October 3, 2001  QUIZ #2  CHEM 101

1) Bowmanics has just dumped enough barium nitrate into your 40,000 L fish pond to make the concentration of barium nitrate = 2.345 x 10^{-3} M. Your job is too add enough of one of the following agents to precipitate all the barium out of solution to save your family who use this water and to prove that your education was worth it!

a) Which of the following solids can be added to the pond to precipitate all the Ba assuming that the reaction goes to completion (circle one): KNO_3  MgS  Na_2SO_4

b) Write down the net ionic reaction for the precipitation reaction.

\[ \text{Ba}^{2+}(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{BaSO}_4(s) \]

c) How many kg of the reagent you chose in a) will you need to precipitate all the barium nitrate assuming complete reaction?

\[ \text{mol of Ba}^{2+} = 2.345 \times 10^{-3} \text{ mol Ba}^{2+}/L \times 40,000 \text{ L} = 93.80 \text{ mol Ba}^{2+} \]

\[ \text{mol Ba}^{2+} = \text{mol SO}_4^{2-} = \text{mol Na}_2\text{SO}_4 = 93.80 \text{ mol} \]

\[ 93.80 \text{ mol Na}_2\text{SO}_4 \times 142.02 \text{ g Na}_2\text{SO}_4/\text{mol} \times 1 \text{ kg}/1000 \text{ g} = 13.32 \text{ kg Na}_2\text{SO}_4 \]

2) Which of the following are oxidation/reduction (redox) reactions? In those that are redox reactions identify the oxidizing agent and the reducing agent.

a) AgNO_3(aq) + Cl^-(aq) \rightarrow AgCl(s) + NO_3^-(aq)

Not a redox reaction

b) 2Cr_2O_3(s) + 3Si(s) \rightarrow 4Cr(s) + 3SiO_2(s)

oxidation #   (+3) (-2) (0) (0) (+4) (-2)

Oxidizing agent: Cr_2O_3  Reducing agent: Si

3) Chlorine is used to purify drinking water. Too much chlorine is harmful to humans. The excess chlorine is often used removed by treatment with sulfur dioxide (SO_2). Balance the following equation in an acidic solution which represents this procedure:

\[ \text{Cl}_2 + \text{SO}_2 \rightarrow \text{Cl}^- + \text{SO}_4^{2-} \]

oxidation no:  0  +4 -2  -1  +6 -2

Half-reactions:

Oxidation:  \text{SO}_2 \rightarrow \text{SO}_4^{2-} \\
Reduction:  \text{Cl}_2 \rightarrow 2\text{Cl}^-

Balanced half-reactions:

Oxidation:  2\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2e^- \\
Reduction:  2e^- + \text{Cl}_2 \rightarrow 2\text{Cl}^-

Balanced reaction:

\[ 2\text{H}_2\text{O} + \text{SO}_2 + \text{Cl}_2 \rightarrow \text{SO}_4^{2-} + 2\text{Cl}^- + 4\text{H}^+ \]

4) A dented (but not punctured) ping pong ball often can be restored to its initial shape by immersing it in hot water. Referring to the ideal gas law explain this observation.

P is proportional to T. Increase in temperature of the gas inside the ball increases the pressure causing the ping pong ball to expand against the dent and push it out.
1) Bowmanics has just dumped enough barium nitrate into your 60,000 L fish pond to make the concentration of barium nitrate = $5.432 \times 10^{-3}$ M. Your job is too add enough of one of the following agents to precipitate all the barium out of solution to save your family who use this water and to prove that your education was worth it!

a) Which of the following solids can be added to the pond to precipitate all the Ba assuming that the reaction goes to completion (circle one):

- $\text{KNO}_3$
- $\text{Na}_2\text{SO}_4$
- $\text{MgS}$

b) Write down the net ionic reaction for the precipitation reaction.

$$\text{Ba}^{2+}(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{BaSO}_4(s)$$

c) How many kg of the reagent you chose in a) will you need to precipitate all the barium nitrate assuming complete reaction?

$$\text{mol of } \text{Ba}^{2+} = 5.432 \times 10^{-3} \text{ mol } \text{Ba}^{2+}/L \times 60,000. \text{ L} = 325.9 \text{ mol } \text{Ba}^{2+}$$

$$\text{mol } \text{Ba}^{2+} = \text{mol } \text{SO}_4^{2-} = \text{mol } \text{Na}_2\text{SO}_4 = 325.9 \text{ mol}$$

$$325.9 \text{ mol } \text{Na}_2\text{SO}_4 \times 142.02 \text{ g } \text{Na}_2\text{SO}_4/\text{mol} \times 1 \text{ kg}/1000 \text{ g} = 46.28 \text{ kg } \text{Na}_2\text{SO}_4$$

2) Which of the following are oxidation/reduction (redox) reactions? In those that are redox reactions identify the oxidation agent and the reducing agent.

a) $2\text{Fe}_2\text{O}_3(s) + 3\text{C}(s) \rightarrow 4\text{Fe}(s) + 3\text{CO}_2(g)$

<table>
<thead>
<tr>
<th>Oxidation #</th>
<th>(+3)</th>
<th>(-2)</th>
<th>(0)</th>
<th>(+4)</th>
<th>(-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxidizing agent:</td>
<td>$\text{Fe}_2\text{O}_3$</td>
<td>Reducing agent:</td>
<td>$\text{C}$</td>
<td></td>
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</tr>
</tbody>
</table>

b) $\text{Pb(NO}_3)_2(aq) + 2\text{Cl}^-(aq) \rightarrow \text{PbCl}_2(s) + 2\text{NO}_3^-(aq)$

Not a redox reaction

3) Bromine is used to purify drinking water. Too much bromine is harmful to humans. The excess bromine is often used removed by treatment with sulfur dioxide ($\text{SO}_2$). Balance the following equation in an acidic solution which represents this procedure:

$$\text{Br}_2 + \text{SO}_2 \rightarrow \text{Br}^- + \text{SO}_4^{2-}$$

<table>
<thead>
<tr>
<th>Oxidation no:</th>
<th>0</th>
<th>+4</th>
<th>-2</th>
<th>-1</th>
<th>+6</th>
<th>-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxidation:</td>
<td>$\text{SO}_2 \rightarrow \text{SO}_4^{2-}$</td>
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<tr>
<td>Reduction:</td>
<td>$\text{Br}_2 \rightarrow \text{Br}^-$</td>
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Balanced half-reactions:

- Oxidation: $2\text{H}_2\text{O} + \text{SO}_2 \rightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$
- Reduction: $2\text{e}^- + \text{Br}_2 \rightarrow 2\text{Br}^-$

Balanced reaction:

$$2\text{H}_2\text{O} + \text{SO}_2 + \text{Br}_2 \rightarrow \text{SO}_4^{2-} + 2\text{Br}^- + 4\text{H}^+$$

4) A dented (but not punctured) ping pong ball often can be restored to its initial shape by immersing it in hot water. Referring to the ideal gas law explain this observation. P is proportional to T. Increase in temperature of the gas inside the ball increases the pressure causing the ping pong ball to expand against the dent and push it out.