Sn}^{2+}(\text{aq})$
- $\text{Cd}^{2+}(\text{aq}) + \text{Sn}^{2+}(\text{aq}) \rightarrow \text{Cd}(\text{s}) + \text{Sn}^{4+}(\text{aq})$
- $\text{Cd}(\text{s}) + \text{Sn}^{4+}(\text{aq}) \rightarrow \text{Cd}^{2+}(\text{aq}) + \text{Sn}^{2+}(\text{aq})$
- $\text{Cd}(\text{s}) + \text{Cd}^{2+}(\text{aq}) \rightarrow \text{Sn}^{2+}(\text{aq}) + \text{Sn}^{4+}(\text{aq})$
- $\text{Cd}(\text{s}) + \text{Sn}^{2+}(\text{aq}) \rightarrow \text{Cd}^{2+}(\text{aq}) + \text{Sn}^{4+}(\text{aq})$

\_\_\_\_\_ 5. Use the standard reduction potentials below to determine which compound or ion is the best oxidizing agent?



- $\text{Cl}_2$
- $\text{Cl}^-$
- $\text{Ag}$
- $\text{Fe}^{2+}$
- $\text{Fe}$

\_\_\_\_\_ 6. Use the standard reduction potentials below to determine which compound or ion is the best reducing agent?



- $\text{Hg}^{2+}$
- $\text{Hg}(\ell)$
- $\text{Cu}^{2+}$
- $\text{Cd}^{2+}$
- $\text{Cd}$

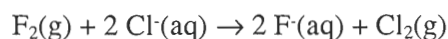
\_\_\_\_\_ 7. Consider the following half-reactions:



Which of the above metals or metal ions are able to oxidize  $\text{Al}(\text{s})$ ?

- $\text{Fe}^{3+}$  and  $\text{Sn}^{2+}$
- $\text{Fe}^{3+}$ ,  $\text{Sn}^{2+}$ , and  $\text{Fe}^{2+}$
- $\text{Fe}^{2+}$ ,  $\text{Sn}$ , and  $\text{Fe}$
- $\text{Mg}$  and  $\text{Mg}^{2+}$
- $\text{Mg}^{2+}$  only

\_\_\_\_\_ 8. Calculate  $E_{\text{cell}}^{\circ}$  for the following reaction:

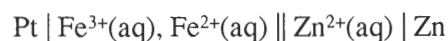


given the following standard reduction potentials.



- a. -4.23 V
- b. -1.51 V
- c. 0.76 V
- d. +1.51 V
- e. +4.23 V

\_\_\_\_\_ 9. Calculate  $E_{\text{cell}}^{\circ}$  for the following electrochemical cell:



given the following reduction half-reactions.

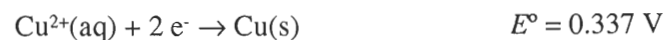


- a. -1.534 V
- b. -0.008 V
- c. +0.008 V
- d. +1.802 V
- e. +2.305 V

\_\_\_\_\_ 10. Calculate  $E$  for the following electrochemical cell at 25°C

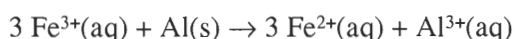


given the following standard reduction potentials.



- a. -0.301 V
- b. +0.278 V
- c. +0.310 V
- d. +0.319 V
- e. +0.355 V

\_\_\_\_\_ 11. Calculate the cell potential, at 25 °C, based upon the overall reaction



if  $[\text{Fe}^{3+}] = 0.300 \text{ M}$ ,  $[\text{Fe}^{2+}] = 0.150 \text{ M}$ , and  $[\text{Al}^{3+}] = 0.300 \text{ M}$ . The standard reduction potentials are as follows:



a. +0.87 V

b. +2.26 V

c. +2.46 V

d. +3.01 V

e. +4.21 V

\_\_\_\_\_ 12. Which one of the changes below will increase the potential of the following electrochemical cell?



a. Switching from a platinum to a graphite anode.

b. Increasing the size of the cathode.

c. Decreasing the concentration of  $\text{Cu}^{2+}$ .

d. Increasing the concentration of  $\text{Sn}^{2+}$ .

e. Increasing the temperature of the cell.

