QUESTION 11

The first stage in the production of zinc from ZnS is the roasting of ZnS in air. This process releases SO_2, which may leak into the surrounding air.

(a) Write an equation for the roasting of ZnS in air to produce SO_2.

(2 marks)

Credit will be given for the correct use of significant figures in answers to part (b). (1 mark)

(b) The following procedure was used to determine the concentration of SO_2 in one sample of polluted air:

Step 1 1.0×10^5 L of the polluted air was bubbled through 0.100 L of 0.02997 mol L^{-1} $KMnO_4$ solution. An equation for the reaction that occurred is shown below:

$$5SO_2 + 2MnO_4^- + 2H_2O \longrightarrow 5SO_4^{2-} + 2Mn^{2+} + 4H^+$$

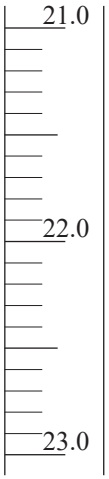
Excess MnO_4^- remained in the solution after the reaction.

Step 2 The excess MnO_4^- was titrated with 0.400 mol L^{-1} Fe^{2+} solution. An equation for the reaction that occurred is shown below:

$$5Fe^{2+} + MnO_4^- + 8H^+ \longrightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$$

A titre value of 22.35 mL was obtained.

(i) On the following diagram, which shows a section of a burette, draw the surface of a solution that would give a reading of 22.35.



(2 marks)

(ii) (1) Calculate the number of moles of MnO_4^- present before the reaction with SO_2 in Step 1.

(2 marks)

(2) State why this result should be reported to three significant figures.

_____

_____ (1 mark)

(iii) Calculate the number of moles of Fe^{2+} required to react with the MnO_4^- in Step 2.

(2 marks)

(iv) Hence calculate the number of moles of MnO_4^- left unreacted after Step 1.

(2 marks)

(v) Hence calculate the number of moles of MnO_4^- that reacted with SO_2 in Step 1.

(2 marks)

(vi) Calculate the number of moles of SO_2 in the 1.0×10^5 L of polluted air.

(2 marks)

(vii) Calculate the concentration, in $\mu g\ L^{-1}$, of SO_2 in the 1.0×10^5 L of polluted air.

(2 marks)

TOTAL: 18 marks