THE MERCK INDEX

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TWELFTH EDITION

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AN ENCYCLOPEDIA OF
CHEMICALS, DRUGS, AND BIOLOGICALS

TWELFTH EDITION

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Published by
Merck Research Laboratories
Division of

MERCK & CO., INC.

Whitehouse Station, NJ

1996

values in degrees Celsius. The percentage concentration (w/v) at isotonicity is given in bold face in the last column.

Using the freezing point depression method an isotonic solution is prepared by matching the freezing point depression value of 0.9% NaCl which is accepted as 0.52. Freezing point depression values are additive in this concentration range; therefore, to make a 2% Hepes buffer solution isotonic with tears, the calculation is as follows:

Freezing point depression of isotonic solution	0.52
Freezing point depression of 2% Hepes from table	0.163
Difference to be supplied by NaCl	0.357

0.9% NaCl has a freezing point depression of 0.52,
x% NaCl has a freezing point depression of 0.357.

Therefore $x/0.9 = 0.357/0.52$

$x = 0.618$

Thus 0.618 g/100ml NaCl combined with 2 g/100ml Hepes produces an isotonic solution. Note: If more than one component is in solution the freezing point depressions of each must be added together before the difference value is obtained.

Using the NaCl equivalents method to prepare a solution involves: Multiplying the number of grams of each component corrected for volume by its NaCl equivalent from the table at the nearest listed concentration. For example to make 60 ml of 1% boric acid isotonic: Add the NaCl equivalents of each solution component.

60 ml of 1% boric acid soln (0.6g boric acid x 0.5g NaCl equiv.) = 0.3g

Calculate the number of grams of NaCl required for the volume being used. (60 ml need 0.54 g) Subtract the NaCl equivalents of the components from the total NaCl required. (0.54 - 0.3 = 0.24g) The difference is the amount of NaCl which must be added to that specific volume. Note: If the difference is less than zero then the solution is already hypertonic and cannot be adjusted without altering the concentration of the components.

Sodium Chloride Equivalents and Freezing Point Depressions (°C)
for Certain Concentrations (w/v) of Solution

Chemical	Concentration of Solution, NaCl Equivalents						
	0.5%	1%	2%	3%	5%	At Isosmotic Concentration	
Acetrizoate methylglucam	0.09 *0.024°*	0.08 *0.04°*	0.08 *0.09°*	0.08 *0.13°*	0.08 *0.22°*	0.07 *0.52°*	**12.12%** **12.12%**
Acetrizoate sodium	0.10 *0.027°*	0.10 *0.05°*	0.10 *0.10°*	0.10 *0.16°*	0.10 *0.27°*	0.09 *0.52°*	**9.64%** **9.64%**
Acetylcysteine	0.20 *0.055°*	0.20 *0.11°*	0.20 *0.22°*	0.20 *0.34°*	— —	0.20 *0.52°*	**4.58%** **4.58%**
Acetylsulfanilamide sodium	0.24 *0.066°*	0.23 *0.13°*	0.23 *0.26°*	0.23 *0.40°*	— —	0.23 *0.52°*	**3.85%** **3.85%**
Acriflavine	0.10 *0.025°*	0.10 *0.05°*	0.09 *0.10°*	0.09 *0.15°*	— —	— —	
Adenosine phosphate	0.50 *0.140°*	0.41 *0.23°*	— —	— —	— —	— —	
Adrenalone hydrochloride	0.30 *0.086°*	0.27 *0.15°*	0.24 *0.27°*	0.22 *0.38°*	— —	0.21 *0.52°*	**4.24%** **4.24%**
Alcohol	0.65 *0.188°*	0.65 *0.37°*	— —	— —	— —	0.65 *0.52°*	**1.39%** **1.39%**
Alcohol, dehydrate	0.70 *0.203°*	0.70 *0.40°*	— —	— —	— —	0.70 *0.52°*	**1.28%** **1.28%**
Alum, potassium	0.20 *0.054°*	0.18 *0.10°*	0.16 *0.18°*	0.15 *0.26°*	0.15 *0.41°*	0.14 *0.52°*	**6.35%** **6.35%**
Aminacrine hydrochloride	0.20 *0.052°*	0.17 *0.09°*	— —	— —	— —	— —	
Aminoacetic acid	0.42 *0.119°*	0.41 *0.23°*	0.41 *0.47°*	— —	— —	0.41 *0.52°*	**2.20%** **2.20%**
Aminocaproic acid	0.26 *0.075°*	0.26 *0.14°*	0.26 *0.29°*	0.26 *0.44°*	— —	0.26 *0.52°*	**3.52%** **3.52%**

