EXTRACTION OF METALS: COPPER

1. If your syllabus doesn't expect you to be able to describe the extraction of copper from its ores, then ignore this question.

   In the extraction of copper from chalcopyrite, $CuFeS_2$, the ore is first concentrated by froth floatation, and then heated in a furnace or series of furnaces with a mixture of silicon dioxide, calcium carbonate and air or oxygen. The overall equation can be considered as

   $$2CuFeS_2 + 2SiO_2 + 4O_2 \longrightarrow Cu_2S + 2FeSiO_3 + 3SO_2$$

   The Cu_2S is converted into copper using a blast of air.

   a) Describe briefly and without details what you understand by "froth floatation".

   b) How does the $FeSiO_3$ separate from the Cu_2S?

   c) What happens to the SO_2?

   d) Write the equation for the reaction of CuS_2 with the final blast of air.

   e) The equation you have written in part (d) is a redox reaction. What is the reducing agent? Explain your answer.

   f) Some copper ores can be turned into copper by a process which involves a chemical reaction in the cold, for example with dilute sulphuric acid. In that case, you are left with copper(II) sulphate solution which can be concentrated, and then electrolysed.

      (i) What could you use as the anode?

      (ii) What could you use for the cathode?

      (iii) Write the cathode equation.

2. In the purification of copper, the impure copper is made the anode in an electrolysis of copper(II) sulphate solution.

   a) State what the cathode made of, and write the cathode equation.

   b) Write the main anode equation.

   c) Explain what happens to metals like zinc which may be present in the impure copper, and which are above copper in the electrochemical series.

   d) Explain what happens to metals like gold and silver which may be present in the impure copper.

   e) The copper(II) sulphate solution has to be continuously purified. Explain why.

3. Give two different uses for copper, and explain why copper is used in each situation.