Appendix B

Properties of Pure Species

Table B.1 Characteristic Properties of Pure Species

Listed here for various chemical species are values for the molar mass (molecular weight), acentric factor ω, critical temperature T_c, critical pressure P_c, critical compressibility factor Z_c, critical molar volume V_c, and normal boiling point T_n. Abstracted from Project 801, DIPPR®, Design Institute for Physical Property Data of the American Institute of Chemical Engineers, they are reproduced with permission. The current full version of this database includes values for 34 constant properties and 15 temperature-dependent thermodynamic and transport properties for more than 2200 chemical species, and new species are added regularly.

Table B.2 Constants for the Antoine Equation for Vapor Pressures of Pure Species

Table B.1: Characteristic Properties of Pure Species

	Molar mass	ω	T_c/K	P_c/bar	Z_c	V_c $cm^3 \cdot mol^{-1}$	T_n/K
Methane	16.043	0.012	190.6	45.99	0.286	98.6	111.4
Ethane	30.070	0.100	305.3	48.72	0.279	145.5	184.6
Propane	44.097	0.152	369.8	42.48	0.276	200.0	231.1
n-Butane	58.123	0.200	425.1	37.96	0.274	255.	272.7
n-Pentane	72.150	0.252	469.7	33.70	0.270	313.	309.2
n-Hexane	86.177	0.301	507.6	30.25	0.266	371.	341.9
n-Heptane	100.204	0.350	540.2	27.40	0.261	428.	371.6
n-Octane	114.231	0.400	568.7	24.90	0.256	486.	398.8
n-Nonane	128.258	0.444	594.6	22.90	0.252	544.	424.0
n-Decane	142.285	0.492	617.7	21.10	0.247	600.	447.3
Isobutane	58.123	0.181	408.1	36.48	0.282	262.7	261.4
Isooctane	114.231	0.302	544.0	25.68	0.266	468.	372.4

Table B.1 (Continued)

	Molar mass	ω	T_c/K	P_c/bar	Z_c	V_c cm^3·mol^{-1}	T_n/K
Cyclopentane	70.134	0.196	511.8	45.02	0.273	258.	322.4
Cyclohexane	84.161	0.210	553.6	40.73	0.273	308.	353.9
Methylcyclopentane	84.161	0.230	532.8	37.85	0.272	319.	345.0
Methylcyclohexane	98.188	0.235	572.2	34.71	0.269	368.	374.1
Ethylene	28.054	0.087	282.3	50.40	0.281	131.	169.4
Propylene	42.081	0.140	365.6	46.65	0.289	188.4	225.5
1-Butene	56.108	0.191	420.0	40.43	0.277	239.3	266.9
cis-2-Butene	56.108	0.205	435.6	42.43	0.273	233.8	276.9
trans-2-Butene	56.108	0.218	428.6	41.00	0.275	237.7	274.0
1-Hexene	84.161	0.280	504.0	31.40	0.265	354.	336.3
Isobutylene	56.108	0.194	417.9	40.00	0.275	238.9	266.3
1,3-Butadiene	54.092	0.190	425.2	42.77	0.267	220.4	268.7
Cyclohexene	82.145	0.212	560.4	43.50	0.272	291.	356.1
Acetylene	26.038	0.187	308.3	61.39	0.271	113.	189.4
Benzene	78.114	0.210	562.2	48.98	0.271	259.	353.2
Toluene	92.141	0.262	591.8	41.06	0.264	316.	383.8
Ethylbenzene	106.167	0.303	617.2	36.06	0.263	374.	409.4
Cumene	120.194	0.326	631.1	32.09	0.261	427.	425.6
o-Xylene	106.167	0.310	630.3	37.34	0.263	369.	417.6
m-Xylene	106.167	0.326	617.1	35.36	0.259	376.	412.3
p-Xylene	106.167	0.322	616.2	35.11	0.260	379.	411.5
Styrene	104.152	0.297	636.0	38.40	0.256	352.	418.3
Naphthalene	128.174	0.302	748.4	40.51	0.269	413.	491.2
Biphenyl	154.211	0.365	789.3	38.50	0.295	502.	528.2
Formaldehyde	30.026	0.282	408.0	65.90	0.223	115.	254.1
Acetaldehyde	44.053	0.291	466.0	55.50	0.221	154.	294.0
Methyl acetate	74.079	0.331	506.6	47.50	0.257	228.	330.1
Ethyl acetate	88.106	0.366	523.3	38.80	0.255	286.	350.2
Acetone	58.080	0.307	508.2	47.01	0.233	209.	329.4
Methyl ethyl ketone	72.107	0.323	535.5	41.50	0.249	267.	352.8
Diethyl ether	74.123	0.281	466.7	36.40	0.263	280.	307.6
Methyl *t*-butyl ether	88.150	0.266	497.1	34.30	0.273	329.	328.4
Methanol	32.042	0.564	512.6	80.97	0.224	118.	337.9
Ethanol	46.069	0.645	513.9	61.48	0.240	167.	351.4
1-Propanol	60.096	0.622	536.8	51.75	0.254	219.	370.4
1-Butanol	74.123	0.594	563.1	44.23	0.260	275.	390.8
1-Hexanol	102.177	0.579	611.4	35.10	0.263	381.	430.6
2-Propanol	60.096	0.668	508.3	47.62	0.248	220.	355.4
Phenol	94.113	0.444	694.3	61.30	0.243	229.	455.0

Table B.1 (Continued)

