

QUESTION 11

Tablets containing sodium fluoride, NaF, can be used to add F^- to drinking water in order to reduce tooth decay.

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

(a) The concentration of NaF in one brand of tablet was determined by titration with a standard solution of $La(NO_3)_3 \cdot 6H_2O$.

(i) Identify the block of the periodic table in which La is found.

_____ (1 mark)

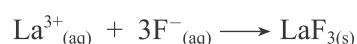
(ii) Calculate the mass, in g, of $La(NO_3)_3 \cdot 6H_2O$ needed to prepare 250.0 mL of solution of concentration $0.0100 \text{ mol L}^{-1}$. The molar mass of $La(NO_3)_3 \cdot 6H_2O$ is $433.026 \text{ g mol}^{-1}$.

(2 marks)

(iii) The following procedure was used to determine the percentage, by mass, of NaF in this brand of tablet:

Step 1 Ten tablets, each of mass 50.0 mg, were crushed and made up to a solution of approximately 30 mL.

Step 2 The 30 mL of solution was titrated with the $0.0100 \text{ mol L}^{-1}$ solution of $La(NO_3)_3 \cdot 6H_2O$ in the burette. The equation for the reaction is shown below:



A titre of 17.86 mL was needed to reach end-point.

(1) Calculate the number of moles of $La(NO_3)_3 \cdot 6H_2O$ needed to reach end-point.

(2 marks)

(2) Hence calculate the number of moles of $F^-_{(aq)}$ in the solution.

(2 marks)

(3) Calculate the mass, in mg, of NaF in the solution.

(2 marks)

(4) Hence calculate the percentage, by mass, of NaF in each tablet.

(2 marks)

(5) State the effect on the titre value if the burette had been rinsed with distilled water immediately before the titration was carried out.

_____ (1 mark)

(b) Another brand of tablet contains 1.2 mg of F^- per tablet.

Calculate the minimum number of these whole tablets that must be dissolved in 5 L of water to achieve a concentration of F^- of at least 0.95 mg L^{-1} .

(2 marks)