South Pasadena • AP Chemistry

Name _____
Period ___ Date ___/___/___

21 • Electron Transfer Reactions

PRACTICE TEST

1. Which of the following is the correct cell notation for the reaction

$$Hg_2^{2+} + Cd(s) \rightarrow Cd^{2+} + 2Hg(l)$$

a) $Cd^{2+} \mid Cd \mid\mid Hg_2^{2+} \mid Hg$
b) $Cd^{2+} \mid Hg_2^{2+} \mid\mid Cd \mid Hg$
c) $Cd \mid Cd^{2+} \mid\mid Hg_2^{2+} \mid Hg$
d) $Cd^{2+} \mid Hg \mid\mid Hg_2^{2+} \mid Cd$
e) $Hg \mid Cd \mid\mid Hg_2^{2+} \mid Cd^{2+}$

2. Consider an electrochemical cell where the following reaction takes place:

$$3Sn^{2+}(aq) + 2Al(s) \rightarrow 3Sn(s) + 2Al^{3+}(aq)$$

Which of the following is the correct cell notation for this cell?

a) $Al \mid Al^{3+} \mid\mid Sn^{2+} \mid Sn$
b) $Al^{3+} \mid Al \mid\mid Sn \mid Sn^{2+}$
c) $Sn \mid Sn^{2+} \mid\mid Al^{3+} \mid Al$
d) $Sn \mid Al^{3+} \mid\mid Al \mid Sn^{2+}$
e) $Al \mid Sn^{2+} \mid\mid Sn \mid Al^{3+}$

Standard Reduction Potentials at 25°C E° (volts)

$F_2(g) + 2e^- \rightarrow 2F^-(aq)$	+2.87
$Au^{3+} + 3e^- \rightarrow Au(s)$	+1.50
$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$	+1.36
$O_2(g) + 4H_3O^+(aq) + 4e^- \rightarrow 6H_2O(l)$	+1.23
$Br_2(l) + 2e^- \rightarrow 2Br^-(aq)$	+1.08
$Ag^+(aq) + e^- \rightarrow Ag(s)$	+0.80
$Hg_2^{2+}(aq) + 2e^- \rightarrow 2Hg(l)$	+0.79
$I_2(s) + 2e^- \rightarrow 2I^-(aq)$	+0.535
$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.337
$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$	+0.15
$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$	-0.14
$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$	-0.40
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	-0.763
$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$	-0.828
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	-1.66
$K^+(aq) + e^- \rightarrow K(s)$	-2.93
$Li^+(aq) + e^- \rightarrow Li(s)$	-3.045

3. Given the two half reactions and their potentials, which net reaction is spontaneous?

$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$ E° = -0.25 V
$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$ E° = -2.37 V

a) $Ni(s) + Mg^{2+}(aq) \rightarrow Mg(s) + Ni^{2+}(aq)$
b) $Ni^{2+}(aq) + Mg(s) \rightarrow Mg^{2+}(aq) + Ni(s)$
c) $Ni(s) + Mg(s) \rightarrow Mg^{2+}(aq) + Ni^{2+}(aq)$
d) $Mg^{2+}(aq) + Ni^{2+}(aq) \rightarrow Mg(s) + Ni(s)$
e) $Mg^{2+}(aq) + Mg(s) \rightarrow Ni(s) + Ni^{2+}(aq)$

4. Calculate E° for the following reaction:

$$Sn^{4+}(aq) + 2K(s) \rightarrow Sn^{2+}(aq) + 2K^+(aq)$$

a) +6.00 V
b) -3.08 V
c) +3.08 V
d) +2.78 V
e) -2.78 V

5. Calculate E° for the following reaction:

$$2Al^{3+}(aq) + 3Cd(s) \rightarrow 2Al(s) + 3Cd^{2+}(aq)$$

a) -2.06 V
b) +4.52 V
c) +2.06 V
d) -4.52 V
e) -1.26 V

6. Using data from the reduction potential table and the reaction

$2Ag(s) + Pt^{2+}(aq) \rightarrow Pt(s) + 2Ag^+(aq)$ E° = 0.38 V

calculate the standard reduction potential of the half-reaction

$$Pt^{2+}(aq) + 2e^- \rightarrow Pt(s)$$

a) -1.18 V
b) -0.40 V
c) 0.40 V
d) 1.18 V
e) 2.00 V

7. Using data from the reduction potential table, predict which of the following is the best *oxidizing* agent.

a) F_2
b) Ag
c) Sn^{4+}
d) Ag^+
e) Al^{3+}

8. An electrochemical cell of notation Pd | Pd^{2+} | | Cu^{2+} | Cu has an E° = -0.65 V. If we know that the standard reduction potential of Cu^{2+}/Cu is E° = 0.34 V, what is the standard reduction potential for Pd^{2+}/Pd?