	Molar mass	ω	T_c/K	P_c/bar	Z_c	V_c cm^3·mol^{-1}	T_n/K
Ethylene glycol	62.068	0.487	719.7	77.00	0.246	191.0	470.5
Acetic acid	60.053	0.467	592.0	57.86	0.211	179.7	391.1
n-Butyric acid	88.106	0.681	615.7	40.64	0.232	291.7	436.4
Benzoic acid	122.123	0.603	751.0	44.70	0.246	344.	522.4
Acetonitrile	41.053	0.338	545.5	48.30	0.184	173.	354.8
Methylamine	31.057	0.281	430.1	74.60	0.321	154.	266.8
Ethylamine	45.084	0.285	456.2	56.20	0.307	207.	289.7
Nitromethane	61.040	0.348	588.2	63.10	0.223	173.	374.4
Carbon tetrachloride	153.822	0.193	556.4	45.60	0.272	276.	349.8
Chloroform	119.377	0.222	536.4	54.72	0.293	239.	334.3
Dichloromethane	84.932	0.199	510.0	60.80	0.265	185.	312.9
Methyl chloride	50.488	0.153	416.3	66.80	0.276	143.	249.1
Ethyl chloride	64.514	0.190	460.4	52.70	0.275	200.	285.4
Chlorobenzene	112.558	0.250	632.4	45.20	0.265	308.	404.9
Tetrafluoroethane	102.030	0.327	374.2	40.60	0.258	198.0	247.1
Argon	39.948	0.000	150.9	48.98	0.291	74.6	87.3
Krypton	83.800	0.000	209.4	55.02	0.288	91.2	119.8
Xenon	131.30	0.000	289.7	58.40	0.286	118.0	165.0
Helium 4	4.003	−0.390	5.2	2.28	0.302	57.3	4.2
Hydrogen	2.016	−0.216	33.19	13.13	0.305	64.1	20.4
Oxygen	31.999	0.022	154.6	50.43	0.288	73.4	90.2
Nitrogen	28.014	0.038	126.2	34.00	0.289	89.2	77.3
Air†	28.851	0.035	132.2	37.45	0.289	84.8	
Chlorine	70.905	0.069	417.2	77.10	0.265	124.	239.1
Carbon monoxide	28.010	0.048	132.9	34.99	0.299	93.4	81.7
Carbon dioxide	44.010	0.224	304.2	73.83	0.274	94.0	
Carbon disulfide	76.143	0.111	552.0	79.00	0.275	160.	319.4
Hydrogen sulfide	34.082	0.094	373.5	89.63	0.284	98.5	212.8
Sulfur dioxide	64.065	0.245	430.8	78.84	0.269	122.	263.1
Sulfur trioxide	80.064	0.424	490.9	82.10	0.255	127.	317.9
Nitric oxide (NO)	30.006	0.583	180.2	64.80	0.251	58.0	121.4
Nitrous oxide (N_2O)	44.013	0.141	309.6	72.45	0.274	97.4	184.7
Hydrogen chloride	36.461	0.132	324.7	83.10	0.249	81.	188.2
Hydrogen cyanide	27.026	0.410	456.7	53.90	0.197	139.	298.9
Water	18.015	0.345	647.1	220.55	0.229	55.9	373.2
Ammonia	17.031	0.253	405.7	112.80	0.242	72.5	239.7
Nitric acid	63.013	0.714	520.0	68.90	0.231	145.	356.2
Sulfuric acid	98.080	. . .	924.0	64.00	0.147	177.	610.0

† Pseudoparameters for $y_{N_2} = 0.79$ and $y_{O_2} = 0.21$. See Eqs. (6.78)–(6.80).

Table B.2: Constants for the Antoine Equation for Vapor Pressures of Pure Species

$$\ln P^{\text{sat}}/\text{kPa} = A - \frac{B}{t/°\text{C} + C}$$

Latent heat of vaporization at the normal boiling point (ΔH_n), and normal boiling point (t_n)