\_\_\_\_\_ 13. Calculate  $\Delta G^\circ$  for the disproportionation of  $\text{Cu}^+$ ,



given the following standard reduction potentials.



a. -1180 kJ

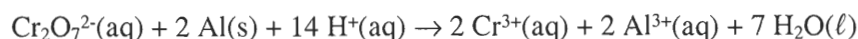
b. -175 kJ

c. -165 kJ

d. -56.8 kJ

e. -34.9 kJ

\_\_\_\_\_ 14. If  $\Delta G^\circ$  for the following reaction is  $-1.73 \times 10^3 \text{ J}$ , calculate  $E_{\text{cell}}^\circ$ .



a. +1.49 V

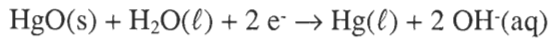
b. +2.18 V

c. +2.99 V

d. +4.48 V

e. +5.98 V

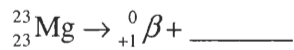
- \_\_\_\_\_ 15. What charge, in coulombs, is required to deposit 0.205 g Ag(s) from a solution of Ag<sup>+</sup>(aq)?
- 2.29 C
  - 54.6 C
  - 103 C
  - 183 C
  - 197 C
- \_\_\_\_\_ 16. One kind of battery used in watches contains mercury (II) oxide. As current is drawn, the mercury oxide is reduced to mercury.



If a watch draws  $1.0 \times 10^{-5}$  amperes continuously for 1,200 days, what mass of Hg(l) is formed?

- 0.0053 g
  - 0.54 g
  - 1.1 g
  - 2.2 g
  - 4.66 g
- \_\_\_\_\_ 17. Plutonium-244 decays by successive  $\alpha$ ,  $\beta$ ,  $\beta$ ,  $\alpha$ , emissions. What nucleus is produced?
- ${}_{88}^{236}\text{Ra}$
  - ${}_{90}^{236}\text{Th}$
  - ${}_{90}^{234}\text{Th}$
  - ${}_{92}^{240}\text{U}$
  - ${}_{92}^{236}\text{U}$
- \_\_\_\_\_ 18.  ${}_{83}^{203}\text{Bi}$  decays by electron capture. What is the product?
- ${}_{81}^{199}\text{Tl}$
  - ${}_{82}^{203}\text{Pb}$
  - ${}_{83}^{202}\text{Bi}$
  - ${}_{84}^{203}\text{Po}$
  - ${}_{84}^{204}\text{Po}$
- \_\_\_\_\_ 19. What element is produced by the beta decay of  ${}_{79}^{197}\text{Au}$ ?
- ${}_{77}^{193}\text{Ir}$
  - ${}_{78}^{197}\text{Pt}$
  - ${}_{79}^{196}\text{Au}$
  - ${}_{80}^{197}\text{Hg}$
  - ${}_{80}^{196}\text{Hg}$

\_\_\_\_\_ 20. Complete the following reaction.



- a.  ${}_{11}^{23}\text{Na}$   
b.  ${}_{12}^{22}\text{Mg}$   
c.  ${}_{12}^{24}\text{Mg}$   
d.  ${}_{13}^{22}\text{Al}$   
e.  ${}_{13}^{23}\text{Al}$
- \_\_\_\_\_ 21. By what (single step) process does bromine-82 decay to krypton-82?  
a.  $\alpha$  particle emission  
b.  $\beta$  particle emission  
c. positron emission  
d. electron capture  
e. neutron capture
- \_\_\_\_\_ 22. The mass of beryllium-9 is 9.012182 g/mol. The mass of a proton is 1.007825 g/mol. The mass of a neutron is 1.008665 g/mol. Calculate the binding energy of Be-9. ( $c = 3.00 \times 10^8$  m/s)  
a.  $2.93 \times 10^{11}$  J/mol  
b.  $8.12 \times 10^{11}$  J/mol  
c.  $3.08 \times 10^{12}$  J/mol  
d.  $5.54 \times 10^{12}$  J/mol  
e.  $5.62 \times 10^{12}$  J/mol
- \_\_\_\_\_ 23. All of the following statements are true EXCEPT  
a. nuclear fission involves the release of more energy than ordinary chemical reactions.  
b. nuclear fusion involves the release of more energy than fission.  
c. the mass of a nucleus equals the combined masses of the protons and neutrons.  
d. the difference in mass between the nucleus and the nucleons is called the mass defect.  
e. the process in which two or more nuclei combine to form a heavier nuclei is called fusion.
- \_\_\_\_\_ 24. Strontium-90 has a half-life of 28.1 years. Starting with 3.2 mg of this isotope, how much would remain after 112.4 years?  
a. 0.1 mg  
b. 0.2 mg  
c. 0.4 mg  
d. 0.8 mg  
e. 1.6 mg
- \_\_\_\_\_ 25. The half-life of carbon-14 is 5730 years. What percentage of carbon-14 remains in a sample after 8.0 half-lives?  
a. 0.39%  
b. 0.78%  
c. 1.56%  
d. 3.13%  
e. 6.25%