‘FROM MINERALS TO ELEMENTS’ TEST  

1. Bromine can be made from a concentrated solution of bromide ions (derived from sea water) by passing chlorine through the solution.

   a. What would you expect to see as the reaction takes place? Explain your answer. (2 marks)

   b. Give the oxidation state of bromine in:
      i. bromide ions; (1 mark)
      ii. bromine molecules. (1 mark)

   c. i. Explain, in terms of electron transfer, why turning bromide ions into bromine molecules is called oxidation. (1 mark)
      ii. Write a half-equation for this process. (1 mark)

   d. i. Suggest how the chlorine used in the extraction of bromine from sea water is manufactured. (2 marks)
      ii. Write the overall equation, with state symbols, for the reaction of chlorine gas with aqueous bromide ions. (3 marks)

   e. When the reaction in d ii is complete, some aqueous silver nitrate is added.
      i. What would you expect to see? (2 marks)
      ii. Write an ionic equation, with state symbols, to explain your observation. (3 marks)

   f. State two safety precautions needed when handling bromine industrially. (2 marks)

   g. The maximum amount of bromine that will dissolve in 100 cm³ water at 25 °C is 1.8 g. Calculate the concentration of Br₂ in this solution in mol dm⁻³. (A₁; Br, 80) (3 marks)

   h. State one large-scale use of bromine or of one of its compounds. (1 mark)

   [TOTAL: 22 MARKS]

2. The flow diagram below shows how nickel can be manufactured.

   Step 1 crush  
   Step 2 froth flotation  
   Step 3 dry  
   Step 4 heat in furnace  
   Step 5 dissolve CuS in Na₂S (l)  
   Step 6 NiS  
   Step 7 reduction with carbon

   a. i. What effect does froth flotation have on the crushed mineral? (1 mark)
      ii. Suggest how step 6 is carried out. (2 marks)
      iii. Suggest a possible environmental problem associated with:
           1. step 2; (1 mark)
           2. step 6. (1 mark)

   b. Copper and nickel compounds often have similar reactions.
      i. In which block of the Periodic Table are copper and nickel both found? (1 mark)
      ii. At which step in the process shown above are copper and nickel separated? (1 mark)

   c. The waste material from the mine will contain silica, SiO₂. Carbon dioxide has a similar formula, yet its properties are very different from those of silica.
      Describe the structures of SiO₂ and CO₂, and explain how these structures lead to differences in properties. (5 marks)

   [TOTAL: 12 MARKS]
This question is about making copper from its ore in the laboratory. The stages are:

I. Roasting the ore
   \[ \text{CuS} + 1.5\text{O}_2 \rightarrow \text{CuO} + \text{SO}_2 \]  
   Equation 3.1

II. Leaching out the copper
   \[ \text{CuO} + 2\text{NH}_4^+ \rightarrow \text{Cu}^{2+} + 2\text{NH}_3 + \text{H}_2\text{O} \]
   \[ \text{Cu}^{2+} + 4\text{NH}_3 \rightarrow [\text{Cu(NH}_3)_4]^{2+} \]
   Equation 3.2
   Equation 3.3

III. Filtering

IV. Acidifying the solution remaining

V. Displacing the copper using zinc

a. Complete the electronic configurations for:
   - copper: 1s^2 2s^2 ... (1 mark)
   - Cu^{2+} ions: 1s^2 2s^2 ... (1 mark)
   - sulphur: 1s^2 2s^2 ... (1 mark)

b. Draw a labelled diagram of the apparatus you would use for vacuum filtration in stage III.
   (3 marks)

c. From Equations 3.1, 3.2 and 3.3, pick:
   i. a redox reaction. Copy out the equation and under each of the atoms write its oxidation state.
      (6 marks)
   ii. an acid-base reaction. Give the number of the equation and identify the acid in the reaction.
      Why is this an acid? (3 marks)

d. The concentration of the ammonia solution used in Equation 3.3 can be checked by titration with hydrochloric acid of known molar concentration. A measured volume of ammonia solution is placed in a flask (using a pipette) and the hydrochloric acid solution is run in from a burette.
   i. Give three other vital instructions that would be necessary for someone to carry out the above titration to obtain an accurate value for the amount of acid needed. (3 marks)
   ii. 25.0 cm^3 of ammonia solution required 21.3 cm^3 of 1.00 mol dm^{-3} hydrochloric acid for complete reaction. Calculate the concentration of the ammonia solution in mol dm^{-3}. (3 marks)

e. Copper sulphide has a structure similar to that of sodium chloride. Draw a three-dimensional sketch of the structure of CuS, labelling the ions. (2 marks)

f. Copper ions are said to be hydrated in aqueous solution. Draw a fully labelled diagram to illustrate this. (3 marks)

[TOTAL: 26 MARKS]

(Adapted from OCR Chemistry (Salters), Module 1, question 3, Jan 1996)