		Parameters for Antoine Eqn.			Temp. Range	ΔH_n	
Name	Formula	A†	B	C	°C	kJ/mol	t_n/°C
Acetone	C_3H_6O	14.3145	2756.22	228.060	−26—77	29.10	56.2
Acetic acid	$C_2H_4O_2$	15.0717	3580.80	224.650	24—142	23.70	117.9
Acetonitrile*	C_2H_3N	14.8950	3413.10	250.523	−27—81	30.19	81.6
Benzene	C_6H_6	13.7819	2726.81	217.572	6—104	30.72	80.0
iso-Butane	C_4H_{10}	13.8254	2181.79	248.870	−83—7	21.30	−11.9
n-Butane	C_4H_{10}	13.6608	2154.70	238.789	−73—19	22.44	−0.5
1-Butanol	$C_4H_{10}O$	15.3144	3212.43	182.739	37—138	43.29	117.6
2-Butanol*	$C_4H_{10}O$	15.1989	3026.03	186.500	25—120	40.75	99.5
iso-Butanol	$C_4H_{10}O$	14.6047	2740.95	166.670	30—128	41.82	107.8
tert-Butanol	$C_4H_{10}O$	14.8445	2658.29	177.650	10—101	39.07	82.3
Carbon tetrachloride	CCl_4	14.0572	2914.23	232.148	−14—101	29.82	76.6
Chlorobenzene	C_6H_5Cl	13.8635	3174.78	211.700	29—159	35.19	131.7
1-Chlorobutane	C_4H_9Cl	13.7965	2723.73	218.265	−17—79	30.39	78.5
Chloroform	$CHCl_3$	13.7324	2548.74	218.552	−23—84	29.24	61.1
Cyclohexane	C_6H_{12}	13.6568	2723.44	220.618	9—105	29.97	80.7
Cyclopentane	C_5H_{10}	13.9727	2653.90	234.510	−35—71	27.30	49.2
n-Decane	$C_{10}H_{22}$	13.9748	3442.76	193.858	65—203	38.75	174.1
Dichloromethane	CH_2Cl_2	13.9891	2463.93	223.240	−38—60	28.06	39.7
Diethyl ether	$C_4H_{10}O$	14.0735	2511.29	231.200	−43—55	26.52	34.4
1,4-Dioxane	$C_4H_8O_2$	15.0967	3579.78	240.337	20—105	34.16	101.3
n-Eicosane	$C_{20}H_{42}$	14.4575	4680.46	132.100	208—379	57.49	343.6
Ethanol	C_2H_6O	16.8958	3795.17	230.918	3—96	38.56	78.2
Ethylbenzene	C_8H_{10}	13.9726	3259.93	212.300	33—163	35.57	136.2
Ethylene glycol*	$C_2H_6O_2$	15.7567	4187.46	178.650	100—222	50.73	197.3
n-Heptane	C_7H_{16}	13.8622	2910.26	216.432	4—123	31.77	98.4
n-Hexane	C_6H_{14}	13.8193	2696.04	224.317	−19—92	28.85	68.7
Methanol	CH_4O	16.5785	3638.27	239.500	−11—83	35.21	64.7
Methyl acetate	$C_3H_6O_2$	14.2456	2662.78	219.690	−23—78	30.32	56.9
Methyl ethyl ketone	C_4H_8O	14.1334	2838.24	218.690	−8—103	31.30	79.6
Nitromethane*	CH_3NO_2	14.7513	3331.70	227.600	56—146	33.99	101.2
n-Nonane	C_9H_{20}	13.9854	3311.19	202.694	46—178	36.91	150.8
iso-Octane	C_8H_{18}	13.6703	2896.31	220.767	2—125	30.79	99.2
n-Octane	C_8H_{18}	13.9346	3123.13	209.635	26—152	34.41	125.6
n-Pentane	C_5H_{12}	13.7667	2451.88	232.014	−45—58	25.79	36.0
Phenol	C_6H_6O	14.4387	3507.80	175.400	80—208	46.18	181.8
1-Propanol	C_3H_8O	16.1154	3483.67	205.807	20—116	41.44	97.2
2-Propanol	C_3H_8O	16.6796	3640.20	219.610	8—100	39.85	82.2

Table B.2 (Continued)

Name	Formula	Parameters for Antoine Eqn. A†	B	C	Temp. Range °C	ΔH_n kJ/mol	t_n/°C
Toluene	C_7H_8	13.9320	3056.96	217.625	13—136	33.18	110.6
Water	H_2O	16.3872	3885.70	230.170	0—200	40.66	100.0
o-Xylene	C_8H_{10}	14.0415	3358.79	212.041	40—172	36.24	144.4
m-Xylene	C_8H_{10}	14.1387	3381.81	216.120	35—166	35.66	139.1
p-Xylene	C_8H_{10}	14.0579	3331.45	214.627	35—166	35.67	138.3

Based primarily on data presented by B. E. Poling, J. M. Prausnitz, and J. P. O'Connell, *The Properties of Gases and Liquids*, 5th ed., App. A, McGraw-Hill, New York, 2001.

*Antoine parameters adapted from J. Gmehling, U. Onken, and W. Arlt, *Vapor-Liquid Equilibrium Data Collection*, Chemistry Data Series, vol. I, parts 1–8, DECHEMA, Frankfurt/Main, 1974–1990.

†Antoine parameters A are adjusted to reproduce the listed values of t_n.

Appendix C

Heat Capacities and Property Changes of Formation

Table C.1: Heat Capacities of Gases in the Ideal-Gas State[†]

Constants in equation $C_P^{ig}/R = A + BT + CT^2 + DT^{-2}$ for T (K) from 298 K to T_{max}

