

JASPERSE CHEM 210 PRACTICE TEST 4 VERSION 3  
 Ch. 19 Electrochemistry  
 Ch. 20 Nuclear Chemistry

Formulas:  $E^\circ_{\text{cell}} = E^\circ_{\text{reduction}} + E^\circ_{\text{oxidation}}$   $\Delta G^\circ = -nFE^\circ_{\text{cell}}$  (for kJ, use  $F = 96.5$ )

$E_{\text{cell}} = E^\circ - [0.0592/n] \log Q$   $\log K = nE^\circ/0.0592$

$\text{Mol } e^- = [A \cdot \text{time (sec)}/96,500]$   $\text{time (sec)} = \text{mol } e^- \cdot 96,500/\text{current (in A)}$

$t = (t_{1/2}/0.693) \ln (A_o/A_t)$   $\ln (A_o/A_t) = 0.693 \cdot t / t_{1/2}$

$E = \Delta mc^2$  (m in kg, E in J,  $c = 3 \times 10^8$  m/s)

1. What is the oxidation number of S in  $\text{KHSO}_4$ ?

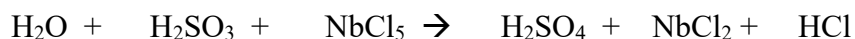
- +3
- +6
- +7
- +12
- none of the above

2. Balance the following reaction. How many electrons would be transferred?



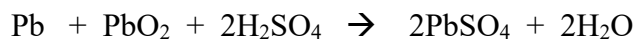
- 2
- 3
- 4
- 6
- none of the above

3. Balance the following reaction. What would be the coefficient for  $\text{NbCl}_2$ ?



- 1
- 2
- 3
- 4
- none of the above

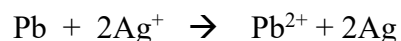
4. Which substance is the oxidizing agent in a car battery, in the reaction shown below?



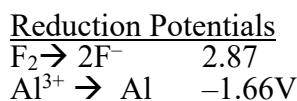
- Pb
- $\text{PbO}_2$
- $\text{H}_2\text{SO}_4$
- $\text{PbSO}_4$

5. Which transformation could not take place at the cathode of an electrochemical cell?
- $\text{NiBr}_2$  to  $\text{Ni}$  and  $\text{Br}^-$
  - $\text{Cl}_2$  to  $\text{Cl}^-$
  - $\text{H}_2\text{O}$  to  $\text{H}_2$  and  $\text{OH}^-$
  - $\text{H}_2\text{O}$  to  $\text{H}^+$  and  $\text{O}_2$
6. Molten  $\text{PbCl}_2$  is subjected to electrolysis in order to form elemental lead and chlorine. Which of the following is true?
- Elemental chlorine gas is formed at the cathode and bubbles away
  - Elemental lead metal is formed and deposited at the anode
  - Lead ions are oxidized in the reaction
  - Chloride ions are the oxidized in the reaction
  - none of the above

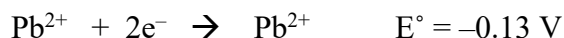
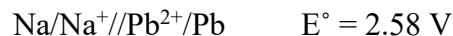
7. The standard reduction potentials for  $\text{Pb}^{2+}$  and  $\text{Ag}^+$  are  $-0.13$  and  $+0.80\text{V}$  respectively. Calculate  $E^\circ$  for a cell in which the overall reaction is:



- $0.93\text{V}$
  - $0.67\text{V}$
  - $1.73\text{V}$
  - $1.47\text{V}$
  - none of the above
8. Consider the following half-reactions and voltages. What will be the  $E^\circ$  for an electrochemical cell involving the chemicals shown?



- $-3.8\text{V}$
  - $4.53\text{V}$
  - $1.21\text{V}$
  - $2.6\text{V}$
  - none of the above
9. What is the standard reduction potential for  $\text{Na}^+$ , given the following information:



- $-2.45\text{V}$
- $-2.71\text{V}$
- $+2.45\text{V}$
- $-2.84\text{V}$
- none of the above

10. The standard reduction potentials for  $\text{Pb}^{2+}$  and  $\text{Ni}^{2+}$  are  $-0.13$  and  $-0.28\text{V}$  respectively. Which of the following substances will be oxidized most easily?

- a.  $\text{Pb}^{2+}$
- b.  $\text{Pb}$
- c.  $\text{Ni}^{2+}$
- d.  $\text{Ni}$

11. Based on the periodic table and general patterns of activity, which of the following would not react with metallic  $\text{Mg}$ ?

