Practice - Selecting Preferred Reactions
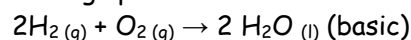
1. A sample of copper is placed in $HNO_{3(aq)}$ and another sample of copper is placed in $HCl_{(aq)}$.

    a. In which acid does a spontaneous redox reaction occur with the copper? __HNO₃ (nitric)__

    b. Calculate the $E°$ for the reaction that occurs. ____+0.62 V____

2. In a fuel cell, the following spontaneous redox reaction occurs in a <u>basic</u> solution:
    $$2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2\,H_2O_{\,(l)}\ (basic)$$
   a. Write the balanced half reaction that occurs at the anode:
       Answer - $2\,H_2\ +\ 4\,OH^-\ \rightarrow\ 4\,H_2O\ +\ 4\,e^-$ $E° = +0.83\,V$

   b. Write the balanced half reaction that occurs at the cathode:
       Answer - $O_2\ +\ 2\,H_2O\ +\ 4\,e^-\ \rightarrow\ 4\,OH^-$ $E° = +1.23\,V$

   c. Determine the $E°$ for the fuel cell.

       Answer - $(+1.23) + (+0.83) = +2.06\,V$

3. What happens to iron as it corrodes?
       A. It loses electrons and is reduced.   <u>C.</u> It loses electrons and is oxidized.
       B. It gains electrons and is reduced.   D. It gains electrons and is oxidized.

4. Why is aluminum a good choice for the manufacture of outdoor structures?
       A. Pure aluminium is easily reduced.
       B. Pure aluminium is not easily oxidized.
       C. Pure aluminium is easily reduced, but forms a protective coating.
       <u>D.</u> Pure aluminium is easily oxidized, but forms a protective coating.

5. Why is gold a good choice for the manufacture of jewelry?
       A. Pure gold is not easily reduced.
       <u>B.</u> Pure gold is not easily oxidized.
       C. Pure gold is easily reduced, but forms a protective coating.
       D. Pure gold is easily oxidized, but forms a protective coating.

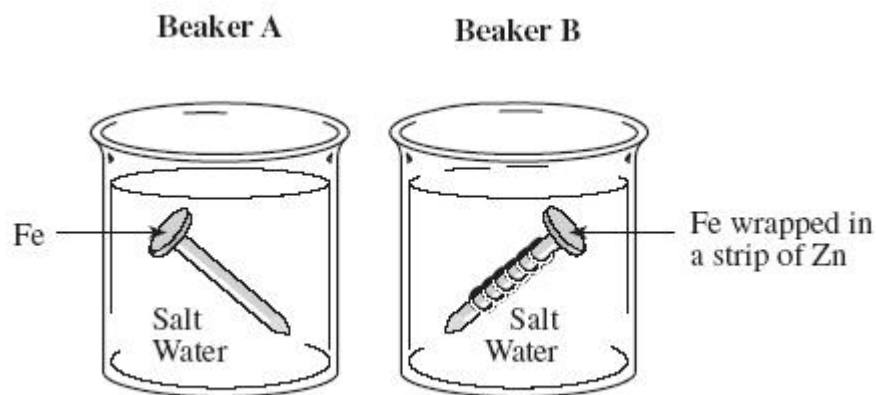6. A sample of Zn corrodes in moist air.
   a. Write the reduction half-reaction.

       Answer - $O_2\ +\ 4\,H^+\ +\ 4\,e^-\ \rightarrow\ 2\,H_2O$

   b. What metal could be attached to the sample to prevent the corrosion of the zinc? Explain.
       Answer – Aluminium would work. We need a sacrificial metal to preferentially oxidize before zinc.
               Aluminium is a metal that is a stronger reducing agent and so is preferentially oxidized over zinc
               (lower on right side of chart)

7. Consider the following diagrams:

Beaker A   Beaker B

Fe —   — Fe wrapped in
                              a strip of Zn
Salt Water   Salt Water

a. Predict what should happen to the Fe in Beaker A.

Prediction: ____The iron nail will rust (oxidize)____

Explanation: _Oxygen (in water) will be reduced and the iron will be oxidized as oxygen is a strong oxidizer._

b. Predict what should happen to the Fe in Beaker B.

Prediction: _____The zinc will slowly "dissolve"._____

Explanation: ____The zinc will oxidize to Zn^{+2} preferentially over the nail and dissolve away.____

8. Which of the following will inhibit the corrosion of iron?
A. high $[O_2]$ B. wet conditions   C. coating with zinc   D. increasing the temperature

9. How is the formation of rust on an iron can inhibited by a tin coating?
A. The tin is a sacrificial anode   C. The tin is a weaker reducing agent than iron
B. The tin cathodically protects the iron   D. The tin keeps the oxygen away from the iron

10. Describe two chemically different methods of preventing the corrosion of iron. Explain how each method works.
Method #1: __paint the iron__
Explanation : The paint is a plastic coating that blocks oxygen from contacting and ultimately reacting with the iron atoms.

Method #2: __Apply a zinc coating (galvanizing).__
Explanation : Applying the zinc coating caused the zinc to selectively oxidize. The oxidized zinc forms an oxidized layer of zinc that doesn't allow more oxygen to contact more zinc and the oxidizing stops.

11. Which of the following metals could be used to cathodically protect iron?
A. tin   B. lead   C. zinc   D. copper

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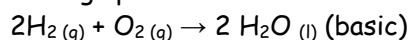A. gold B. lead   C. aluminium   D. cobalt

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    <u>Answer -</u> $O_2\ +\ 2\ H_2O\ +\ 4\ e^-\ \rightarrow\ 4\ OH^-$ $E° = +1.23\ V$

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    <u>Answer -</u> $(+1.23) + (+0.83) = +2.06\ V$

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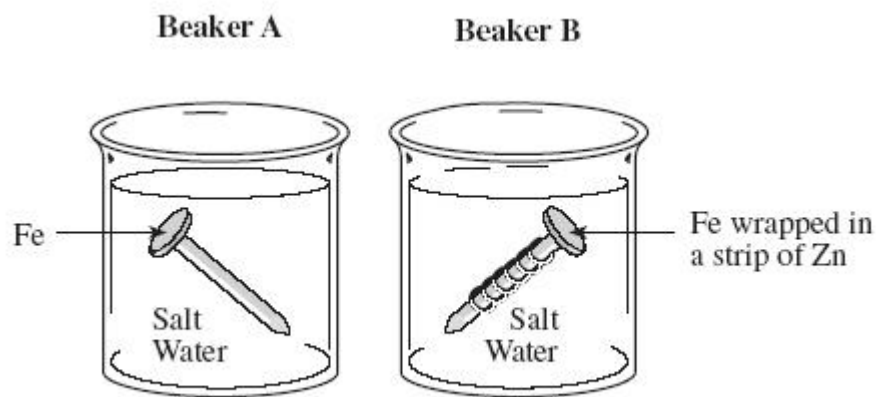
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