Chemical species		T_{max}	$C_{P_{298}}^{ig}/R$	A	$10^3\,B$	$10^6\,C$	$10^{-5}\,D$
Alkanes:							
Methane	CH_4	1500	4.217	1.702	9.081	−2.164	.....
Ethane	C_2H_6	1500	6.369	1.131	19.225	−5.561	.....
Propane	C_3H_8	1500	9.011	1.213	28.785	−8.824	.....
n-Butane	C_4H_{10}	1500	11.928	1.935	36.915	−11.402	.....
iso-Butane	C_4H_{10}	1500	11.901	1.677	37.853	−11.945	.....
n-Pentane	C_5H_{12}	1500	14.731	2.464	45.351	−14.111	.....
n-Hexane	C_6H_{14}	1500	17.550	3.025	53.722	−16.791	.....
n-Heptane	C_7H_{16}	1500	20.361	3.570	62.127	−19.486	.....
n-Octane	C_8H_{18}	1500	23.174	4.108	70.567	−22.208	.....
1-*Alkenes:*							
Ethylene	C_2H_4	1500	5.325	1.424	14.394	−4.392	.....
Propylene	C_3H_6	1500	7.792	1.637	22.706	−6.915	.....
1-Butene	C_4H_8	1500	10.520	1.967	31.630	−9.873	.....
1-Pentene	C_5H_{10}	1500	13.437	2.691	39.753	−12.447	.....
1-Hexene	C_6H_{12}	1500	16.240	3.220	48.189	−15.157	.....
1-Heptene	C_7H_{14}	1500	19.053	3.768	56.588	−17.847	.....
1-Octene	C_8H_{16}	1500	21.868	4.324	64.960	−20.521	.....
Miscellaneous organics:							
Acetaldehyde	C_2H_4O	1000	6.506	1.693	17.978	−6.158	.....
Acetylene	C_2H_2	1500	5.253	6.132	1.952	.....	−1.299
Benzene	C_6H_6	1500	10.259	−0.206	39.064	−13.301	.....
1,3-Butadiene	C_4H_6	1500	10.720	2.734	26.786	−8.882	.....
Cyclohexane	C_6H_{12}	1500	13.121	−3.876	63.249	−20.928	.....
Ethanol	C_2H_6O	1500	8.948	3.518	20.001	−6.002	.....
Ethylbenzene	C_8H_{10}	1500	15.993	1.124	55.380	−18.476	.....
Ethylene oxide	C_2H_4O	1000	5.784	−0.385	23.463	−9.296	.....
Formaldehyde	CH_2O	1500	4.191	2.264	7.022	−1.877	.....
Methanol	CH_4O	1500	5.547	2.211	12.216	−3.450	.....
Styrene	C_8H_8	1500	15.534	2.050	50.192	−16.662	.....
Toluene	C_7H_8	1500	12.922	0.290	47.052	−15.716	.....
Miscellaneous inorganics:							
Air		2000	3.509	3.355	0.575	.....	−0.016
Ammonia	NH_3	1800	4.269	3.578	3.020	.....	−0.186
Bromine	Br_2	3000	4.337	4.493	0.056	.....	−0.154
Carbon monoxide	CO	2500	3.507	3.376	0.557	.....	−0.031
Carbon dioxide	CO_2	2000	4.467	5.457	1.045	.....	−1.157
Carbon disulfide	CS_2	1800	5.532	6.311	0.805	.....	−0.906
Chlorine	Cl_2	3000	4.082	4.442	0.089	.....	−0.344
Hydrogen	H_2	3000	3.468	3.249	0.422	.....	0.083
Hydrogen sulfide	H_2S	2300	4.114	3.931	1.490	.....	−0.232
Hydrogen chloride	HCl	2000	3.512	3.156	0.623	.....	0.151
Hydrogen cyanide	HCN	2500	4.326	4.736	1.359	.....	−0.725
Nitrogen	N_2	2000	3.502	3.280	0.593	.....	0.040
Nitrous oxide	N_2O	2000	4.646	5.328	1.214	.....	−0.928
Nitric oxide	NO	2000	3.590	3.387	0.629	.....	0.014
Nitrogen dioxide	NO_2	2000	4.447	4.982	1.195	.....	−0.792
Dinitrogen tetroxide	N_2O_4	2000	9.198	11.660	2.257	.....	−2.787
Oxygen	O_2	2000	3.535	3.639	0.506	.....	−0.227
Sulfur dioxide	SO_2	2000	4.796	5.699	0.801	.....	−1.015
Sulfur trioxide	SO_3	2000	6.094	8.060	1.056	.....	−2.028
Water	H_2O	2000	4.038	3.470	1.450	.....	0.121

[†]Selected from H. M. Spencer, *Ind. Eng. Chem.*, vol. 40, pp. 2152–2154, 1948; K. K. Kelley, *U.S. Bur. Mines Bull. 584*, 1960; L. B. Pankratz, *U.S. Bur. Mines Bull. 672*, 1982.

Table C.2: Heat Capacities of Solids†

Constants for the equation $C_p/R = A + BT + DT^{-2}$ for T (K) from 298 K to T_{max}

Chemical species	T_{max}	$C^{ig}_{P_{298}}/R$	A	$10^3\,B$	$10^{-5}\,D$
CaO	2000	5.058	6.104	0.443	−1.047
$CaCO_3$	1200	9.848	12.572	2.637	−3.120
$Ca(OH)_2$	700	11.217	9.597	5.435	.....
CaC_2	720	7.508	8.254	1.429	−1.042
$CaCl_2$	1055	8.762	8.646	1.530	−0.302
C (graphite)	2000	1.026	1.771	0.771	−0.867
Cu	1357	2.959	2.677	0.815	0.035
CuO	1400	5.087	5.780	0.973	−0.874
Fe(α)	1043	3.005	−0.111	6.111	1.150
Fe_2O_3	960	12.480	11.812	9.697	−1.976
Fe_3O_4	850	18.138	9.594	27.112	0.409
FeS	411	6.573	2.612	13.286	.....
I_2	386.8	6.929	6.481	1.502	.....
LiCl	800	5.778	5.257	2.476	−0.193
NH_4Cl	458	10.741	5.939	16.105	.....
Na	371	3.386	1.988	4.688	.....
NaCl	1073	6.111	5.526	1.963	.....
NaOH	566	7.177	0.121	16.316	1.948
$NaHCO_3$	400	10.539	5.128	18.148	.....
S (rhombic)	368.3	3.748	4.114	−1.728	−0.783
SiO_2 (quartz)	847	5.345	4.871	5.365	−1.001

†Selected from K. K. Kelley, *U.S. Bur. Mines Bull. 584*, 1960; L. B. Pankratz, *U.S. Bur. Mines Bull. 672*, 1982.

