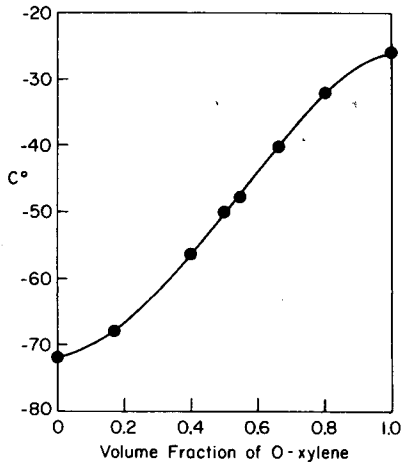
C. Low-Temperature Baths

Two types of systems are shown in this table. One involves pouring liquid nitrogen (bp 196°) into a solvent by stirring until a slush is formed. The temperature may be maintained by periodically adding nitrogen to maintain the slush. These data are taken from R. E. Randeau, J. Chem. Eng. Data, 11, 124 (1966). The second system involves addition of small lumps of dry ice to the solvent until a slight excess of dry ice coated with frozen solvent remains. Again, temperature may be maintained by periodically adding more dry ice. These data are taken for the most part from A. M. Phipps and D. N. Hume, J. Chem. Educ., 45, 664 (1968). The latter reference describes the use of the dry ice method in mixtures of ortho and meta xylene of varying composition. Their plot of temperature versus volume fraction of o-xylene is reproduced at the end of this table.

System	°C	System	°C
p-Xylene/N_2	13	Carbitol acetate/CO_2	-67
p-Dioxane/N_2	12	t-Butyl amine/N_2	-68
Cyclohexane/N_2	6	Ethanol/CO_2	-72
Benzene/N_2	5	Trichloroethylene/N_2	-73
Formamide/N_2	2	Butyl acetate/N_2	-77
Aniline/N_2	-6	Acetone/CO_2	-77
Cycloheptane/N_2	-12	Isoamyl acetate/N_2	-79
Benzonitrile/N_2	-13	Acrylonitrile/N_2	-82
Ethylene glycol/CO_2	-15	Sulfur dioxide/CO_2	-82
o-Dichlorobenzene/N_2	-18	Ethyl acetate/N_2	-84
Tetrachloroethane/N_2	-22	Ethyl methyl ketone/N_2	-86
Carbon tetrachloride/N_2	-23	Acrolein/N_2	-88
Carbon tetrachloride/CO_2	-23	Nitroethane/N_2	-90
m-Dichlorobenzene/N_2	-25	Heptane/N_2	-91
Nitromethane/N_2	-29	Cyclopentane/N_2	-93
o-Xylene/N_2	-29	Hexane/N_2	-94
Bromobenzene/N_2	-30	Toluene/N_2	-95
Iodobenzene/N_2	-31	Methanol/N_2	-98
Thiophene/N_2	-38	Diethyl ether/CO_2	-100
3-Heptanone/CO_2	-38	n-Propyl iodide/N_2	-101
Acetonitrile/N_2	-41	n-Butyl iodide/N_2	-103
Pyridine/N_2	-42	Cyclohexene/N_2	-104
Acetonitrile/CO_2	-42	Isooctane/N_2	-107
Chlorobenzene/N_2	-45	Ethyl iodide/N_2	-109
Cyclohexanone/CO_2	-46	Carbon disulfide/N_2	-110
m-Xylene/N_2	-47	Butyl bromide/N_2	-112
n-Butyl amine/N_2	-50	Ethyl bromide/N_2	-119
Diethyl carbitol/CO_2	-52	Acetaldehyde/N_2	-124
n-Octane/N_2	-56	Methyl cyclohexane/N_2	-126
Chloroform/CO_2	-61(-77)	n-Pentane/N_2	-131
Chloroform/N_2	-63	1,5-Hexadiene/N_2	-141
Methyl iodide/N_2	-66	i-Pentane/N_2	-160



Steady state temperature of dry-ice—o-xylene, *m*-xylene mixtures.

D. Salt-Ice Cooling Mixtures

This table lists salt/ice cooling mixtures that can be obtained by mixing the salt (at about room temperature) with water or ice at the specified temperature in the amount noted. In actual practice, these temperatures are often difficult to reach and may depend on rate of stirring and on how finely crushed the ice is.

