KEY

# Practice - Reduction Potentials

1. A piece of Cu reacts spontaneously with $1.0\ M$ $Pd^{2+}$ because

   A. Cu is a weaker reducing agent than Pd and $E^\circ > 0$

   B. Cu is a weaker reducing agent than Pd and $E^\circ < 0$

   C. Cu is a stronger reducing agent than Pd and $E^\circ > 0$

   D. Cu is a stronger reducing agent than Pd and $E^\circ < 0$

2. Consider the following: $Sn^{4+} + 2Cl^- \rightarrow Sn^{2+} + Cl_2$ What is true for this reaction?

   A. $E^\circ_{cell} = +1.51\ V$ and it is spontaneous

   B. $E^\circ_{cell} = +1.21\ V$ and it is spontaneous

   C. $E^\circ_{cell} = -1.21\ V$ and it is not spontaneous

   D. $E^\circ_{cell} = -1.51\ V$ and it is not spontaneous

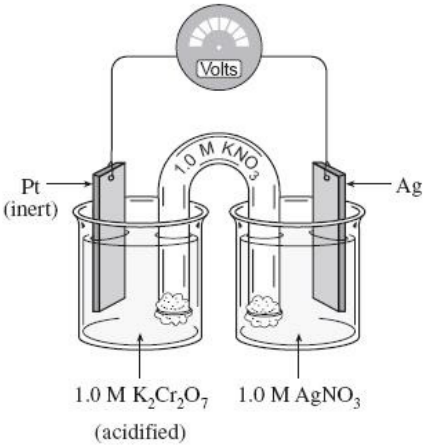
3. Consider the following half-reactions under standard conditions:

   I. $ClO_2 + e^- \rightarrow ClO_2^-$ II. $PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$ III. $Fe^{3+} + 3e^- \rightarrow Fe$

   In an experiment when $ClO_2$ and Fe were combined, they reacted. In a second experiment when $PbSO_4$ and Fe were combined, there was no observable change. Which of the following shows the reduction half-reactions I, II and III in order of decreasing $E^\circ$?

   A. I, II, III B. I, III, II C. II, III, I D. III, II, I

4. Consider the following electrochemical cell:




   What is the cell voltage at equilibrium?

   A. $-0.43\ V$

   B. $0.00\ V$

   C. $+0.43\ V$

   D. $+2.03\ V$

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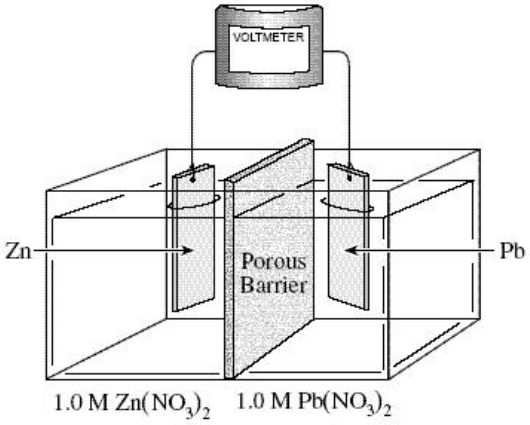
5. Consider the following diagram:




As the cell operates, the voltage gradually changes. Which of the following is responsible for this change?

A. The $[Pb^{+2}]$ is increasing

B. The $[Pb^{+2}]$ is decreasing

C. The $[Zn^{+2}]$ is decreasing

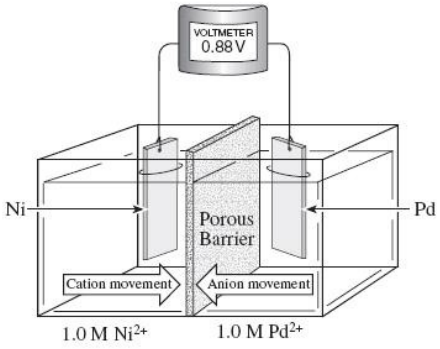
D. The mass of the $Pb_{(s)}$ electrode is decreasing

6. Consider the following: $2\ Cr^{2+} + Tl^{3+} \rightarrow 2Cr^{3+} + Tl^{+} \quad E° = +1.19\ V$

Identify the standard potential for the half-cell reaction: $Tl^{+} \rightarrow Tl^{3+} + 2e^{-}$

A. $-0.78\ V$ B. $+1.60\ V$ C. $+0.78\ V$ D. $+1.19\ V$

7. Consider the following diagram:




What is the voltage for the **oxidation** half reaction of Pd?