$\text{HNO}_3$                        $\text{LiBr}$                        $\text{FeCl}_3$                        $\text{AlCl}_3$                        $\text{AuBr}_2$

- a.  $\text{HNO}_3$
- b.  $\text{LiBr}$
- c.  $\text{FeCl}_3$
- d.  $\text{AlCl}_3$
- e.  $\text{AuBr}_2$

12. Given the reduction potential for  $\text{Cr}^{3+}$ , if a solution containing  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ , and  $\text{Li}^+$  was treated with elemental  $\text{Cr}$ , **which elemental metal would be produced?**

$\text{Ni}^{2+} -0.28\text{V}$   
 $\text{Cr}^{3+} -0.74\text{V}$   
 $\text{Mn}^{2+}, -1.18\text{V}$   
 $\text{Mg}^{2+}, -2.38$   
 $\text{Ca}^{2+}, -2.76$   
 $\text{Li}^+, -3.04\text{V}$

- a. magnesium
- b. lithium
- c. nickel
- d. manganese
- e. calcium

13. What is the value for  $\Delta G^\circ$  (in  $\text{kJ/mol}$ ) for the following reaction? ( $F = 96.5\text{ kJ/V}\cdot\text{mol}$ )



- a.  $-98$
- b.  $+136$
- c.  $-386$
- d.  $-193$
- e. none of the above

14. The  $\Delta G^\circ$  for a redox reaction is **positive**. Which of the following statements is true?

- a. The reaction is at equilibrium
- b.  $E^\circ$  is negative
- c. The reaction is product-favored
- d.  $K > 1$
- e.  $E^\circ$  is positive
- f. None of the above

15. What is the value of K for the following reaction?

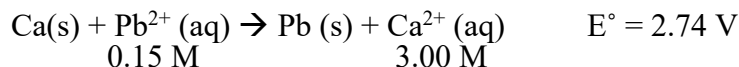


- $3.8 \times 10^{-18}$
- $2.6 \times 10^{-19}$
- $3.8 \times 10^{18}$
- $6.7 \times 10^{-22}$
- none of the above

16. How many seconds will be required to produce 1.0 g of chromium metal (51.996 g/mol) by the electrolysis of a  $\text{Cr}(\text{NO}_3)_3$  solution using a current of 3.0 A?

- 36
- $6.3 \times 10^2$
- $1.9 \times 10^3$
- $3.7 \times 10^3$

17. What is the actual voltage for the following reaction, given the concentrations shown?



- 2.52 V
- 2.78 V
- 3.28 V
- 2.70 V
- none of the above

18. Which of the following statements would be false?

<u>Reduction Potentials</u>		
$\text{Br}_2 \rightarrow 2\text{Br}^-$	1.09 V	
$\text{I}_2 \rightarrow 2\text{I}^-$		0.54 V
$\text{Cu}^{2+} \rightarrow \text{Cu}$	0.34 V	
$\text{H}^+ \rightarrow \text{H}_2$	0.00 V	
$\text{Ni}^{2+} \rightarrow \text{Ni}$	-0.28 V	

- $\text{Br}_2$  is the strongest oxidizing agent
- Ni is the strongest reducing agent
- $\text{I}^-$  would react with  $\text{Br}_2$ , but would not react with  $\text{Cu}^{2+}$
- Cu would react with both  $\text{Br}_2$  and  $\text{I}_2$ , but would not react with either  $\text{H}^+$  or  $\text{H}_2$
- Ni would react with both  $\text{Br}^-$  and  $\text{I}^-$

19. **How many grams of aluminum** metal (26.982 g/mol) can be produced by the electrolysis of  $\text{Al}_2\text{O}_3$  using a current of 100 amperes for 24 hours?
- a. 805  
 b. 2,400  
 c.  $8.1 \times 10^5$   
 d.  $2.2 \times 10^{13}$   
 e.  $7.5 \times 10^{12}$

20. Given the following information, rank the “activity” of the metals as reducing agents:

Cr reacts with  $\text{NiBr}_2$  and  $\text{CdBr}_2$ , but not with  $\text{ZnBr}_2$   
 Cd reacts with  $\text{NiBr}_2$ , but not with  $\text{ZnBr}_2$  or  $\text{CrBr}_3$

- a.  $\text{Zn} > \text{Cr} > \text{Cd} > \text{Ni}$   
 b.  $\text{Ni} > \text{Cr} > \text{Cd} > \text{Zn}$   
 c.  $\text{Zn} > \text{Cr} > \text{Ni} > \text{Cd}$   
 d.  $\text{Zn} > \text{Cd} > \text{Cr} > \text{Ni}$
21. The standard reduction potentials for  $\text{Sn}^{2+}/\text{Sn}$  ( $E^\circ = -0.14\text{V}$ ) and  $\text{Cu}^{2+}/\text{Cu}$  ( $E^\circ = +0.34\text{V}$ ). For an electrochemical cell involving Sn and Cu, which of the following statements is **true**?
- a. Copper is oxidized and serves as the anode  
 b. Tin is reduced and serves as the cathode  
 c. The oxidizing agent is  $\text{Cu}^{2+}$   
 d. The reducing agent is Cu  
 e. The cathode metal electrode will dissolve away as the reaction proceeds
22. What is the standard cell potential for a voltaic cell using the  $\text{Pb}^{2+}/\text{Pb}$  and  $\text{Mg}^{2+}/\text{Mg}$  half-reactions? Which metal is the cathode? (Use the Standard Reduction Potentials table shown above)