a) -0.99 V
b) -0.31 V
c) +0.31 V
d) 0.62 V
e) +0.99 V

9. The standard cell potential for
$3Sn^{4+}(aq) + 2Al(s) \rightarrow 3Sn^{2+}(aq) + 2Al^{3+}(aq)$
is E° = 1.81 V. What is E_{cell} when
$[Sn^{4+}] = 1.0$,
$[Sn^{2+}] = 1.0 \times 10^{-2}$, and
$[Al^{3+}] = 1.5 \times 10^{-3}$ at 298 K.

a) 1.70 V
b) 1.76 V
c) 1.81 V
d) 1.86 V
e) 1.93 V

10. Predict the product at the anode when electric current is passed through a solution of KI.

a) $I_2(l)$
b) $K^+(aq)$
c) $H_2(g)$
d) K(s)
e) $O_2(g)$

11. If electric current is passed through aqueous LiBr, the product at the cathode would be _____ and the product at the anode would be _____.

a) $H_2O(l)$, $Li^+(aq)$
b) $Br_2(l)$, Li(s)
c) Li(s), $Br_2(l)$
d) $Br_2(l)$, $H_2(g)$
e) $H_2(g)$, $Br_2(l)$

12. How long would it take to deposit 1.36 g of copper from an aqueous solution of copper(II) sulfate by passing a current of two amperes through the solution?

a) 2070 sec
b) 1.11×10^{-5} sec
c) 2570 sec
d) 736 sec
e) 1030 sec

13. If a current of 6.0 amps is passed through a solution of Ag^+ for 1.5 hours, how many grams of silver are produced?

a) 0.60 g
b) 36 g
c) 0.34 g
d) 3.0 g
e) 1.0 g

14. How is aluminum currently produced in industry?

a) by reduction of Al^{3+} in Al_2O_3 with Na(s)
b) electrochemical reduction of pure Al_2O_3 to give Al and O_2
c) electrolysis of AlF_3 to give Al and F_2
d) electrolysis of a mixture of Al_2O_3 and Na_3AlF_6 to give Al and O_2
e) by reduction of Al^{3+} in Al_2O_3 with CO(g)

15. How was aluminum originally made?

a) the Hall-Heroult process
b) Al_2O_3 mixed with cryolite is electrolyzed
c) electrolysis of molten Al_2O_3
d) mining and purifying directly
e) reducing $AlCl_3$ with sodium

16. Under acidic conditions the bromate ion is reduced to the bromide ion. Write the balanced half-reaction for this process.

a) $BrO_3^- + 6H^+ + 6e \rightarrow Br^- + 3H_2O$
b) $2BrO_3^- + 6H^+ \rightarrow Br_2^- + 6H_2O + 3e$
c) $Bro_3^- + 6H_2O + 10e \rightarrow Br_2^- + 12H^+ + 3\ O_2$
d) $2BrO_3^- + 6H_2O \rightarrow 2Br^- + 12H^+ + 6\ O_2 + 8e$
e) $2BrO_3^- + 6H^+ \rightarrow Br_2^- + 3H_2O + 3e$

17. Balance the following redox equation which occurs in acidic solution.
$N_2H_4(g) + BrO_3^-(aq) \rightarrow Br^-(aq) + N_2(g)$

a) $3N_2H_4 + BrO_3^- \rightarrow 3N_2 + Br^- + 3H_2O + 6H^+$
b) $N_2H_4 + BrO_3^- + 2H^+ \rightarrow 2Br^- + N_2 + 3H_2O$
c) $3N_2H_4 + 2BrO_3^- + 12H^+ \rightarrow 3N_2 + 2Br^- + 6H_2O + 12H^+$
d) $N_2H_4 + 2BrO_3^- + 8H^+ \rightarrow 2Br^- + N_2 + 6H_2O$
e) $3N_2H_4 + 2BrO_3^- \rightarrow 3N_2 + 2Br^- + 6H_2O$

18. Which of the following reactions is NOT a redox reaction?

a) $2HgO(s) \rightarrow 2\ Hg(l) + O_2(g)$
b) $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$
c) $2HCl(aq) + Zn(s) \rightarrow H_2(g) + ZnCl_2(aq)$
d) $H_2CO_3(aq) \rightarrow H_2O(l) + CO_2(g)$
e) $2KClO_3 \rightarrow 2KCl(s) + 3\ O_2(g)$

1.C 2.A 3.B 4.C 5.E 6.D 7.A 8.E 9.E 10.A
11.E 12.A 13.B 14.D 15.E 16.A 17.E 18.D