A. $-0.62\ V$

B. $+0.62\ V$

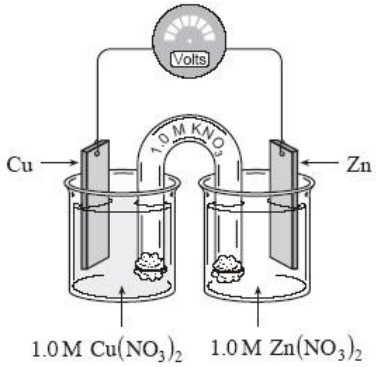
C. $+0.88\ V$

D. $-0.88\ V$

8. The value of $E°$ for a cell can be used to determine

A. rate B. spontaneity C. temperature D. activation energy

9. Consider the following cell:




The $E°$ for the cell is

A. $-1.10\ V$

B. $-0.42\ V$

C. $+0.42\ V$

D. $+1.10\ V$

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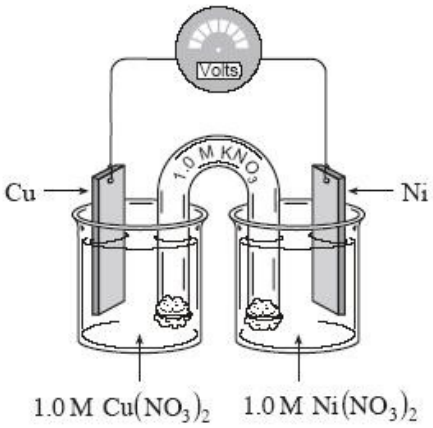
10. Consider the following cell:




The $E°$ for the cell is

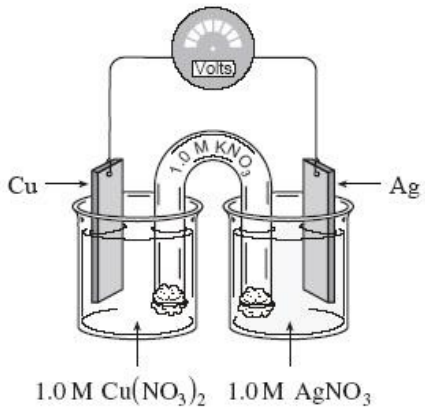
A. $-0.04\ V$

B. $-0.60\ V$

C. $+0.04\ V$

D. $+0.60\ V$

11. Consider the following cell:




The $E°$ for the cell is

A. $-1.14\ V$

B. $-0.46\ V$

C. $+0.46\ V$

D. $+1.14\ V$

12. Consider the following equation:

$$Cd^{2+} + 2I^- \rightarrow Cd + I_2 \qquad E°_{cell} = -0.94\ V$$

What is the $E°$ for the reduction of $Cd^{2+}$

A. $-0.40\ V$ B. $-1.48\ V$ C. $+1.48\ V$ D. $+0.40\ V$

13. What is the standard cell potential for the following reaction:

$$2\ Cr_{(s)} + 3Cu^{2+} \rightarrow 2\ Cr^{3+} + 3Cu_{(s)}$$

A. $-1.08\ V$ B. $+0.40\ V$ C. $+1.08\ V$ D. $-0.40\ V$

14. What is the standard cell potential for the following reaction:

$$Al_{(s)} + 3Ag^{+} \rightarrow Al^{3+} + 3Ag_{(s)}$$

A. $+2.46\ V$ B. $+0.74\ V$ C. $+4.06\ V$ D. $-0.86\ V$

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15. Given the following half-reactions:

$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O \qquad E° = +1.69\ V$

$PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-} \qquad E° = -0.36\ V$

Which of the following best describes the overall reaction and the standard cell voltage in a lead acid storage battery?

