JASPERSE CHEM 160 PRACTICE TEST 4 VERSION 1
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)

$t = (t_{1/2}/0.693) \ln (m_o/m_t)$ $\ln (m_o/m_t) = (0.693/t_{1/2})\bullet t$

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

1. What is the oxidation number of As in $NaAsO_3$?

   a. 0
   b. +2
   c. +4
   d. +5
   e. none of the above

2. What substance is reduced in the following reaction?

$$Cr_2O_7^{2-} + 6S_2O_3^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 3S_4O_6^{2-} + 7H_2O$$

   a. $Cr_2O_7^{2-}$
   b. $S_2O_3^{2-}$
   c. H^+
   d. Cr^{3+}
   e. $S_4O_6^{2-}$
   f. H_2O

3. Which substance is the reducing agent in the reaction below?

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

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

4. What is the coefficient of the permanganate ion when the following equation is correctly balanced?

$$H^+ + MnO_4^- + Br^- \rightarrow Mn^{2+} + Br_2 + H_2O$$

   a. 1
   b. 2
   c. 3
   d. 5

5. The electrode at which oxidation occurs is called the

   a. oxidizing agent
   b. cathode
   c. reducing agent
   d. anode

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

   a. Cr^{3+} to $Cr_2O_7^{2-}$
   b. F_2 to F^-
   c. O_2 to H_2O
   d. AsO_2 to As

7. From the information given, which of the following statements is true?

Substance	Reduction Potential (V)
$F_2 \rightarrow 2F^-$	2.85
$Cl_2 \rightarrow 2Cl^-$	1.36
$Br_2 \rightarrow 2Br^-$	1.09
$I_2 \rightarrow 2I^-$	0.54

   a. F_2 is the best oxidizing agent, F^- is the best reducing agent
   b. I_2 is the best oxidizing agent, F^- is the best reducing agent
   c. I_2 is the best oxidizing agent, I^- is the best reducing agent
   d. F_2 is the best oxidizing agent, I^- is the best reducing agent
   e. F_2 is the best oxidizing agent, I_2 is the best reducing agent

8. The two electrodes $Cr(s)/Cr^{3+}(aq)$ and $Sn(s)/Sn^{2+}(aq)$ are combined to afford a product–favored electrochemical equation. The standard reduction potentials in V for $Cr^{3+}(aq)$ and $Sn^{2+}(aq)$ are –0.74V and –0.14V, respectively. E° in V is: ?

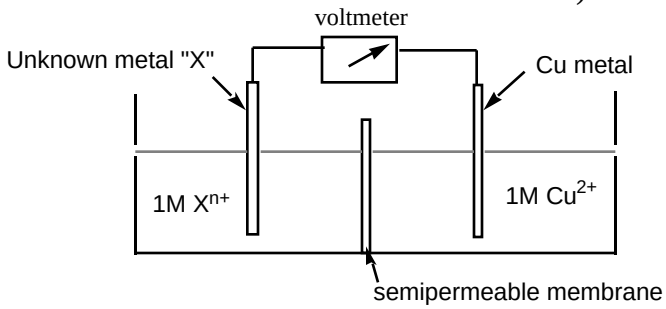
   a. +0.88V
   b. –0.88V
   c. +0.60V
   d. –0.60V
   e. +2.50V

9. The standard reduction potentials are –0.13 V for Pb^{2+} and +0.80 V for Ag^+. Calculate E° for the following reaction:

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

   a. 0.93
   b. 0.67
   c. 1.73
   d. 1.47

10. A cell is constructed as shown below in which copper is one of the electrodes, and in which the overall E° is 0.46 ± 0.01V. Given the following standard reduction potentials, identify which metal is "X" (Do not assume that the left half is anode and the ride cathode or vice versa).



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

11. The reduction potentials for Ag^+ and Zn^{2+} are +0.80 and –0.76. Which substance would be oxidized in a voltaic cell involving silver and zinc?

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

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

HBr NaI $MgCl_2$ AgBr

a. All four
b. $MgCl_2$ only
c. HBr only
d. NaI and $MgCl_2$ only
e. HBr and AgBr only

13. Why is it generally necessary to store reducing agents such that they are not in contact with air?

a. they rapidly react with atmospheric water vapor
b. to prevent oxidation by atmospheric oxygen
c. they are usually highly volatile substances that will vaporize and be lost
d. they are generally highly hygroscopic and will hydrate extensively with atmospheric water vapor
e. they are rapidly deactivated by reaction with even trace amounts of carbon dioxide

14. Which could be used to oxidize iodide to iodine?

Reduction Potentials

$Br_2 \rightarrow 2Br^-$ 1.09

$I_2 \rightarrow 2I^-$ 0.54

$Cu^{2+} \rightarrow Cu$ +0.34 V

$H^+ \rightarrow H_2$ 0.00 V

$Ni^{2+} \rightarrow Ni$ –0.28 V

a. Br_2
b. Cu^{2+}
c. H^+
d. Ni
e. Ni^{2+}

15. A product–favored electrochemical reaction has:

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 $K >> 1$

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

$$Pb(s) + 2H^+(aq) \rightarrow Pb^{2+}(aq) + H_2(g) \qquad E^\circ = +0.13V$$

a. –25
b. +25
c. –12
d. +12
e. none of the above

17. The value of E° for the following reaction is 1.10 V. What is the value of E_{cell} when the concentration of Cu^{2+} is 1.0×10^{-5} M and the concentration of Zn^{2+} is 1.0 M?