Table C.3: Heat Capacities of Liquids†

Constants for the equation $C_P/R = A + BT + CT^2$ for T from 273.15 to 373.15 K

Chemical species	$C^{ig}_{P_{298}}/R$	A	$10^3\,B$	$10^6\,C$
Ammonia	9.718	22.626	−100.75	192.71
Aniline	23.070	15.819	29.03	−15.80
Benzene	16.157	−0.747	67.96	−37.78
1,3-Butadiene	14.779	22.711	−87.96	205.79
Carbon tetrachloride	15.751	21.155	−48.28	101.14
Chlorobenzene	18.240	11.278	32.86	−31.90
Chloroform	13.806	19.215	−42.89	83.01
Cyclohexane	18.737	−9.048	141.38	−161.62
Ethanol	13.444	33.866	−172.60	349.17
Ethylene oxide	10.590	21.039	−86.41	172.28
Methanol	9.798	13.431	−51.28	131.13
n-Propanol	16.921	41.653	−210.32	427.20
Sulfur trioxide	30.408	−2.930	137.08	−84.73
Toluene	18.611	15.133	6.79	16.35
Water	9.069	8.712	1.25	−0.18

†Based on correlations presented by J. W. Miller Jr., G. R. Schorr, and C. L. Yaws, *Chem. Eng.*, vol. 83(23), p. 129, 1976.

Table C.4: Standard Enthalpies and Gibbs Energies of Formation at 298.15 K†

Joules per mole of the substance formed

Chemical species		State (Note 2)	ΔH°_{f298} (Note 1)	ΔG°_{f298} (Note 1)
Alkanes:				
Methane	CH_4	(*g*)	−74,520	−50,460
Ethane	C_2H_6	(*g*)	−83,820	−31,855
Propane	C_3H_8	(*g*)	−104,680	−24,290
n-Butane	C_4H_{10}	(*g*)	−125,790	−16,570
n-Pentane	C_5H_{12}	(*g*)	−146,760	−8,650
n-Hexane	C_6H_{14}	(*g*)	−166,920	150
n-Heptane	C_7H_{16}	(*g*)	−187,780	8,260
n-Octane	C_8H_{18}	(*g*)	−208,750	16,260
1-***Alkenes:***				
Ethylene	C_2H_4	(*g*)	52,510	68,460
Propylene	C_3H_6	(*g*)	19,710	62,205
1-Butene	C_4H_8	(*g*)	−540	70,340
1-Pentene	C_5H_{10}	(*g*)	−21,280	78,410
1-Hexene	C_6H_{12}	(*g*)	−41,950	86,830
1-Heptene	C_7H_{14}	(*g*)	−62,760	
Miscellaneous organics:				
Acetaldehyde	C_2H_4O	(*g*)	−166,190	−128,860
Acetic acid	$C_2H_4O_2$	(*l*)	−484,500	−389,900
Acetylene	C_2H_2	(*g*)	227,480	209,970
Benzene	C_6H_6	(*g*)	82,930	129,665
Benzene	C_6H_6	(*l*)	49,080	124,520
1,3-Butadiene	C_4H_6	(*g*)	109,240	149,795
Cyclohexane	C_6H_{12}	(*g*)	−123,140	31,920
Cyclohexane	C_6H_{12}	(*l*)	−156,230	26,850
1,2-Ethanediol	$C_2H_6O_2$	(*l*)	−454,800	−323,080
Ethanol	C_2H_6O	(*g*)	−235,100	−168,490
Ethanol	C_2H_6O	(*l*)	−277,690	−174,780
Ethylbenzene	C_8H_{10}	(*g*)	29,920	130,890
Ethylene oxide	C_2H_4O	(*g*)	−52,630	−13,010
Formaldehyde	CH_2O	(*g*)	−108,570	−102,530
Methanol	CH_4O	(*g*)	−200,660	−161,960
Methanol	CH_4O	(*l*)	−238,660	−166,270
Methylcyclohexane	C_7H_{14}	(*g*)	−154,770	27,480
Methylcyclohexane	C_7H_{14}	(*l*)	−190,160	20,560
Styrene	C_8H_8	(*g*)	147,360	213,900
Toluene	C_7H_8	(*g*)	50,170	122,050
Toluene	C_7H_8	(*l*)	12,180	113,630

Table C.4 (Continued)