Chemical							
p-Aminohippuric acid	0.13 0.035°	0.13 0.07°	— —	— —	— —	— —	
p-Aminosalicylate sodium	0.30 0.086°	0.29 0.16°	0.29 0.32°	0.28 0.47°	— —	0.27 0.52°	3.27% 3.27%
Ammonium carbonate	0.70 0.202°	0.70 0.40°	— —	— —	— —	0.70 0.52°	1.29% 1.29%
Ammonium chloride	1.10 0.315°	— —	— —	— —	— —	1.07 0.52°	0.84% 0.84%
Ammonium lactate	0.33 0.093°	0.33 0.18°	0.33 0.37°	— —	— —	0.33 0.52°	2.76% 2.76%
Ammonium nitrate	0.69 0.200°	0.69 0.40°	— —	— —	— —	0.69 0.52	1.30% 1.30%
Ammonium phosphate, dibasic	0.58 0.165°	0.55 0.31°	— —	— —	— —	0.51 0.52°	1.76% 1.76%
Ammonium sulfate	0.55 0.158°	0.55 0.31°	— —	— —	— —	0.54 0.52°	1.68% 1.68%
Antimony potassium tartrate	0.22 0.065°	0.18 0.10°	0.15 0.17°	0.13 0.23°	0.10 0.33°	— —	
Antipyrine	0.18 0.050°	0.17 0.09°	0.16 0.17°	0.14 0.25°	0.14 0.39°	0.13 0.52°	6.81% 6.81%
Arecoline hydrobromide	0.030 0.084°	0.27 0.15°	0.25 0.28°	0.24 0.41°	— —	0.23 0.52°	3.88% 3.88%
Arginine glutamate	0.17 0.048°	0.17 0.09°	0.17 0.19°	0.17 0.29°	0.17 0.48°	0.17 0.52°	5.37% 5.37%
L-Arginine hydrochloride	0.31 0.087°	0.30 0.17°	0.28 0.32°	0.27 0.46°	— —	0.26 0.52°	3.43% 3.43%
Arsenic trioxide	0.30 0.085°	0.30 0.16°	— —	— —	— —	— —	
Ascorbic acid	0.20 0.053°	0.18 0.10°	0.18 0.20°	0.18 0.31°	0.18 0.51°	0.18 0.52°	5.94% 5.94%
Atropine methylnitrate	0.20 0.055°	0.18 0.10°	0.16 0.18°	0.15 0.26°	0.14 0.41°	0.14 0.52°	6.52% 6.52%
Atropine sulfate	0.14 0.039°	0.13 0.07°	0.12 0.13°	0.11 0.19°	0.11 0.31°	0.10 0.52°	8.85% 8.85%
Aurothioglucose	0.03 0.007°	0.03 0.01°	0.03 0.02°	0.03 0.04°	0.03 0.07°	— —	
Barbital sodium	0.32 0.087°	0.30 0.17°	0.29 0.33°	0.29 0.50°	— —	0.29 0.52°	3.12% 3.12%
Benzalkonium chloride	0.18 0.048°	0.16 0.09°	0.15 0.17°	0.14 0.24°	0.13 0.38°	— —	
Benzethonium chloride	0.08 0.022°	0.05 0.02°	0.03 0.03°	0.02 0.04°	0.02 0.05°	— —	
Benzyl alcohol	0.18 0.049°	0.17 0.09°	0.16 0.18°	0.15 0.26°	— —	— —	
Bismuth potassium tartrate	0.10 0.033°	0.09 0.05°	0.07 0.08°	0.06 0.10°	0.05 0.14°	— —	
Bismuth sodium tartrate	0.14 0.041°	0.13 0.07°	0.13 0.13°	0.12 0.19°	0.11 0.31°	0.10 0.52°	8.91% 8.91%