$$Cr(s) + 3Ag^+(aq) \rightarrow 3Ag(s) + Cr^{3+}(aq) \qquad E^\circ = 1.54\ V$$
$$0.12\ M \qquad\qquad 0.40\ M$$

a. 1.49 V
b. 1.44 V
c. 1.59 V
d. 1.64 V
e. none of the above

18. How long will it take to plate out 2.19 g of chromium metal (52.0 g/mol) from a solution of $CrBr_3$, using a current of 35.2 amps?

a. 5.77 minutes
b. 346 minutes
c. 115 minutes
d. 1.92 minutes
e. none of the above

19. How many grams of Cu metal (63.55 g/mol) will be produced by passing a current of 12 amps through a solution of $CuSO_4$ for 15 minutes.

a. 0.016 g
b. 3.6 g
c. 7.1 g
d. 14 g
e. none of the above

20. Given the following reduction potentials, which statement describes what will happen when a current is passed through an aqueous solution of MnI_2? (Hint: remember which chemicals and ions are really in the solution and subject to the electrolysis.)

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$	$E^\circ = 0.82$ V
$I_2 + 2e^- \rightarrow 2I^-$	$E^\circ = 0.54$ V
$Pb^{2+} + 2e^- \rightarrow Pb$	$E^\circ = -0.13$ V
$2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-$	$E^\circ = -0.41$ V
$Mn^{2+} + 2e^- \rightarrow Mn$	$E^\circ = -1.18$ V

a. Mn will form at the cathode and I_2 will form at the anode
b. H_2 will form at the cathode and I_2 will form at the anode
c. Mn will form at the cathode and O_2 will form at the anode
d. H_2 will form at the cathode and O_2 will form at the anode
e. None of the above

21. Of the following processes, which one does not change the atomic number?

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

22. By what process does Th–230 decay to Ra–226?

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

23. ^{41}Ca undergoes electron capture; the resulting isotope then undergoes positron decay. What is the final product after both reactions have occurred?

a. Ti
b. Ca
c. Ar
d. Cl

24. What is the missing product from this reaction?

$$^{32}_{15}\text{P} \rightarrow {}^{32}_{16}\text{S} + ???$$

a. $^{4}_{2}\text{He}$ b. $^{0}_{-1}\text{e}$ c. $^{0}_{0}\gamma$ d. $^{0}_{+1}\text{e}$

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

a. $^{39}_{19}\text{K}$ b. $^{27}_{13}\text{Al}$ c. $^{127}_{53}\text{I}$ d. $^{243}_{95}\text{Am}$

26. Bombardment of U–235 with a neutron generates Te–135, 2 neutrons and:

a. Sr–99
b. Kr–101
c. Kr–99
d. Zr–99
e. Zr–00

27. The beta decay of Cs–137 has a half–life of 30.0 years. How many years must pass to reduce a 25 mg sample of Cs–137 to 0.78 mg?

a. 60 years
b. 150 years
c. 180 years
d. 750 years
e. 5 years

28. I–131 has a half–life of 8.04 days. Assuming you start with a 1.35 mg sample, how much will remain after 13.0 days?

a. 0.835 mg
b. 0.268 mg
c. 0.422 mg
d. 0.440 mg
e. none of the above

29. What is the binding energy in kJ/mol for $^{60}_{28}\text{Ni}$, given the following respective masses?

Proton: 1.00783 Neutron: 1.00867 Ni–60: 59.9308

a. 5.09×10^{10} kJ/mol
b. 3.69×10^{7} kJ/mol
c. 7.48×10^{13} kJ/mol
d. 4.22×10^{10} kJ/mol
e. none of the above

30. Which of the following statement is true?

a. When energy is released during a nuclear reaction, the total mass of the products is less than the total mass of the reactants
b. The biological impact of different forms of radiation is the same
c. Isotopes have the same number of neutrons but differing numbers of electrons
d. A strong nuclear force is required to overcome the repulsion between neutrons
e. All stable nuclei have a 1:1 ratio of neutrons to protons

31. In a U–235 fission reactor, fission reactions can be run continuously because:

a. the reactors generate more fissionable fuel than they consume
b. cadmium control rods provide additional protons when the process becomes subcritical
c. many more neutrons are produced in each fission reaction than are consumed
d. neutrons split into protons and electrons
e. none of the above.

32. Fact: ^{40}Sc 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 low</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>.

33. The isotope ^{90}Sr has a half–life of 28.8 years. How long will be required for a 5.40 g sample to decay to 2.44 g?

a. 33 years
b. 30 years
c. 14 years
d. 42 years
e. none of the above

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