Substance	Initial Temperature (°C)	g/100g H_2O	Final Temperature (°C)
Na_2CO_3	-1 (ice)	20	-2.0
NH_4NO_3	20	106	-4.0
$NaC_2H_3O_2$	10.7	85	-4.7
NH_4Cl	13.3	30	-5.1
$NaNO_3$	13.2	75	-5.3
$Na_2S_2O_3 \cdot 5H_2O$	10.7	110	-8.0
$CaCl_2 \cdot 6H_2O$	-1 (ice)	41	-9.0
KCl	0 (ice)	30	-10.9
KI	10.8	140	-11.7
NH_4NO_3	13.6	60	-13.6
NH_4Cl	-1 (ice)	25	-15.4
NH_4NO_3	-1 (ice)	45	-16.8
NH_4SCN	13.2	133	-18.0
NaCl	-1 (ice)	33	-21.3
$CaCl_2 \cdot 6H_2O$	0 (ice)	81	-21.5
H_2SO_4 (66.2%)	0 (ice)	23	-25
NaBr	0 (ice)	66	-28
H_2SO_4 (66.2%)	0 (ice)	40	-30
C_2H_5OH (4°)	0 (ice)	105	-30
$MgCl_2$	0 (ice)	85	-34
H_2SO_4 (66.2%)	0 (ice)	91	-37
$CaCl_2 \cdot 6H_2O$	0 (ice)	123	-40.3
$CaCl_2 \cdot 6H_2O$	0 (ice)	143	-55

Low Temperature Baths

CO_2 / Nitrogen Based[1]

System	°C	System	°C
p-xylene/N_2	13	carbitol acetate/CO_2	-67
p-dioxane/N_2	12	*t*-butyl amine/N_2	-68
cyclohexane/N_2	6	ethanol/CO_2	-72
benzene/N_2	5	trichloroethylene/N_2	-73
formamide/N_2	2	butyl acetate/N_2	-77
aniline/N_2	-6	acetone/CO_2	-77
cycloheptane/N_2	-12	isoamyl acetate/N_2	-79
benzonitrile/N_2	-13	acrylonitrile/N_2	-82
ethylene glycol/CO_2	-15	sulfur dioxide/CO_2	-82
o-dichlorobenzene/N_2	-18	ethyl acetate/N_2	-84
tetrachloroethane/N_2	-22	ethyl methyl ketone/N_2	-86
carbon tetrachloride/N_2	-23	acrolein/N_2	-88
carbon tetrachloride/CO_2	-23	nitroethane/N_2	-90
m-dichlorobenzene/N_2	-25	heptane/N_2	-91
nitromethane/N_2	-29	cyclopentane/N_2	-93
o-xylene/N_2	-29	hexane/N_2	-94
bromobenzene/N_2	-30	toluene/N_2	-95
iodobenzene/N_2	-31	methanol/N_2	-98
thiophene/N_2	-38	diethyl ether/CO_2	-100
3-heptanone/CO_2	-38	*n*-propyl iodide/N_2	-101
acetonitrile/N_2	-41	*n*-butyl iodide/N_2	-103
pyridine/N_2	-42	cyclohexene/N_2	-104
acetonitrile/CO_2	-42	isoctane/N_2	-107
chlorobenzene/N_2	-45	ethyl iodide/N_2	-109
cyclohexanone/CO_2	-46	carbon disulfide/N_2	-110
m-xylene/N_2	-47	butyl bromide/N_2	-112
n-butyl amine/N_2	-50	ethyl bromide/N_2	-119
diethyl carbitol/CO_2	-52	acetaldehyde/N_2	-124
n-octane/N_2	-56	methyl cyclohexane/N_2	-126
chloroform/CO_2	-61 (-77)	*n*-pentane/N_2	-131
chloroform/N_2	-63	1,5-hexadiene/N_2	-141
methyl iodide/N_2	-66	*i*-pentane/N_2	-160

Ice Based[2]

Substance	Initial Temperature (°C)	g of salt/100ml H_2O	Final Temperature (°C)
Na_2CO_3	-1 (ice)	20	-2.0
NH_4NO_3	20	106	-4.0
NaO_2CCH_3	10.7	85	-4.7
NH_4Cl	13.3	30	-5.1
$NaNO_3$	13.2	75	-5.3
$Na_2S_2O_3 \cdot 5H_2O$	10.7	110	-8.0
$CaCl_2 \cdot 6H_2O$	-1 (ice)	41	-9.0
KCl	0 (ice)	30	-10.9
KI	10.8	140	-11.7
NH_4NO_3	13.6	60	-13.6
NH_4Cl	-1 (ice)	25	-15.4
NH_4NO_3	-1 (ice)	45	-16.8
NH_4SCN	13.2	133	-18.0
NaCl	-1 (ice)	33	-21.3
$CaCl_2 \cdot 6H_2O$	0 (ice)	81	-21.5
H_2SO_4 (66.2%)	0 (ice)	23	-25
NaBr	0 (ice)	66	-28
H_2SO_4 (66.2%)	0 (ice)	40	-30
C_2H_5OH (4°)	0 (ice)	105	-30
$MgCl_2$	0 (ice)	85	-34
H_2SO_4 (66.2%)	0 (ice)	91	-37
$CaCl_2 \cdot 6H_2O$	0 (ice)	123	-40.3
$CaCl_2 \cdot 6H_2O$	0 (ice)	143	-55

1. Addition of liquid nitrogen to solvent with stirring to generate a slurry or addition of dry ice to solvent until a slight excess of dry ice remains. Data taken from 1966J.Chem.Eng.Data124 and 1968J.Chem.Ed664.
2. Temperature obtained after mixing the given amount of salt (at room temperature) with water or ice at the temperature indicated