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

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

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

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

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

$E = \Delta mc^2$ (m in kg, E in J, c = $3x10^8$ m/s)

1. What is the oxidation number of S in $KHSO_4$?
   a. +3
   b. +6
   c. +7
   d. +12
   e. none of the above

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

$$HNO_3 + FeO \rightarrow NO + Fe_2O_3 + H_2O$$

   a. 2
   b. 3
   c. 4
   d. 6
   e. none of the above

3. Balance the following reaction. What would be the coefficient for $NbCl_2$?

$$H_2O + H_2SO_3 + NbCl_5 \rightarrow H_2SO_4 + NbCl_2 + HCl$$

   a. 1
   b. 2
   c. 3
   d. 4
   e. none of the above

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

$$Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$$

   a. Pb
   b. PbO_2
   c. H_2SO_4
   d. $PbSO_4$

5. Which transformation could not take place at the cathode of an electrochemical cell?

   a. $NiBr_2$ to Ni and Br^-
   b. Cl_2 to Cl^-
   c. H_2O to H_2 and OH^-
   d. H_2O to H^+ and O_2

6. Molten $PbCl_2$ is subjected to electrolysis in order to form elemental lead and chlorine. Which of the following is true?

   a. Elemental chlorine gas is formed at the cathode and bubbles away
   b. Elemental lead metal is formed and deposited at the anode
   c. Lead ions are oxidized in the reaction
   d. Chloride ions are the oxidized in the reaction
   e. none of the above

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

   $$Pb + 2Ag^+ \rightarrow Pb^{2+} + 2Ag$$

   a. 0.93V
   b. 0.67V
   c. 1.73 V
   d. 1.47 V
   e. none of the above

8. Consider the following half–reactions and voltages. What will be the E˚ for an electrochemical cell involving the chemicals shown?

   Reduction Potentials

   $F_2 \rightarrow 2F^-$ 2.87

   $Al^{3+} \rightarrow Al$ –1.66V

   a. –3.8 V
   b. 4.53 V
   c. 1.21 V
   d. 2.6 V
   e. none of the above

9. What is the standard reduction potential for Na^+, given the following information:

   $Na/Na^+//Pb^{2+}/Pb$ E˚ = 2.58 V

   $Pb^{2+} + 2e^- \rightarrow Pb^{2+}$ E˚ = –0.13 V

   a. –2.45 V
   b. –2.71 V
   c. +2.45 V
   d. –2.84 V
   e. none of the above

10. The standard reduction potentials for Pb^{2+} and Ni^{2+} are –0.13 and –0.28V respectively. Which of the following substances will be <u>oxidized</u> most easily?

    a. Pb^{2+}
    b. Pb
    c. Ni^{2+}
    d. Ni

11. Based on the periodic table and general patterns of activity, which of the following would <u>not</u> react with metallic Mg?

    HNO_3 LiBr $FeCl_3$ $AlCl_3$ $AuBr_2$

    a. HNO_3
    b. LiBr
    c. $FeCl_3$
    d. $AlCl_3$
    e. $AuBr_2$

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

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

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

13. What is the value for ΔG° (in kJ/mol) for the following reaction? (F = 96.5 kJ/V•mol)

    $$Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O \qquad E^\circ = 2.0\ V$$

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

14. The ΔG° for a redox reaction is **<u>positive</u>**. Which of the following statements is true?

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

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

$$I_2 + 2Br^- \rightarrow Br_2 + 2I^- \qquad E^\circ = -0.55\ V$$

a. 3.8×10^{-18}
b. 2.6×10^{-19}
c. 3.8×10^{18}
d. 6.7×10^{-22}
e. 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 $Cr(NO_3)_3$ solution using a current of 3.0 A?

