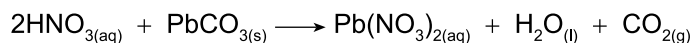


## QUESTION 9

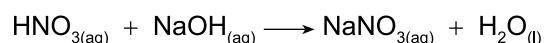
Volumetric analysis is used for the quantitative determination of  $\text{PbCO}_3$  in mineral ores.

A 3.15 g sample of an ore was analysed to determine the percentage of  $\text{PbCO}_3$  present, using the following procedure:

**Step 1** An excess of  $0.6293 \text{ mol L}^{-1} \text{ HNO}_{3(\text{aq})}$  was added to the sample. The equation for this reaction is shown below:



**Step 2** When the reaction was complete, the unreacted  $\text{HNO}_3$  was titrated with  $0.1423 \text{ mol L}^{-1} \text{ NaOH}_{(\text{aq})}$ . The equation for the titration reaction is shown below:



(a) State *one* observation that would indicate that the reaction in Step 1 was complete.

\_\_\_\_\_ (1 mark)

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

(b) (i) The volume of  $\text{HNO}_3$  added in Step 1 was 25.00 mL.

Calculate the number of moles of  $\text{HNO}_3$  added to the sample.

(2 marks)

(ii) The volume of  $\text{NaOH}$  required was 23.67 mL.

Calculate the number of moles of  $\text{NaOH}$  that reacted with the  $\text{HNO}_3$  in Step 2.

(2 marks)

(iii) (1) Calculate the number of moles of unreacted  $\text{HNO}_3$  that remained after Step 1.

(1 mark)

(2) Hence, calculate the number of moles of  $\text{HNO}_3$  that reacted during Step 1.

(1 mark)

(iv) Calculate the number of moles of  $\text{PbCO}_3$  in the ore sample.

(2 marks)

(v) Calculate the percentage, by mass, of  $\text{PbCO}_3$  in the ore sample.

(3 marks)

(c) The ore analysed also contained  $\text{CaCO}_3$ .

State and explain the effect of  $\text{CaCO}_3$  on the calculated percentage of  $\text{PbCO}_3$  in the ore sample.

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(3 marks)

TOTAL: 16 marks