Chemical species		State (Note 2)	$\Delta H^{\circ}_{f_{298}}$ (Note 1)	$\Delta G^{\circ}_{f_{298}}$ (Note 1)
Miscellaneous inorganics:				
Ammonia	NH_3	(*g*)	−46,110	−16,400
Ammonia	NH_3	(*aq*)		−26,500
Calcium carbide	CaC_2	(*s*)	−59,800	−64,900
Calcium carbonate	$CaCO_3$	(*s*)	−1,206,920	−1,128,790
Calcium chloride	$CaCl_2$	(*s*)	−795,800	−748,100
Calcium chloride	$CaCl_2$	(*aq*)		−8,101,900
Calcium chloride	$CaCl_2{\cdot}6H_2O$	(*s*)	−2,607,900	
Calcium hydroxide	$Ca(OH)_2$	(*s*)	−986,090	−898,490
Calcium hydroxide	$Ca(OH)_2$	(*aq*)		−868,070
Calcium oxide	CaO	(*s*)	−635,090	−604,030
Carbon dioxide	CO_2	(*g*)	−393,509	−394,359
Carbon monoxide	CO	(*g*)	−110,525	−137,169
Hydrochloric acid	HCl	(*g*)	−92,307	−95,299
Hydrogen cyanide	HCN	(*g*)	135,100	124,700
Hydrogen sulfide	H_2S	(*g*)	−20,630	−33,560
Iron oxide	FeO	(*s*)	−272,000	
Iron oxide (hematite)	Fe_2O_3	(*s*)	−824,200	−742,200
Iron oxide (magnetite)	Fe_3O_4	(*s*)	−1,118,400	−1,015,400
Iron sulfide (pyrite)	FeS_2	(*s*)	−178,200	−166,900
Lithium chloride	LiCl	(*s*)	−408,610	
Lithium chloride	$LiCl{\cdot}H_2O$	(*s*)	−712,580	
Lithium chloride	$LiCl{\cdot}2H_2O$	(*s*)	−1,012,650	
Lithium chloride	$LiCl{\cdot}3H_2O$	(*s*)	−1,311,300	
Nitric acid	HNO_3	(*l*)	−174,100	−80,710
Nitric acid	HNO_3	(*aq*)		−111,250
Nitrogen oxides	NO	(*g*)	90,250	86,550
	NO_2	(*g*)	33,180	51,310
	N_2O	(*g*)	82,050	104,200
	N_2O_4	(*g*)	9,160	97,540
Sodium carbonate	Na_2CO_3	(*s*)	−1,130,680	−1,044,440
Sodium carbonate	$Na_2CO_3{\cdot}10H_2O$	(*s*)	−4,081,320	
Sodium chloride	NaCl	(*s*)	−411,153	−384,138
Sodium chloride	NaCl	(*aq*)		−393,133
Sodium hydroxide	NaOH	(*s*)	−425,609	−379,494
Sodium hydroxide	NaOH	(*aq*)		−419,150
Sulfur dioxide	SO_2	(*g*)	−296,830	−300,194
Sulfur trioxide	SO_3	(*g*)	−395,720	−371,060
Sulfur trioxide	SO_3	(*l*)	−441,040	
Sulfuric acid	H_2SO_4	(*l*)	−813,989	−690,003
Sulfuric acid	H_2SO_4	(*aq*)		−744,530
Water	H_2O	(*g*)	−241,818	−228,572
Water	H_2O	(*l*)	−285,830	−237,129

†From *TRC Thermodynamic Tables—Hydrocarbons*, Thermodynamics Research Center, Texas A & M Univ. System, College Station, TX; "The NBS Tables of Chemical Thermodynamic Properties," *J. Phys. and Chem. Reference Data*, vol. 11, supp. 2, 1982.

Notes

1. The standard property changes of formation ΔH°_{f298} and ΔG°_{f298} are the changes occurring when 1 mol of the listed compound is formed from its elements with each substance in its standard state at 298.15 K (25°C).
2. Standard states: (*a*) Gases (*g*): pure ideal gas at 1 bar and 25°C. (*b*) Liquids (*l*) and solids (*s*): pure substance at 1 bar and 25°C. (*c*) Solutes in aqueous solution *(aq):* Hypothetical ideal 1-molal solution of solute in water at 1 bar and 25°C.

Table C.5: Standard Enthalpies and Gibbs Energies of Formation at 298.15 K for Substances in Dilute Aqueous Solution at Zero Ionic Strength†

Joules per mole of the substance formed

Chemical species		ΔH°_{f298}	ΔG°_{f298}
Acetaldehyde	C_2H_4O	−212.2	−139.0
Acetate	$C_2H_2O_2^-$	−486.0	−369.3
Acetic acid	$C_2H_3O_2$	−485.8	−396.5
Acetone	C_3H_6O	−221.7	−159.7
Adenosine	$C_{10}H_{13}N_5O_4$	−621.3	−194.5
Adenosine cation	$C_{10}H_{14}N_5O_4^+$	−637.7	−214.3
Adenosine 5′ diphosphate (ADP)	$C_{10}H_{12}N_5O_{10}P_2^{3-}$	−2626.5	−1906.1
	$C_{10}H_{13}N_5O_{10}P_2^{2-}$	−2620.9	−1947.1
	$C_{10}H_{14}N_5O_{10}P_2^-$	−2638.5	−1972.0
Adenosine 5′ monophosphate (AMP)	$C_{10}H_{12}N_5O_{10}P^{2-}$	−1635.4	−1040.5
	$C_{10}H_{13}N_5O_{10}P^-$	−1630.0	−1078.9
	$C_{10}H_{14}N_5O_7P$	−1648.1	−1101.6
Adenosine 5′ triphosphate (ATP)	$C_{10}H_{12}N_5O_{13}P_3^{4-}$	−3619.2	−2768.1
	$C_{10}H_{13}N_5O_{13}P_3^{3-}$	−3612.9	−2811.5
	$C_{10}H_{14}N_5O_{13}P_3^{2-}$	−3627.9	−2838.2
Alanine	$C_3H_7NO_2$	−554.8	−371.0
Ammonia	NH_3	−80.3	−26.5
Ammonium	NH_4^+	−132.5	−79.3
D-arabinose	$C_5H_{10}O_5$	−1043.8	−742.2
L-asparagine	$C_4H_8N_2O_3$	−766.1	−525.9
L-aspartate	$C_4H_7NO_4$	−943.4	−695.9
Citrate	$C_6H_5O_7^{3-}$	−1515.1	−1162.7
	$C_6H_6O_7^{2-}$	−1518.5	−1199.2
	$C_6H_7O_7^-$	−1520.9	−1226.3
Carbon dioxide	CO_2	−413.8	−386.0
Carbonate	CO_3^{-2}	−677.1	−527.8
Bicarbonate	CHO_3^-	−692.0	−586.8
Carbonic acid	CH_2O_3	−694.9	−606.3

Table C.5 (Continued)

