Prelude: You've decided to drop out of school to fulfill a life-long dream of mining gold at Mt. East Rock to become stinking rich. After mining for an hour, you find a gold-colored nugget. Hoping to start your new career with this first sample, you take it to the bank to exchange for money.

However, the banker is afraid you have fool's gold (pyrite, FeS_2). This is tricky because pyrite is a strange salt made of Fe^{2+} cations and S_2^{2-} anions (rather than the S^{2-} anions you might expect!).

You

VS

The Banker

1. The banker suggests a test for fool's gold: Dissolve your "gold" in sulfuric acid and stir. If it *is* fool's gold, your sample would dissolve and react with air to release Fe^{2+} and sulfate ions.
   a) Determine the oxidation state of each element in the unbalanced equation. Then label the elements that are being reduced or oxidized. (Note: S_2 has a total charge of 2–, *i.e.*, S_2^{2-})

$$FeS_2\,(s) + O_2 + H_2O \rightarrow FeSO_4 + H_2SO_4$$

   b) What type of reaction is this? Explain.

   c) Balance the half reactions:

$$\_\_\_\_\ H_2O + \_\_\_\_\ S_2^{2-} \rightarrow \_\_\_\_\ H^+ + \_\_\_\_\ SO_4^{2-} + \_\_\_\_\ e^-$$

$$\_\_\_\_\ e^- + \_\_\_\_\ H^+ + \_\_\_\_\ O_2 \rightarrow \_\_\_\_\ H_2O$$

   d) Write the balanced chemical equation.

   e) Draw an illustration that depicts the products of this reaction on the molecular scale.

2. The banker has some extra sulfuric acid that he uses to fend off robbers.
   a) He wants you to dispose of it by reacting it with barium chloride. Why would he suggest this?

   b) Write the overall ionic equation for this reaction.

   c) Write a net ionic equation for this reaction.

   d) How many grams of barium chloride would you need to add to completely react with all the sulfate in 10. mL of the banker's 10.0 M sulfuric acid solution?

3. After taking care of his sulfuric acid the banker takes you under his wing and wants to teach you about Beer's Law. He asks you to find the concentration of his $KMnO_4$ solution.
   a) The banker informs you that the path length is 1.0 cm and that the $KMnO_4$ has a molar absorptivity of 1142.7 $L \cdot mol^{-1} \cdot cm^{-1}$. If the $KMnO_4$ solution has an absorbance of 0.79, what is its concentration?

   b) The banker wants to dilute 100. mL of his $KMnO_4$ solution (use concentration from part 3a) to 7.0×10^{-6} M. How much solvent would you need to add to obtain this molarity? How many moles of $KMnO_4$ do you have before and after the dilution?

More Practice, if you have time:

4. An alternate method to determine Fe^{2+} concentration is to titrate Fe^{2+} using $KMnO_4$ in acid. In this redox titration, Fe^{2+} is converted to Fe^{3+} and $KMnO_4$ is converted to Mn^{2+}. Identify which species are being oxidized and reduced, and use the half reactions to determine the balanced equation.

5. What is the molarity of Fe^{2+} in solution if you needed 20. mL of 7.0×10^{-6} M $KMnO_4$ to completely react with 100. mL of your Fe^{2+} solution?