Table G.6 Isotonic borate buffer

0.2 M boric acid: 1.24% boric acid in aqueous solution ($FD_{1\%}$ = 0.288 °C).

0.05 M borax: 1.91% borax in aqueous solution ($FD_{1\%}$ = 0.241 °C).

To obtain a solution with a particular pH value, these solutions are mixed in the proportions shown below, and to make the solution isotonic the specified amount of sodium chloride is added, as shown.

0.2 M boric acid (mL)	0.05 M borax (mL)	NaCl (g)	pH value at 25 °C	pH value at 37 °C
97	3	0.27	6.8	6.8
94	6	0.27	7.1	7.1
90	10	0.27	7.4	7.4
85	15	0.26	7.6	7.6
80	20	0.26	7.9	7.8
70	30	0.24	8.1	8.1
65	35	0.23	8.2	8.2
55	45	0.21	8.4	8.4
45	55	0.19	8.6	8.5
40	60	0.18	8.7	8.6
30	70	0.14	8.8	8.7
20	80	0.11	9.0	8.9
10	90	0.07	9.1	9.0

Table G.7 Isotonic citrate buffer

1.1% citric acid monohydrate in aqueous solution ($FD_{1\%}$ = 0.098 °C).

1.5% sodium citrate in aqueous solution ($FD_{1\%}$ = 0.178 °C).

To obtain a solution with a particular pH value, these solutions are mixed in the proportions shown below, and to make the solution isotonic the specified amount of sodium chloride is added, as shown.

1.1% citric acid monohydrate (mL)	1.5% sodium citrate (mL)	NaCl (g)	pH value at 37 °C
32.1	67.9	0.54	5.0
29.7	70.3	0.53	5.1
24.5	75.5	0.51	5.3
17.8	82.2	0.49	5.6
10.7	89.3	0.48	5.9
6.2	93.8	0.47	6.2
3.2	96.8	0.46	6.5

Table G.8 McIlvaine universal citrate–phosphate buffer

'Universal' buffers contain two or more buffer systems and give a buffering action over a relatively wide range of pH values. Their buffering capacity is lower than that of the general buffers at the same concentration. The citrate–phosphate buffer system (McIlvaine) covers the range from pH 2.2 to pH 8.0.

To obtain a solution with a particular pH value, the following amounts of sodium phosphate ($Na_2HPO_4.12H_2O$) and citric acid ($C_6H_8O_7.H_2O$) are added to 1 litre of water.

pH	$Na_2HPO_4.1\ 2H_2O$ (g/L)	$C_6H_80_7.H_2O$ (g/L)
2.2	1.4	20.6
2.4	4.4	19.7
2.6	7.8	18.7
2.8	11.4	17.7
3.0	14.7	16.7
3.2	17.7	15.8
3.4	20.4	15.0
3.6	23.1	14.2
3.8	25.4	13.6
4.0	27.6	12.9
4.2	29.7	12.3
4.4	31.6	11.7
4.6	33.5	11.2
4.8	35.3	10.7
5.0	36.9	10.2
5.2	38.4	9.7
5.4	39.9	9.3
5.6	41.5	8.8
5.8	43.3	8.3
6.0	45.2	7.7
6.2	47.3	7.1
6.4	49.6	6.5
6.6	52.1	5.7
6.8	55.3	4.8
7.0	59.0	3.7
7.2	62.3	2.7
7.4	65.1	1.9
7.6	67.1	1.3
7.8	68.6	0.9
8.0	69.7	0.58

References

1. Lund W, ed. The pharmaceutical codex. 12th edn. London: The Pharmaceutical Press, 1994;67–9.