Name: **Period:**   **Seat#:**
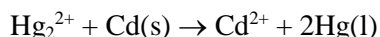
Directions: Show all work and/or annotate with an AP Chem level explanation for non-math answers. Use binder paper as needed.

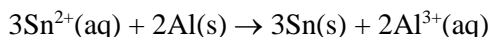**Standard Reduction Potentials at 25°C E° (volts)**

$F_2(g) + 2e^- \rightarrow 2F^-(aq)$	+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
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	-0.7632
$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$	-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

1) Which of the following is the correct cell notation for the reaction
$$Hg_2^{2+} + Cd(s) \rightarrow Cd^{2+} + 2Hg(l)$$
a) $Cd^{2+} \,|\, Cd \,||\, Hg_2^{2+} \,|\, Hg$
b) $Cd^{2+} \,|\, Hg_2^{2+} \,||\, Cd \,|\, Hg$
c) $Cd \,|\, Cd^{2+} \,||\, Hg_2^{2+} \,|\, Hg$
d) $Cd^{2+} \,|\, Hg \,||\, Hg_2^{2+} \,|\, Cd$
e) $Hg \,|\, Cd \,||\, Hg_2^{2+} \,|\, Cd^{2+}$

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) $Al \,|\, Al^{3+} \,||\, Sn^{2+} \,|\, Sn$
b) $Al^{3+} \,|\, Al \,||\, Sn \,|\, Sn^{2+}$
c) $Sn \,|\, Sn^{2+} \,||\, Al^{3+} \,|\, Al$
d) $Sn \,|\, Al^{3+} \,||\, Al \,|\, Sn^{2+}$
e) $Al \,|\, Sn^{2+} \,||\, Sn \,|\, Al^{3+}$

3) Given the two half reactions and their potentials, which net reaction is spontaneous?
$$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s) \qquad E° = -0.25 \text{ V}$$
$$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s) \qquad E° = -2.37 \text{ V}$$
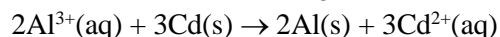a) $Ni(s) + Mg^{2+}(aq) \rightarrow Mg(s) + Ni^{2+}(aq)$
b) $Ni^{2+}(aq) + Mg(s) \rightarrow Mg^{2+}(aq) + Ni(s)$
c) $Ni(s) + Mg(s) \rightarrow Mg^{2+}(aq) + Ni^{2+}(aq)$
d) $Mg^{2+}(aq) + Ni^{2+}(aq) \rightarrow Mg(s) + Ni(s)$
e) $Mg^{2+}(aq) + Mg(s) \rightarrow Ni(s) + Ni^{2+}(aq)$
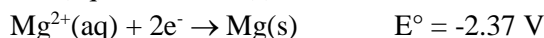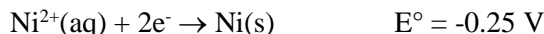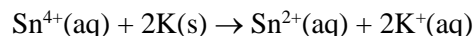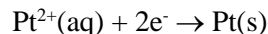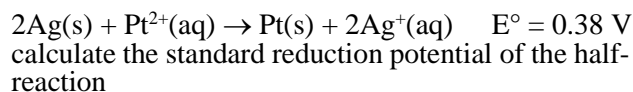
4) Calculate E° for the following reaction:
$$Sn^{4+}(aq) + 2K(s) \rightarrow Sn^{2+}(aq) + 2K^+(aq)$$
a) +6.00 V
b) -3.08 V
c) +3.08 V
d) +2.78 V
e) -2.78 V

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
$$2Ag(s) + Pt^{2+}(aq) \rightarrow Pt(s) + 2Ag^+(aq) \qquad E° = 0.38 \text{ V}$$
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 reductionpotential for Pd^{2+}/Pd?

a) -0.99 V   d) 0.62 V

b) -0.31 V   e) +0.99 V

c) +0.31 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 x 10^{-2}, and
[Al^{3+}] = 1.5 x 10^{-3} at 298 K.

a) 1.70 V   d) 1.86 V

b) 1.76 V   e) 1.93 V

c) 1.81 V

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

a) I$_2$(l)   d) K(s)

b) K$^+$(aq)   e) O$_2$(g)

c) H$_2$(g)

11) If electric current is passed through aqueousLiBr,
the product at the cathode would be _____and the
product at the anode would be _____.

a) H$_2$O(l), Li$^+$(aq)   d) Br$_2$(l), H$_2$(g)

b) Br$_2$(l), Li(s)   e) H$_2$(g), Br$_2$(l)

c) Li(s), 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   d) 736 sec

b) 1.11 x 10^{-5} sec   e) 1030 sec

c) 2570 sec

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

a) 0.60 g   d) 3.0 g

b) 36 g   e) 1.0 g

c) 0.34 g

14) How is aluminum currently produced inindustry?

a) by reduction of Al^{3+} in Al$_2$O$_3$ with Na(s)

b) electrochemical reduction of pure Al$_2$O$_3$ to
give Al and O$_2$

c) electrolysis of AlF$_3$ to give Al and F$_2$

d) electrolysis of a mixture of Al$_2$O$_3$ and
Na$_3$AlF$_6$ to give Al and O$_2$

e) by reduction of Al^{3+} in Al$_2$O$_3$ with CO(g)

15) How was aluminum originally made?

a) the Hall-Heroult process

b) Al$_2$O$_3$ mixed with cryolite is electrolyzed

c) electrolysis of molten Al$_2$O$_3$

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 → Br$^-$ + 3H$_2$O

b) 2BrO$_3^-$ + 6H$^+$ → Br$_2^-$ +6H$_2$O + 3e

c) BrO$_3^-$ + 6H$_2$O + 10e → Br$_2^-$ + 12H$^+$ + 3O$_2$

d) 2BrO$_3^-$ + 6H$_2$O → 2Br$^-$ + 12H$^+$ + 6O$_2$ + 8e

e) 2BrO3$^-$ + 6H$^+$ → Br$_2^-$ + 3H$_2$O + 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$_2$H$_4$ + BrO$_3^-$ → 3N$_2$ + Br$^-$ + 3H$_2$O + 6H$^+$

b) N$_2$H$_4$ + BrO$_3^-$ + 2H$^+$ → 2Br$^-$ + N$_2$ +3H$_2$O

c) 3N$_2$H$_4$ + 2BrO$_3^-$ + 12H$^+$ →
3N$_2$ + 2Br$^-$ + 6H$_2$O + 12H$^+$

d) N$_2$H$_4$ + 2BrO$_3^-$ + 8H$^+$ → 2Br$^-$ + N$_2$ + 6H$_2$O

e) 3N$_2$H$_4$ + 2BrO$_3^-$ → 3N$_2$ + 2Br$^-$ + 6H$_2$O

18) Which of the following is NOT a redox reaction?

a) 2HgO(s) → 2 Hg(l) + O$_2$(g)

b) H$_2$(g) + Br$_2$(g) → 2HBr(g)

c) 2HCl(aq) + Zn(s) → H$_2$(g) + ZnCl$_2$(aq)

d) H$_2$CO$_3$(aq) → H$_2$O(l) + CO$_2$(g)

e) 2KClO$_3$ → 2KCl(s) + 3 O$_2$(g)