Chemical species		ΔH°_{f298}	ΔG°_{f298}
Carbon monoxide	CO	−121.0	−119.9
Ethanol	C_2H_6O	−288.3	−181.6
Ethyl acetate	$C_4H_8O_2$	−482.0	−337.7
Formate	CHO_2^-	−425.6	−351.0
D-fructose	$C_6H_{12}O_6$	−1259.4	−915.5
D-fructose 6-phosphate	$C_6H_{11}O_9P^{2-}$	−2267.7*	−1760.8
	$C_6H_{12}O_9P^-$	−2265.9*	−1796.6
D-fructose 1,6-biphosphate	$C_6H_{11}O_{12}P_2^{3-}$	−3320.1*	−2639.4
	$C_6H_{12}O_{12}P_2^{2-}$	−3318.3*	−2673.9
Fumarate	$C_4H_2O_4^{2-}$	−777.4	−601.9
	$C_4H_3O_4^-$	−774.5	−628.1
	$C_4H_4O_4$	−774.9	−645.8
D-galactose	$C_6H_{12}O_6$	−1255.2	−908.9
D-glucose	$C_6H_{12}O_6$	−1262.2	−915.9
D-glucose 6-phosphate	$C_6H_{11}O_9P^{2-}$	−2276.4	−1763.9
	$C_6H_{12}O_9P^-$	−2274.6	−1800.6
L-glutamate	$C_5H_8NO_4^-$	−979.9	−697.5
L-glutamine	$C_5H_{10}N_2O_3$	−805.0	−528.0
Glycerol	$C_3H_8O_3$	−676.6	−497.5
Glycine	$C_2H_5NO_2$	−523.0	−379.9
Glycylglycine	$C_4H_8N_2O_3$	−734.3	−520.2
Hydrogen	H_2	−4.2	17.6
Hydrogen peroxide	H_2O_2	−191.2	−134.0
Hydrogen ion (Note 2)	H^+	0.0	0.0
Indole	C_8H_7N	97.5	223.8
Lactate	$C_3H_5O_3^-$	−686.6	−516.7
Lactose	$C_{12}H_{22}O_{11}$	−2233.1	−1567.3
L-leucine	$C_6H_{13}NO_2$	−643.4	−352.3
Maltose	$C_{12}H_{22}O_{11}$	−2238.1	−1574.7
D-mannose	$C_6H_{12}O_6$	−1258.7	−910.0
Methane	CH_4	−89.0	−34.3
Methanol	CH_4O	−245.9	−175.3
Methylammonium	CH_6N^+	−124.9	−39.9
Nitrogen	N_2	−10.5	18.7
Nicotinamide-adenine dinucleotide (ox)	NAD^+ (Note 2)	0.0	0.0
Nicotinamide-adenine dinucleotide (red)	NADH (Note 2)	−31.9	22.7
Nicotinamide-adenine dinucleotide phosphate (ox)	$NADP^+$ (Note 2)	0.0	−835.2

Table C.5 (Continued)

Chemical species		ΔH°_{f298}	ΔG°_{f298}
Nicotinamide-adenine dinucleotide phosphate (red)	NADPH (Note 2)	−29.2	−809.2
Oxygen	O_2	−11.7	16.4
Oxalate	$C_2O_4^{2-}$	−825.1	−673.9
Hydrogen phosphate	HPO_4^{2-}	−1299.0	−1096.1
Dihydrogen phosphate	$H_2PO_4^-$	−1302.6	−1137.3
2-propanol	C_3H_8O	−330.8	−185.2
Pyrophosphate	$P_2O_7^{4-}$	−2293.5	−1919.9
	$HP_2O_7^{3-}$	−2294.9	−1973.9
	$H_2P_2O_7^{2-}$	−2295.4	−2012.2
	$H_3P_2O_7^-$	−2290.4	−2025.1
	$H_4P_2O_7$	−2281.2	−2029.9
Pyruvate	$C_3H_3O_3^-$	−596.2	−472.3
D-ribose	$C_5H_{10}O_5$	−1034.0	−738.8
D-ribose 5-phosphate	$C_5H_9O_8P^{2-}$	−2041.5	−1582.6
	$C_5H_{10}O_8P^-$	−2030.2	−1620.8
D-ribulose	$C_5H_{10}O_5$	−1023.0	−735.9
L-sorbose	$C_6H_{12}O_6$	−1263.3	−912.0
Succinate	$C_4H_4O_4^2-$	−908.7	−690.4
	$C_4H_5O_4^-$	−908.8	−722.6
	$C_4H_6O_4$	−912.2	−746.6
Sucrose	$C_{12}H_{22}O_{11}$	−2199.9	−1564.7
L-tryptophan	$C_{11}H_{12}N_2O_2$	−405.2	−114.7
Urea	CH_4N_2O	−317.7	−202.8
L-valine	$C_5H_{11}NO_2$	−612.0	−358.7
D-xylose	$C_5H_{10}O_5$	−1045.9	−750.5
D-xylulose	$C_5H_{10}O_5$	−1029.7	−746.2

*Estimated using data from R. N. Goldberg, Y. B. Tewari, and T. N. Bhat, *Thermodynamics of Enzyme Catalyzed Reactions*, NIST Standard Reference Database 74, http://xpdb.nist.gov/enzyme_thermodynamics.

†From Robert A. Alberty, *Thermodynamics of Biochemical Reactions*, Wiley-Interscience, Hoboken, NJ, 2003. Table 3.2, pp. 52–55 and Table 8.2, p. 151.

