Worksheet 8.1

Acid–base titrations

NAME: **CLASS:**

INTRODUCTION

Probably the most used analytical procedure of old is the acid–base titration. The calculations involved use the same stoichiometry procedures encountered earlier in your studies. There are certain practical steps necessary, however, to ensure accurate results. These involve the choice of indicators, choice of liquids for rinsing glassware and the correct preparation of standard solutions.

No.	Question	Answer
1	Explain the steps required to prepare 250 mL of a standard solution of 0.0500 mol L^{-1} sodium carbonate, using anhydrous Na_2CO_3.	
2	20 mL of 0.10 mol L^{-1} nitric acid, HNO_3, sits in a flask. Several drops of indicator are added to the flask. When sodium hydroxide solution, NaOH, of an unknown concentration is added dropwise into the flask, there is a colour change after 5 drops of sodium hydroxide has been added. What conclusion can you draw about the concentration of the sodium hydroxide?	
3	20 mL of 0.1 mol L^{-1} nitric acid sits in a flask. Indicator is added. When sodium hydroxide is added, a colour change occurs after exactly 5 mL of sodium hydroxide has been added. Without calculating any mole quantities, what must the concentration of the sodium hydroxide be? Can you use this ratio technique to solve all titration calculations?	

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4	**a** Write a balanced equation for the reaction between solutions of sodium carbonate, Na_2CO_3, and nitric acid. **b** What volume of 0.20 mol L^{-1} sodium carbonate is required to neutralise 40 mL of 0.10 mol L^{-1} nitric acid?	
5	**a** Write a balanced equation for the reaction between solutions of ammonia, NH_3, and hydrochloric acid, HCl. **b** A solution of 0.1 mol L^{-1} ammonia in a flask is to be titrated with 0.1 mol L^{-1} hydrochloric acid. Ammonia is a weak base. The approximate pH of the ammonia solution before the titration begins is 11. **i** What do you think the pH of the solution in the flask will be at the equivalence point? (Hint: Look at the products of the reaction.) **ii** After significant extra hydrochloric acid has been added, what will the approximate pH be? **iii** Sketch the pH curve for this titration.	
6	A 25.0 mL sample of ethanoic acid is diluted to 100.0 mL. A 20.00 mL aliquot is then titrated with 0.114 mol L^{-1} sodium hydroxide. The titre required is 15.45 mL. Calculate the concentration of the original ethanoic acid solution.	

No.	Question	Answer
7	Suggest two reasons why an indirect (back) titration might be performed, rather than a direct titration.	
8	**a** Draw a pH curve for the addition of 0.1 mol L^{-1} acetic acid, CH_3COOH, to 0.1 mol L^{-1} sodium hydroxide, NaOH. **b** What will be the approximate pH at the equivalence point? **c** Use your curve to explain why an indicator such as methyl red would be a poor choice for this titration.	
9	10.0 mL of hydrochloric acid is added to a 250 mL volumetric flask. The flask is made up to the mark and 20.0 mL aliquots of this solution are added to conical flasks for titration with 0.100 mol L^{-1} sodium carbonate from a burette. **a** State which liquid should be used to rinse each of the following items. **i** Volumetric flask **ii** Pipette **iii** Burette **iv** Conical flasks **b** The average titre of sodium carbonate is 18.3 mL. Calculate the concentration of the original HCl used.	

No.	Question	Answer
10	A 0.10 mol L^{-1} magnesium hydroxide, $Mg(OH)_2$, solution is used to find the concentration of a solution of nitric acid. An aliquot of 25.0 mL of magnesium hydroxide is added to a flask. The volume of nitric acid required to neutralise it is 13.5 mL. Calculate the concentration of the nitric acid solution.	