JASPERSE CHEM 210 PRACTICE TEST 4 VERSION 2
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 • 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 Mn in $KMnO_4$?
   a. +3
   b. +6
   c. +7
   d. +12
   e. none of the above

2. After balancing the following redox reaction, what is the coefficient for H_2O?

$$H^+ + H_2CrO_4 + I^- \rightarrow Cr^{3+} + I_2 + H_2O$$

   a. 2
   b. 6
   c. 8
   d. 16
   e. none of the above

3. Balance the following reaction. How many electrons are transferred <u>in the balanced reaction</u>? (Remember, coefficients must be whole numbers, not fractions.)

$$Al + Br_2 \rightarrow AlBr_3$$

   a. 1
   b. 3
   c. 6
   d. 8
   e. none of the above

4. Given the following reduction potentials, what would function as the <u>reducing agent</u> in a product–favored cell involving these chemicals?

$Ag^+ + e^- \rightarrow Ag$ $E^\circ = +0.80$ V
$Ni^{2+} + 2e^- \rightarrow Ni$ $E^\circ = -0.28$ V

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

5. Which of the following statements about electrochemical cells <u>is true</u>?

   a. Oxidation occurs at the cathode
   b. Reduction occurs at the anode
   c. The oxidation half–reaction and the reduction half–reaction need not be separated
   d. To produce current, the oxidation half–cell and the reduction half–cell must be connected by an external circuit
   e. None of the above

6. What is ΔG° for the following balanced reaction?

$$Cu + 2NO_3^- + 4H^+ \rightarrow Cu^{2+} + 2NO_2 + 2H_2O \qquad E^\circ = +0.46\ V$$

   a. –44 kJ/mol
   b. –89 kJ/mol
   c. 1000 kJ/mol
   d. –1400 kJ/mol
   e. none of the above

7. Which of the following should be true for any product–favored electrochemical reaction?

   a. $\Delta G^\circ = 0$, $E^\circ = 0$, and $K > 1$
   b. $\Delta G^\circ < 0$, $E^\circ > 0$, and $K > 1$
   c. $\Delta G^\circ > 0$, $E^\circ < 0$, and $K < 1$
   d. $\Delta G^\circ > 0$, $E^\circ > 0$, and $K > 1$
   e. $\Delta G^\circ < 0$, $E^\circ = 0$, and $K > 1$

8. Given the following reduction potentials, what would be E° for the reaction shown?

$Ag^+ + e^- \rightarrow Ag \qquad E^\circ = +0.80\ V$
$Fe^{2+} + 2e^- \rightarrow Fe \qquad E^\circ = -0.44\ V$

$$2Ag^+ + Fe \rightarrow 2Ag + Fe^{2+} \qquad E^\circ = ??$$

   a. 0.36 V
   b. 1.16 V
   c. 1.24 V
   d. 2.04 V
   e. none of the above

9. Molten KF is subjected to electrolysis. Fluorine gas, F_2, is produced at electrode A. Which of the following is true?

   a. Electrode A is the <u>cathode</u>
   b. Electrode B is the <u>anode</u>
   c. Oxidation occurs at electrode B
   d. Reduction occurs at electrode B
   e. None of the above

10. What is K for the following <u>unbalanced</u> reaction, given that the reduction potentials for Ag^+ and Cu^{2+} are +0.80 and +0.34 V.

$$Ag^+ (aq) + \quad Cu (aq) \rightarrow \quad Ag (s) + \quad Cu^{2+} (aq)$$

a. 3.47×10^{15}
b. 6.94×10^{15}
c. 1.73×10^{15}
d. 2.48×10^{13}
e. none of the above

11. What is the standard cell potential for a voltaic cell using the Al^{3+}/Al and Fe^{3+}/Fe half-reactions? Which metal is the anode? (Use the Standard Reduction Potentials table shown above)

	Standard Reduction Potentials (volts) in Aqueous Solution	
	$Fe^{3+} + 3e^- \rightarrow Fe$	+0.771
	$I_2 + 2e^- \rightarrow 2\ I^-$	+0.535
	$Al^{3+} + 3e^- \rightarrow Al$	–1.66

a. –2.43 V, Al is the anode
b. +2.43 V, Al is the anode
c. –0.89 V, Fe is the anode
d. +0.89 V, Fe is the anode
e. None of the above

12. Given the following reduction potentials, what would be the E˚ for a cell for a product–favored reaction involving the chemicals shown?