a. 36
b. 6.3×10^2
c. 1.9×10^3
d. 3.7×10^3

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

$$\underset{0.15\ M}{Ca(s) + Pb^{2+}(aq)} \rightarrow \underset{3.00\ M}{Pb(s) + Ca^{2+}(aq)} \qquad E^\circ = 2.74\ V$$

a. 2.52 V
b. 2.78 V
c. 3.28 V
d. 2.70 V
e. none of the above

18. Which of the following statements would be <u>false</u>?

<u>Reduction Potentials</u>

$Br_2 \rightarrow 2Br^-$	1.09 V
$I_2 \rightarrow 2I^-$	0.54 V
$Cu^{2+} \rightarrow Cu$	0.34 V
$H^+ \rightarrow H_2$	0.00 V
$Ni^{2+} \rightarrow Ni$	–0.28 V

a. Br_2 is the strongest oxidizing agent
b. Ni is the strongest reducing agent
c. I^- would react with Br_2, but would not react with Cu^{2+}
d. Cu would react with both Br_2 and I_2, but would not react with either H^+ or H_2
e. Ni would react with both Br^- and I^-

19. **How many grams of aluminum** metal (26.982 g/mol) can be produced by the electrolysis of Al_2O_3 using a current of 100 amperes for 24 hours?

a. 805
b. 2,400
c. 8.1×10^5
d. 2.2×10^{13}
e. 7.5×10^{12}

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

Cr reacts with $NiBr_2$ and $CdBr_2$, but not with $ZnBr_2$
Cd reacts with $NiBr_2$, but not with $ZnBr_2$ or $CrBr_3$

a. Zn > Cr > Cd > Ni
b. Ni > Cr > Cd > Zn
c. Zn > Cr > Ni > Cd
d. Zn > Cd > Cr > Ni

21. The standard reduction potentials for Sn^{2+}/Sn ($E^\circ = -0.14V$) and Cu^{2+}/Cu ($E^\circ = +0.34V$). 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 Cu^{2+}
d. The reducing agent is Cu
e. The cathode metal electrode will dissolve away as the reaction procedes

22. What is the standard cell potential for a voltaic cell using the Pb^{2+}/Pb and Mg^{2+}/Mg half-reactions? Which metal is the cathode? (Use the Standard Reduction Potentials table shown above)

	Standard Reduction Potentials (volts) in Aqueous Solution	
	$Pb^{2+} + 2e^- \rightarrow Pb$	-0.12
	$Mg^{2+} + 2e^- \rightarrow Mg$	–2.37

a. –2.25 V, Pb is the cathode
b. +2.25 V, Mg is the cathode
c. –2.25 V, Mg is the cathode
d. +2.25 V, Pb is the cathode
e. –2.49 V, Mg is the cathode

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

$$^{15}O \rightarrow {}^{15}N + \_\_\_\_\_$$

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?

$$^{14}C \rightarrow {}^{14}N + \_\_\_\_\_$$

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?

$$^{14}N + {}^{1}n \rightarrow {}^{1}H + \_\_\_\_\_$$

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

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

a. ^{236}U
b. ^{232}Pa
c. ^{228}Ra
d. ^{228}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?

    a. 29.2 days
    b. 30.4 days
    c. 31.7 days
    d. 32.5 days
    e. none of the above

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

    a. Fission reactions involve the combination of two smaller nuclides to make a larger nuclide
    b. Fusion involves the splitting of larger nuclides into smaller nuclides
    c. 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
    d. The mass of a nuclide is greater then the sum of the masses of it's constituent protons and neutrons
    e. Protons attract each other, and this explains why a nucleus holds together

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

    ^{12}C ^{21}Al ^{103}Rh (Z=45) ^{263}Lr (Z=103)

    a. ^{12}C is the only radioactive nuclide
    b. ^{21}A is the only radioactive nuclide
    c. ^{263}Lr is the only radioactive nuclide
    d. ^{21}Al and ^{263}Lr are both radioactive
    e. ^{21}Al, ^{263}Lr and ^{103}Rh are all radioactive

33. Fact: ^{19}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?

    a. Its n/p ratio is <u>too low</u>, it should undergo <u>electron capture</u> to produce ^{19}N
    b. Its n/p ratio is <u>too low</u>, it should undergo <u>alpha emission</u> to produce ^{23}Ne
    c. Its n/p ratio is <u>too low</u>, it should undergo either <u>electron capture or positron emission</u> to produce ^{19}F.
    d. Its n/p ratio is <u>too high</u>, it should undergo <u>beta emission</u> to produce ^{19}F.
    e. Its n/p ratio is <u>too high</u>, it should undergo <u>positron emission</u> to produce ^{19}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