Worksheet 8.2

A back titration

NAME: **CLASS:**

INTRODUCTION

Marble is a metamorphic rock that is almost pure calcium carbonate. The following experiment was conducted to determine the calcium carbonate content of a marble sample. An accurately weighed sample of crushed marble was added to a measured volume of recently standardised HCl solution. The solution was heated to drive off the evolved carbon dioxide. The remaining solution was titrated with a recently standardised NaOH solution, using a methyl red indicator. The results obtained are shown below.

Mass of marble sample: 1.740 g
Volume of HCl solution added: 40.00 mL
Concentration of the standardised HCl solution: 1.020 mol L^{-1}
Concentration of the standardised NaOH solution: 0.275 mol L^{-1}
Average titre of NaOH: 25.56 mL

No.	Question	Answer
1	Write an equation for the reaction of HCl with: **a** $CaCO_3(s)$ **b** NaOH(aq)	
2	Calculate: **a** the amount (in mol) of HCl added initially **b** the amount (in mol) of NaOH used in the titration **c** the amount (in mol) of unreacted HCl **d** the amount (in mol) of HCl reacting with the $CaCO_3$ **e** the amount (in mol) of $CaCO_3$ in the marble sample **f** the mass (in g) of $CaCO_3$ in the marble sample **g** the percentage by mass of $CaCO_3$ in the marble sample.	

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No.	Question	Answer
3	The sodium hydroxide solution used was recently standardised. Why is sodium hydroxide unsuitable as a primary standard?	
4	Why was it necessary to drive off the evolved carbon dioxide before performing the titration? How would the result be affected if this step was omitted?	
5	Why was it necessary to use a back titration for this analysis, rather than a direct titration of the marble with HCl solution?	
6	How would each of the following errors, if made during the analysis, alter the calculated value for the percentage $CaCO_3$? **a** The 40.0 mL pipette used to deliver the HCl was rinsed only with water prior to its use. **b** The burette was rinsed only with water prior to its use. **c** The volumetric flask was rinsed only with water prior to its use.	
7	An alternative method of analysis involves reacting the crushed marble with excess HCl and collecting the evolved carbon dioxide. In one such experiment, 95.0 mL of gas was collected at a pressure of 765 mmHg at 23°C when 0.411 g of marble was reacted. Determine the percentage by mass of $CaCO_3$ in the marble sample, based on this data.	

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No.	Question	Answer
8	Suggest reasons why the value obtained by this method is smaller than that obtained using the back titration.	