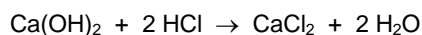


# GENERAL CALCULATIONS 1

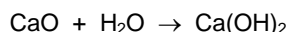
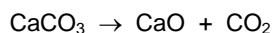
Name ..... Form .....



- 1) A tank contained 4 m<sup>3</sup> of waste hydrochloric acid. It was decided to neutralise the acid by adding slaked lime, Ca(OH)<sub>2</sub>.
- a) The concentration of the acid was first determined by titration of a 25.0 cm<sup>3</sup> sample against 0.121 M sodium hydroxide of which 32.4 cm<sup>3</sup> were required.
- Calculate the molarity of the hydrochloric acid in the sample.
  - Calculate the total number of moles of HCl in the tank. (4)
- b) Calculate the mass, in kg, of slaked lime required to neutralise the acid. Slaked lime reacts with hydrochloric acid according to the equation shown below. (3)



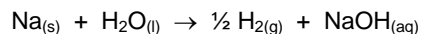
- c) The slaked lime was manufactured by roasting lime and then adding water.



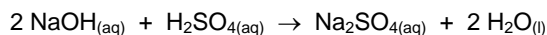
Calculate the mass of limestone which is required to produce 1 kg of slaked lime. (2)

(Ch01 Spring 1996)

- 2) a) When 0.25 g of sodium metal was added to 200 cm<sup>3</sup> (an excess) of water, the following reaction occurred.



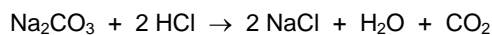
- Calculate the number of moles of sodium taking part in the reaction.
  - Calculate the molarity of the sodium hydroxide solution which was formed.
  - Calculate the volume of hydrogen gas produced at 300 K and 100 kPa. Assume that hydrogen is insoluble in water under these conditions. (6)
- b) In another experiment, 25.0 cm<sup>3</sup> of 0.183 M sodium hydroxide were neutralised by 13.7 cm<sup>3</sup> of sulphuric acid according to the following equation.



Calculate the molarity of the sulphuric acid. (3)

(Ch01 Spring 1997)

- 3) A solid sample of hydrated sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>·xH<sub>2</sub>O) contained an unknown amount of water of crystallisation. The sample (2.995 g) was dissolved in water and made up to exactly 250 cm<sup>3</sup> of solution. When 25.0 cm<sup>3</sup> of this solution was titrated against 0.113 M hydrochloric acid, 21.2 cm<sup>3</sup> of the acid was required for complete neutralisation.

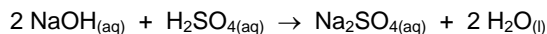


Calculate the mass of sodium carbonate in the original sample and hence the value of x. (7)

(Ch01 Summer 1996)

- 4) 50 kg of pure sulphuric acid were accidentally released into a lake when a storage vessel leaked. Two methods were proposed to neutralise it.

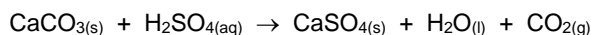
- a) The first proposal was to add a solution of 5 M NaOH to the lake. Sodium hydroxide reacts with sulphuric acid as follows.



Calculate the volume of 5 M NaOH required to neutralise the sulphuric acid by answering the following questions.

- i) How many moles of sulphuric acid are there in 50 kg of the acid?  
ii) How many moles of sodium hydroxide are required to neutralise this acid?  
iii) Calculate the volume, in  $\text{dm}^3$ , of 5 M NaOH which contains this number of moles. (4)

- b) The second proposal was to add powdered calcium carbonate, which reacts as follows.

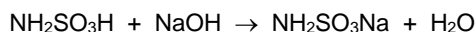


Calculate the mass of calcium carbonate required to neutralise 50 kg of sulphuric acid. (3)

- c) Suggest **two** reasons why the addition of calcium carbonate is the preferred method in practice. (2)

(Ch01 Spring 1995)

- 5) a) Sulphamic acid reacts with sodium hydroxide according to the following equation:



A standard solution of sulphamic acid was made by dissolving 5.210 g of the acid in water and making the volume up to exactly  $250 \text{ cm}^3$  with more water.

- i) Calculate the number of moles of acid used and the molarity of the acid solution.  
ii) In a titration,  $22.6 \text{ cm}^3$  of this acid solution were required to neutralise  $25.0 \text{ cm}^3$  of sodium hydroxide solution. Calculate the molarity of the sodium hydroxide solution. (5)

- b) In a separate experiment, sodium hydroxide was used to prepare a sample of Glauber's salt,  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ , by neutralisation with sulphuric acid followed by recrystallisation from aqueous solution. Calculate the maximum mass of Glauber's salt which could be made from 5.0 g of sodium hydroxide. (4)
- $$\text{H}_2\text{SO}_4 + 2 \text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2 \text{H}_2\text{O}$$

(Ch01 Summer 1995)

- 6) a) Give the meaning of the term *empirical formula*. (1)

- b) If the empirical formula of a compound is known, what additional piece of information is required in order to determine its molecular formula? (1)

- c) A compound contains 20.2 % by mass of phosphorus, 10.4% by mass of oxygen and 69.4% by mass of chlorine. Calculate its empirical formula. (3)

(Ch01 Summer 1996)