$Cl_2 + 2e^- \rightarrow 2Cl^-$ E˚ = +1.32 V
$Cr^{3+} + 3e^- \rightarrow Cr$ E˚ = –0.74 V

a. 2.1V
b. 4.9 V
c. 0.58 V
d. 1.72 V
e. none of the above

13. What is the actual E, given the following concentrations?

$$3Ag(s) + Au^{3+} (aq) \rightarrow Au (s) + 3Ag^+ (aq) \qquad E˚ = +0.70 \text{ V}$$
$$0.10 \text{ M} \qquad\qquad 2.2 \text{ M}$$

a. 0.72 V
b. 0.63 V
c. 0.81 V
d. 0.66 V
e. none of the above

14. Which transformation could take place at the anode of an electrochemical cell?

a. Mn^{2+} to Mn
b. H_2O to O_2
c. H_2SO_4 to $H_2S_2O_3$
d. Br_2 to Br^-
e. none of the above

15. Given the following reduction potentials, which species would react with Cu^{2+}?

$Br_2 + 2e^- \rightarrow 2Br^-$	$E^\circ = +1.08$ V
$I_2 + 2e^- \rightarrow 2I^-$	$E^\circ = +0.54$ V
$Cu^{2+} + 2e^- \rightarrow Cu$	$E^\circ = +0.34$ V
$2H^+ + 2e^- \rightarrow H_2$	$E^\circ = 0.0$ V
$Ni^{2+} + 2e^- \rightarrow Ni$	$E^\circ = -0.28$ V

a. Ni only
b. Ni and H_2 only
c. Br^- and I^- only
d. Br_2+ I_2 only
e. none of the above

16. The reduction potentials for Sn^{2+}/Sn and Fe^{2+}/Fe are –0.16 and –0.44. Which of the following substances will be oxidized most easily?

a. Sn^{2+}
b. Sn
c. Fe^{2+}
d. Fe

17. How many grams of Fe metal (55.85 g/mol) will be produced by passing a current of 3.2 amps through a solution of FeI_3 for 48 minutes.

a. 2.96×10^{-2} g
b. 1.78 g
c. 2.2 g
d. 4.4 g
e. none of the above

18. Based on the periodic table and general patterns of activity, which of the following would react with metallic sodium?

$CaBr_2$ $AlCl_3$ $FeCl_2$ $CuBr_2$

a. $CaBr_2$ and $AlCl_3$ only
b. $CuBr_2$ only
c. $AlCl_3$ and $FeCl_2$ and $CuBr_2$ only
d. none of them would react
e. all of them would react

19. A cell is constructed in which copper is one of the electrodes, and in which the overall E° is 1.10 V. Given the following standard reduction potentials, identify which metal is involved in the other half reaction.

Reduction Potentials	
$Ag^{+} \rightarrow Ag$	+0.80 V
$Cu^{2+} \rightarrow Cu$	+0.34 V
$Fe^{2+} \rightarrow Fe$	–0.41 V
$Zn^{2+} \rightarrow Zn$	–0.76 V
$Mn^{2+} \rightarrow Mn$	–1.18 V

a. Ag
b. Fe
c. Mn
d. Zn

20. Which of the following correctly ranks the "activity" (strength as reducing agents) of the metallic elements W, X, Y and Z, given the following observed reactivity information?

$W + XCl_2 \rightarrow X + WCl_2$
$W + YCl_2 \rightarrow$ no reaction
$Z + YCl_2 \rightarrow Y + ZCl_2$

a. Z > Y > W > X
b. X > W > Y > Z
c. Y > W > Z > X
d. W > Y > X > Z
e. none of the above

21. For an electrochemical cell, the standard reduction potentials are –0.14 V for Sn^{2+} and –0.25 V for Ni^{2+}. Based on the reduction potentials, the _____ electrode is where the reduction will occur and it is called the _____.

a. Sn, cathode
b. Sn, anode
c. Ni, cathode
d. Ni, anode
e. none of the above

22. Given the electrochemical retivitytion shown, if the standard reduction potential of $Cu^{2+} \rightarrow$ Cu is +0.34 V, **what is the standard reduction potential of $Sn^{2+} \rightarrow$ Sn**?

