Distribution of 2-hydroxybenzoic acid between water and an organic solvent

Teacher and technician sheet

Health and safety note

Make sure that students wear eye protection and that there are no naked flames. 10% v/v ethyl ethanoate in hexane is highly flammable and harmful.

Equipment and materials

Each student or group of students will require:

Distribution

- Organic solvent (10% v/v ethyl ethanoate in hexane) − Highly flammable, Harmful
- Range of buffer solutions, each containing 0.2 g dm^{-3} 2-hydroxybenzoic acid

  pH's of buffer solutions: 1.0, 1.6, 2.3, 2.8, 3.2, 4.0, 4.5, 5.1
- Boiling tube with stopper x 8
- 5 cm^3 measuring cylinder x 2

Colorimetric analysis

- Colorimeter and suitable filter (green/yellow)
- 2 cm^3 pipette
- 5 cm^3 measuring cylinder x 2
- 10 cm^3 measuring cylinder
- 0.025 mol dm^{-3} iron(III) nitrate solution

Since many measurements need to be made, students could work in groups, sharing the workload.

Preparation of solutions

2-hydroxybenzoic acid buffered solutions Weigh 0.100 g of 2-hydroxybenzoic acid (Harmful) into a 100 cm^3 beaker. Add 5 cm^3 of 95% ethanol (Highly flammable, Harmful) and swirl the contents of the beaker to dissolve the solid. Add 20 cm^3 of the buffer solution and swirl the beaker again to mix the contents. Transfer quantitatively to a 500 cm^3 volumetric flask and make up to volume with buffer solution. The concentration of this solution is 0.2 g dm^{-3} 2-hydroxybenzoic acid.

0.025 mol dm^{-3} iron(III) nitrate solution Weigh 10 g iron(III) nitrate-9-water (Oxidising, Irritant) into a 250 cm^3 beaker. Add about 50 cm^3 of deionised water and swirl the flask until the solid dissolves. Transfer quantitatively to a 1 dm^3 measuring cylinder and make up to volume with deionised water. Mix thoroughly.

Buffer solutions[1]

Commercially-available buffer tablets may also be used. However, if they are not to make buffer solutions at a range of pH values you will need:

- 100 cm^3 measuring cylinders (number depends on which buffer solutions are being made), pH probe and meter.

[1] P. S. Marrs, *Journal of Chemical Education,* 2004, **81**, 870.

- 0.02 mol dm^{-3} solutions of: hydrochloric acid; potassium chloride (14.9 g in 1 dm^3 of deionised water); ethanoic acid (12.0 g glacial ethanoic acid (Corrosive) in 1 dm^3 of deionised water); sodium hydroxide (8 g sodium hydroxide (Corrosive) in 1 dm^3 of deionised water).

Volumes of component solutions (each 0.02 mol dm^{-3}) used to make 100 cm^3 of buffer.

HCl	KCl	CH_3COOH	NaOH	H_2O	pH of buffer solution
75	25				1.0
10	25			65	1.6
2	25			75	2.3
		100			2.8
		10		90	3.2
		50	10	40	4.0
		50	25	25	4.5
		50	40	10	5.1

In each case the pH value is approximate and the actual value should be measured using a pH probe and meter.