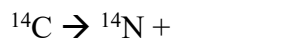
<i>Standard Reduction Potentials (volts) in Aqueous Solution</i>		
	$\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$	-0.12
	$\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$	-2.37

- a.  $-2.25\text{ V}$ , Pb is the cathode  
 b.  $+2.25\text{ V}$ , Mg is the cathode  
 c.  $-2.25\text{ V}$ , Mg is the cathode  
 d.  $+2.25\text{ V}$ , Pb is the cathode  
 e.  $-2.49\text{ V}$ , Mg is the cathode
23. What is the missing particle for the following radioactive decay reaction?



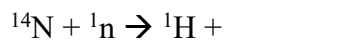
- a. alpha particle  
 b. beta particle  
 c. neutron  
 d. gamma ray  
 e. positron

24. What is the missing particle for the following radioactive decay reaction?



- a. alpha particle
- b. beta particle
- c. neutron
- d. gamma ray
- e. positron

25. What is the missing particle for the following radioactive decay reaction?



- a.  $^{13}\text{N}$
- b.  $^{14}\text{C}$
- c.  $^{13}\text{C}$
- d.  $^{14}\text{O}$
- e. none of the above

26. What is the other product when  $^{232}\text{Th}$  undergoes alpha emission??

- a.  $^{236}\text{U}$
- b.  $^{232}\text{Pa}$
- c.  $^{228}\text{Ra}$
- d.  $^{228}\text{Rn}$
- e. none of the above

27. Which of the following is true when a nuclide emits a positron?

- a. The mass number and atomic number increase
- b. The mass number increases
- c. The atomic number decreases
- d. The nuclide is unchanged
- e. None of the above

28. Cs-137 has a half-life of 30 years. How much of a 240g sample will remain after 120 years?

- a. 30 g
- b. 15 g
- c. 7.0 g
- d. 2.8 g
- e. none of the above

29. C-14 has a half-life of 5730 years. The C-14 in a sample of cotton is found to have a disintegration rate of 10.4 (disintegrations/gram-minute). The disintegration rate of "live" carbon is 15.3. What is the age of the cotton sample?

- a. 3110 years
- b. 3190 years
- c. 3320 years
- d. 3440 years
- e. none of the above

30. A 3.60 g sample of a radioactive isotope decays to 1.62 g over a period of 35 days. What is the half-life of the isotope?

- 29.2 days
- 30.4 days
- 31.7 days
- 32.5 days
- none of the above

31. Which of the following statements is **true**:

- Fission reactions involve the combination of two smaller nuclides to make a larger nuclide
- Fusion involves the splitting of larger nuclides into smaller nuclides
- In both fission and fusion reactions, energy is released because the mass of the product nuclides is smaller than the mass of the reactant nuclides
- The mass of a nuclide is greater than the sum of the masses of its constituent protons and neutrons
- Protons attract each other, and this explains why a nucleus holds together

32. Which of these nuclides is certain to be radioactive?



- $^{12}\text{C}$  is the only radioactive nuclide
- $^{21}\text{Al}$  is the only radioactive nuclide
- $^{263}\text{Lr}$  is the only radioactive nuclide
- $^{21}\text{Al}$  and  $^{263}\text{Lr}$  are both radioactive
- $^{21}\text{Al}$ ,  $^{263}\text{Lr}$  and  $^{103}\text{Rh}$  are all radioactive

33. Fact:  $^{19}\text{O}$  is unstable and radioactive. Is its n/p ratio too high or too low? In that case, which process could lead to stability, and what nuclide would be produced?

- Its n/p ratio is too low, it should undergo electron capture to produce  $^{19}\text{N}$
- Its n/p ratio is too low, it should undergo alpha emission to produce  $^{23}\text{Ne}$
- Its n/p ratio is too low, it should undergo either electron capture or positron emission to produce  $^{19}\text{F}$ .
- Its n/p ratio is too high, it should undergo beta emission to produce  $^{19}\text{F}$ .
- Its n/p ratio is too high, it should undergo positron emission to produce  $^{19}\text{F}$ .

## Answers, Test4-210-Version 3

## Electrochemistry and Nuclear Chemistry

1. B
2. D
3. B
4. B
5. D
6. D
7. A
8. B
9. B
10. D
11. B
12. C
13. C
14. B
15. B
16. C
17. D
18. E
19. A
20. A
21. C
22. D
23. E
24. B
25. B
26. C
27. C
28. B
29. B
30. B
31. C
32. D
33. D