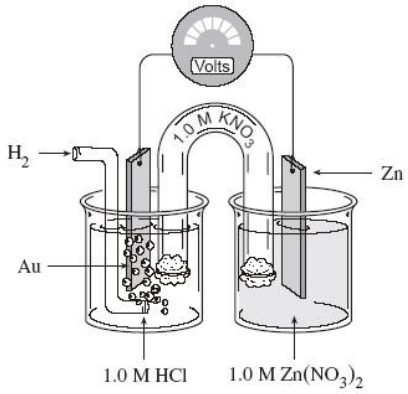
A. $Pb + 2H_2O \rightarrow PbO_2 + 4H^+ + 4e^- \qquad E°_{cell} = +1.33\ V$

B. $PbO_2 + 4H^+ + 4e^- \rightarrow Pb + 2H_2O \qquad E°_{cell} = +1.33\ V$

C. $Pb + PbO_2 + 2SO_4^{2-} + 4H^+ \rightarrow 2PbSO_4 + 2H_2O \qquad E°_{cell} = +2.05V$

D. $2PbSO_4 + 2H_2O \rightarrow Pb + PbO_2 + 2SO_4^{2-} + 4H^+ \qquad E°_{cell} = +2.05\ V$

16. Consider the following cell:




What is the value of the standard cell potential?

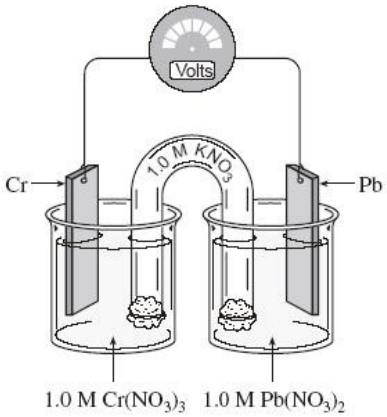
A. $-0.76\ V$

B. $+0.76\ V$

C. $+2.12\ V$

D. $+2.26\ V$

17. Consider the following cell:




At equilibrium what is the cell voltage?

A. $+0.87\ V$

B. $+0.61\ V$

C. $+0.65\ V$

D. $+0.00\ V$

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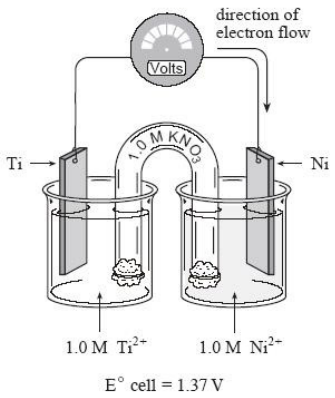
18. Consider the following electrochemical cell:




a. Write the balanced equation for the half-reaction that occurs at the anode.

Answer - $Ti \rightarrow Ti^{+2} + 2\ e^-$

b. Calculate the $E°$ for the reduction of $Ti^{2+}$.

Answer - $+1.37 = (-0.26) + (Ti^{+2})$ $\quad Ti^{+2} = +1.63\ V$

19. Which of the following describes an electrochemical cell?

| | $E°_{cell}$ | Type of reaction |
|---|---|---|
| A. | positive | spontaneous |
| B. | positive | non-spontaneous |
| C. | negative | spontaneous |
| D. | negative | non-spontaneous |

20. Consider the reaction: $Ni^{2+} + 2Ag \rightarrow 2Ag^{+} + Ni$ Which of the following is true?

| | $E°$ | Reaction |
|---|---|---|
| A. | $-1.06\ V$ | non-spontaneous |
| B. | $-0.54\ V$ | non-spontaneous |
| C. | $+0.54\ V$ | spontaneous |
| D. | $+1.06\ V$ | spontaneous |

21. Consider the reaction: $Ni + Ag_2S \rightarrow 2Ag + Ni^{2+} + S^{2-}$ Which of the following is true?

| | $E°$ | Reaction |
|---|---|---|
| A. | $-0.95\ V$ | non-spontaneous |
| B. | $-0.43\ V$ | non-spontaneous |
| C. | $+0.43\ V$ | spontaneous |
| D. | $+1.06\ V$ | spontaneous |