Boric acid	0.32 *0.146°*	0.30 *0.28°*	— —	— —	— —	0.47 *0.52°*	1.9% 1.9%
Bromodiphenhydramine hydrochloride	0.20 *0.067°*	0.17 *0.10°*	0.14 *0.16°*	0.10 *0.18°*	0.07 *0.20°*	— —	
Butabarbital sodium	0.27 *0.078°*	0.27 *0.15°*	0.27 *0.31°*	0.27 *0.47°*	— —	0.27 *0.52°*	3.33% 3.33%
Caffeine	0.08 *0.025°*	0.08 *0.04°*	— —	— —	— —	— —	
Calcium aminosalicylate	0.30 *0.091°*	0.27 *0.15°*	0.23 *0.26°*	0.21 *0.36°*	— —	— —	
Calcium chloride dihydrate	0.50 *0.145°*	0.51 *0.29°*	— —	— —	— —	0.53 *0.52°*	1.70% 1.70%
Calcium chloride hexahydrate	0.34 *0.097°*	0.35 *0.20°*	0.36 *0.41°*	— —	— —	0.36 *0.52°*	2.5% 2.5%
Calcium chloride, anhydrous	0.70 *0.206°*	0.70 *0.40°*	— —	— —	— —	0.70 *0.52°*	1.29% 1.29%
Calcium disodium edetate	0.21 *0.061°*	0.21 *0.12°*	0.21 *0.24°*	0.20 *0.35°*	— —	0.20 *0.52°*	4.50% 4.50%
Calcium gluconate	0.18 *0.050°*	0.16 *0.09°*	0.15 *0.16°*	0.14 *0.23°*	— —	— —	
Calcium lactate	0.26 *0.073°*	0.23 *0.13°*	0.22 *0.25°*	0.21 *0.37°*	— —	0.20 *0.52°*	4.5% 4.5%
Chiniofon	0.14 *0.039°*	0.13 *0.07°*	0.12 *0.13°*	0.11 *0.20°*	— —	— —	
Chloramine-T	0.24 *0.064°*	0.23 *0.12°*	0.22 *0.25°*	0.22 *0.38°*	— —	0.22 *0.52°*	4.1% 4.1%
Chlorobutanol, hydrated	0.24 *0.071°*	— —	— —	— —	— —	— —	— —
Chlorophyll	0.14 *0.037°*	0.10 *0.05°*	0.08 *0.08°*	0.06 *0.11°*	0.05 *0.15°*	— —	
Citric acid	0.18 *0.050°*	0.18 *0.09°*	0.17 *0.19°*	0.17 *0.28°*	0.16 *0.47°*	0.16 *0.52°*	5.52% 5.52%
Congo red	0.05 *0.015°*	0.05 *0.03°*	0.05 *0.05°*	0.05 *0.09°*	0.05 *0.15°*	— —	
Cromolyn sodium	0.16 *0.046°*	0.14 *0.08°*	0.11 *0.12°*	0.09 *0.14°*	0.05 *0.15°*		
Cupric sulfate	0.20 *0.054°*	0.18 *0.09°*	0.16 *0.17°*	0.15 *0.25°*	0.14 *0.39°*	0.13 *0.52°*	6.85% 6.85%
Cupric sulfate, anhydrous	0.30 *0.084°*	0.27 *0.15°*	0.25 *0.28°*	0.23 *0.39°*	— —	0.22 *0.52°*	4.09% 4.09%
Cyclophosphamide	0.10 *0.031°*	0.10 *0.06°*	0.10 *0.12°*	— —	— —	— —	
Dextrose	0.16 *0.045°*	0.16 *0.09°*	0.16 *0.18°*	0.16 *0.27°*	0.16 *0.47°*	0.16 *0.52°*	5.51% 5.51%
Dextrose, anhydrous	0.18 *0.050°*	0.18 *0.10°*	0.18 *0.20°*	0.18 *0.31°*	0.18 *0.51°*	0.18 *0.52°*	5.05% 5.05%
Diatrizoate sodium	0.10 *0.025°*	0.09 *0.04°*	0.09 *0.09°*	0.09 *0.14°*	0.09 *0.24°*	0.09 *0.52°*	10.55% 10.55%

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