QUESTION 11

Proteins are important biological compounds.

Credit will be given for the correct use of significant figures in calculations in answers to part (a).

(a) The nitrogen content of a sample of dried protein, with a mass of 0.895 g, was determined by converting all the nitrogen in the protein into ammonia gas, NH_3.

The ammonia was then bubbled through 50.0 mL of 0.1970 mol L^{-1} HCl solution. A reaction occurred, as shown in the equation below:

$$NH_3 + HCl \longrightarrow NH_4^+ + Cl^-$$

(i) Calculate the initial number of moles of HCl present before the reaction with ammonia.

(2 marks)

(ii) After the ammonia had reacted, excess HCl remained. The excess HCl was neutralised by titrating with 5.90 mL of 1.000 mol L^{-1} NaOH. A reaction occurred, as shown in the equation below:

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

Calculate the number of moles of NaOH that were used.

(1 mark)

(iii) Hence determine the number of moles of excess HCl.

(1 mark)

(iv) Calculate the number of moles of HCl that reacted with the NH_3.

(1 mark)

(v) Hence determine the number of moles of NH_3 that reacted with the HCl solution.

(1 mark)

(vi) Calculate the mass of nitrogen in the sample of dried protein.

(2 marks)

(vii) Calculate the percentage mass of nitrogen in the sample of dried protein.

(2 marks)