Rate of permeation of paracetamol through cellulose tubing

Teacher and technician sheet

Health and safety note

Make sure that students wear eye protection. 5 mol dm^{-3} hydrochloric acid is irritant.

Equipment and materials

Each student or pair of students will require:

For the permeation

- 15 cm length of cellulose tubing knotted at one end (twist twice, fold over and tie with cotton thread)
- Sawn-off plastic syringe barrel to support the cellulose tubing (figure 1 – student sheet)
- Elastic band
- 400 cm^3 beaker
- 1 cm^3 pipette (or plastic syringe)
- Paddle stirrer
- 0.05 mol dm^{-3} paracetamol in buffer solution

For the colorimetric analysis

- Calibration graph for the colorimetric determination of paracetamol (see *Colorimetric analysis of paracetamol*)
- Colorimeter and suitable filter
- Boiling tubes (x7)
- 0.02 mol dm^{-3} iron(III) chloride solution
- 0.002 mol dm^{-3} potassium hexacyanoferrate(III) solution
- 5 mol dm^{-3} hydrochloric acid − Irritant
- 5 cm^3 graduated pipette (or plastic syringe) (x3)

Preparation of solutions

0.05 mol dm^{-3} paracetamol Weigh out 0.75 g paracetamol (Harmful) and transfer quantitatively to a 1 dm^3 volumetric flask. Add about 250 cm^3 of deionised water and swirl the flask to dissolve the solid. Make up to the mark with deionised water.

0.02 mol dm^{-3} iron(III) chloride solution Weigh out 5.44 g iron(III) chloride-6-water (Harmful) and transfer quantitatively to a 1 dm^3 volumetric flask. Add about 100 cm^3 and swirl the flask to dissolve the solid. Now add 3 cm^3 of concentrated hydrochloric acid (Corrosive) and 10 g of potassium chloride. Again swirl the contents of the flask to dissolve the potassium chloride before making up to the mark with deionised water.

0.002 mol dm^{-3} potassium hexacyanoferrate(III) solution Weigh out 0.66 g potassium hexacyanoferrate(III) and transfer quantitatively to a 1 dm^3 volumetric flask. Add about 100 cm^3 and swirl the flask to dissolve the solid. Make up to the mark with deionised water.

Buffer solution

It is suggested that a buffer of pH 1.6 is used as this pH is typical on conditions found in the stomach. Other buffers may be used to compare the permeability at pH values found in other parts of the gastrointestinal tract.

For 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

and depending on the buffer being made:

- 0.02 mol dm^{-3} hydrochloric acid
- 0.02 mol dm^{-3} potassium chloride solution (14.9 g in 1 dm^3 of deionised water)
- 0.02 mol dm^{-3} ethanoic acid (12.0 g glacial ethanoic acid (Corrosive) in 1 dm^3 of deionised water)
- 0.02 mol dm^{-3} potassium dihydrogenphosphate solution (27.2 g in 1 dm^3 of deionised water)
- 0.02 mol dm^{-3} boric acid (12.4 g in 1 dm^3 of deionised water)
- 0.02 mol dm^{-3} sodium hydroxide solution (8 g sodium hydroxide (Corrosive) in 1 dm^3 of deionised water)

Some buffer recipes[1]

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

HCl	KCl	CH_3COOH	KH_2PO_4	H_3BO_3	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
		50			48	2	5.9
			50		10	40	6.2
			50		25	25	6.7
			50		40	10	7.2
			50		50		8.1
				50	10	40	8.6
				50	25	25	9.2
				50	35	15	9.6
				50	42	10	10.1
				50	50		10.6

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

Commercially-available buffer tablets may also be used.

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