$Sn / Sn^{2+}(aq) // Cu^{2+}(aq) / Cu \qquad E° = +0.48\ V$

a. –0.14 V
b. +0.14 V
c. +0.37 V
d. –0.37 V
e. none of the above

23. Which particle/ray is emitted in the following reaction?

$^{121}I \rightarrow {}^{121}Te +$ _____

a. alpha
b. beta
c. neutron
d. positron
e. gamma

24. The following reaction is an example of _____ decay: Po–210 → Pb–206

a. alpha
b. beta
c. neutron
d. positron
e. gamma

25. Bombardment of U–238 with a single neutron generates Sr–90, 5 neutrons, and:

a. ^{144}Xe
b. ^{144}Nd
c. ^{146}Xe
d. ^{152}Sn
e. ^{228}Pa

26. What is the missing particle from the reaction shown, an important reaction by which C–14 is generated in the atmosphere: $^{14}N \rightarrow {}^{14}C + {}^{1}H$

a. beta emission
b. bombardment by a neutron
c. electron capture
d. neutron emission
e. bombardment by an alpha particle

27. The half–life for beta decay of Sr–90 is 28.8 years. A sample is found to contain 10.3 mg Sr–90. How many years would pass before the Sr–90 quantity would drop to 1.0 mg?

a. 92.3
b. 0.112
c. 186
d. 96.9
e. 131

28. I–131 has a half–life of 8.04 days. Assuming you start with a 2.35 mg sample, how much will remain after 15.0 days?

a. 0.835 mg
b. 0.645 mg
c. 0.542 mg
d. 0.440 mg
e. none of the above

29. Consider the following nuclides: which would you expect to be radioactive?

$$\frac{44}{19}\text{K} \qquad \frac{27}{13}\text{Al} \qquad \frac{127}{53}\text{I} \qquad \frac{232}{90}\text{Th}$$

a. K–44 only
b. Both Al–27 and I–127 only
c. Th–232 only
d. Both K–44 and Th–232 only
e. All four nuclides

30. Fact: ^{24}Na is unstable and radioactive. Is its n/p ratio too high or too low? In that case, which process could lead to stability? (Make sure that both parts of the answer are correct.)

a. Its n/p ratio is <u>too low</u>. It could attain stability by <u>electron capture</u> <u>only</u>
b. Its n/p ratio is <u>too low</u>. It could attain stability by <u>beta emission</u>.
c. Its n/p ratio is <u>too high</u>. It could attain stability by <u>electron capture or positron emission</u>.
d. Its n/p ratio is <u>too high</u>. It could attain stability by <u>beta emission</u>.
e. Its n/p ratio is <u>too high</u>. It could attain stability by <u>positron emission</u>.

31. Which of the following statements is true for a $^{34}S^{2-}$ anion?

a. it has 16 protons, 14 electrons, and 18 neutrons
b. it has 34 protons, 18 electrons, and 34 neutrons
c. it has 16 protons, 16 electrons, and 34 neutrons
d. it has 16 protons, 18 electrons, and 18 neutrons
e. none of the above

32. Which of the following processes would <u>not</u> change the atomic number by exactly <u>one</u> (would not either increase the atomic number by one or decrease the atomic number by one?)

a. alpha emission only
b. beta emission only
c. gamma emission only
d. positron emission only
e. electron capture only
f. alpha and gamma emission only

33. Which of the following statements is <u>false</u>?

a. Nuclear reactions often involve large amounts of energy, because mass is interconverted into energy in the process
b. The reason that nuclides with multiple protons can hold together is because some missing mass is converted into a strong nuclear binding force/energy, which more than makes up for proton–proton repulsion
c. The half–lives for radioactive nuclei can vary from seconds to millions of years or more
d. Radon–222 is radioactive, as expected based on the "Rule of 83"
e. Perfect "conservation of mass" applies to nuclear reactions just as it does to chemical reactions

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