Experiment worksheet

4.2 Acid reactions depend on strength and concentration

Pages 92–93 and 203

Experiment 4.2: Acid titrations

Aim

To compare the reactions of a strong acid, hydrochloric acid, and a weak acid, ethanoic acid, (common name acetic acid).

Materials

- Dropper bottles containing:
  - 0.1 M hydrochloric acid (HCl)
  - 0.1 M ethanoic acid (acetic acid) (CH_3COOH)
  - 0.1 M sodium hydroxide (NaOH)
  - 1 M hydrochloric acid (HCl
  - 1 M ethanoic acid (acetic acid) (CH_3COOH)
  - universal indicator solution
- pH colour chart
- Small pieces of magnesium ribbon
- 4 test tubes and test-tube rack
- Dropping pipette
- Matches

CAUTION: Wear a laboratory coat, gloves and safety glasses throughout this experiment. Most of the substances used in this experiment need to be handled with care.

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Method

PART A

1 Draw up a table to record each test and the results for each acid.

2 Place 2 mL of 0.1 M hydrochloric acid in one test tube and add 2 drops of universal indicator solution. Record the colour of the indicator and the corresponding pH from the colour chart.

3 Repeat step 2 with 0.1 M ethanoic acid, using a fresh test tube.

4 To the first test tube add 0.1 M sodium hydroxide drop by drop, counting the drops, until the solution is neutral (i.e. pH = 7).

5 Repeat step 4 with ethanoic acid.

PART B

1 Add 2 mL of 1 M hydrochloric acid to a fresh test tube.

2 Add a small piece of magnesium ribbon to the test tube and invert a clean test tube over the top so there is only a small gap between the test tubes.

3 Record your observations.

4 Lightly touch the base of the bottom test tube. Record your observations of the temperature of the mixture.

5 When the reaction has ceased, light a match and hold it just inside the inverted test tube. Do you hear a loud popping sound? This is evidence of hydrogen gas being produced.

6 Repeat steps 1–6 with 2 mL of 1 M ethanoic acid.

Results

Record your results in an appropriate table.

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Discussion

1 When you tested the pH of the two acids, you used the same concentration (0.1 M).

a Why were they compared at the same concentration?

b Why did they have a different pH?

c What can be concluded about the strength of ethanoic acid compared with the strength of hydrochloric acid?

2 Compare the number of drops of sodium hydroxide used to neutralise each acid. Is this what you expected? Explain using your results.

3 Write a balanced equation for each neutralisation reaction.

4 The pop test is the standard test for hydrogen gas. The 'pop' sound is a mini-explosion due to the combustion of hydrogen gas in air, which is a very exothermic (heat producing) reaction.

The equation for the reaction is: $2H_2(g) + O_2(g) \rightarrow 2H_2O(l) + \text{energy}$

a Did your tests confirm that hydrogen gas was produced?

b Was there a difference in how fast the reactions with the two different acids occurred? If so, suggest why.

5 Write a balance chemical equation for the reaction between the two acids and the magnesium ribbon.

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Conclusion

1 What do you know about neutralisation reactions?

2 What do you know about reactions between metals and acids?

3 What do you know about the difference between strength and concentration of acids?

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