Notes

1. The standard property changes of formation ΔH°_{f298} and ΔG°_{f298} are the changes occurring when 1 mol of the listed compound is formed from its elements with each substance in its standard state at 298.15 K (25°C), except as explained in Note 2.
2. Conventions used in this table are that $\Delta G^\circ_{f298} = \Delta H^\circ_{f298} = 0$ for H^+ and for oxidized nicotinamide-adenine dinucleotide (NAD^-_{ox}). For the latter, and other NAD species, no molecular formula is provided because their properties are computed relative to this convention rather than relative to the elements in their standard states.

Appendix D

The Lee/Kesler Generalized-Correlation Tables

The Lee/Kesler tables are adapted and published by permission from "A Generalized Thermodynamic Correlation Based on Three-Parameter Corresponding States," by Byung Ik Lee and Michael G. Kesler, *AIChE J.,* vol. 21, pp. 510–527, 1975. The numbers printed in italic type are liquid-phase properties.

TABLES

Table D.1: Values of Z^0

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*0.0029*	*0.0145*	*0.0290*	*0.0579*	*0.1158*	*0.1737*	*0.2315*	0.2892
0.35	*0.0026*	*0.0130*	*0.0261*	*0.0522*	*0.1043*	*0.1564*	*0.2084*	0.2604
0.40	*0.0024*	*0.0119*	*0.0239*	*0.0477*	*0.0953*	*0.1429*	*0.1904*	0.2379
0.45	*0.0022*	*0.0110*	*0.0221*	*0.0442*	*0.0882*	*0.1322*	*0.1762*	0.2200
0.50	*0.0021*	*0.0103*	*0.0207*	*0.0413*	*0.0825*	*0.1236*	*0.1647*	0.2056
0.55	0.9804	*0.0098*	*0.0195*	*0.0390*	*0.0778*	*0.1166*	*0.1553*	0.1939
0.60	0.9849	*0.0093*	*0.0186*	*0.0371*	*0.0741*	*0.1109*	*0.1476*	0.1842
0.65	0.9881	0.9377	*0.0178*	*0.0356*	*0.0710*	*0.1063*	*0.1415*	0.1765
0.70	0.9904	0.9504	0.8958	*0.0344*	*0.0687*	*0.1027*	*0.1366*	0.1703
0.75	0.9922	0.9598	0.9165	*0.0336*	*0.0670*	*0.1001*	*0.1330*	0.1656
0.80	0.9935	0.9669	0.9319	0.8539	*0.0661*	*0.0985*	*0.1307*	0.1626
0.85	0.9946	0.9725	0.9436	0.8810	*0.0661*	*0.0983*	*0.1301*	0.1614
0.90	0.9954	0.9768	0.9528	0.9015	0.7800	*0.1006*	*0.1321*	0.1630
0.93	0.9959	0.9790	0.9573	0.9115	0.8059	0.6635	*0.1359*	0.1664
0.95	0.9961	0.9803	0.9600	0.9174	0.8206	0.6967	*0.1410*	0.1705
0.97	0.9963	0.9815	0.9625	0.9227	0.8338	0.7240	0.5580	0.1779
0.98	0.9965	0.9821	0.9637	0.9253	0.8398	0.7360	0.5887	0.1844
0.99	0.9966	0.9826	0.9648	0.9277	0.8455	0.7471	0.6138	0.1959
1.00	0.9967	0.9832	0.9659	0.9300	0.8509	0.7574	0.6355	0.2901
1.01	0.9968	0.9837	0.9669	0.9322	0.8561	0.7671	0.6542	0.4648
1.02	0.9969	0.9842	0.9679	0.9343	0.8610	0.7761	0.6710	0.5146
1.05	0.9971	0.9855	0.9707	0.9401	0.8743	0.8002	0.7130	0.6026
1.10	0.9975	0.9874	0.9747	0.9485	0.8930	0.8323	0.7649	0.6880
1.15	0.9978	0.9891	0.9780	0.9554	0.9081	0.8576	0.8032	0.7443
1.20	0.9981	0.9904	0.9808	0.9611	0.9205	0.8779	0.8330	0.7858
1.30	0.9985	0.9926	0.9852	0.9702	0.9396	0.9083	0.8764	0.8438
1.40	0.9988	0.9942	0.9884	0.9768	0.9534	0.9298	0.9062	0.8827
1.50	0.9991	0.9954	0.9909	0.9818	0.9636	0.9456	0.9278	0.9103
1.60	0.9993	0.9964	0.9928	0.9856	0.9714	0.9575	0.9439	0.9308
1.70	0.9994	0.9971	0.9943	0.9886	0.9775	0.9667	0.9563	0.9463
1.80	0.9995	0.9977	0.9955	0.9910	0.9823	0.9739	0.9659	0.9583
1.90	0.9996	0.9982	0.9964	0.9929	0.9861	0.9796	0.9735	0.9678
2.00	0.9997	0.9986	0.9972	0.9944	0.9892	0.9842	0.9796	0.9754
2.20	0.9998	0.9992	0.9983	0.9967	0.9937	0.9910	0.9886	0.9865
2.40	0.9999	0.9996	0.9991	0.9983	0.9969	0.9957	0.9948	0.9941
2.60	1.0000	0.9998	0.9997	0.9994	0.9991	0.9990	0.9990	0.9993
2.80	1.0000	1.0000	1.0001	1.0002	1.0007	1.0013	1.0021	1.0031
3.00	1.0000	1.0002	1.0004	1.0008	1.0018	1.0030	1.0043	1.0057
3.50	1.0001	1.0004	1.0008	1.0017	1.0035	1.0055	1.0075	1.0097
4.00	1.0001	1.0005	1.0010	1.0021	1.0043	1.0066	1.0090	1.0115

Table D.2: Values of Z^1

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*−0.0008*	*−0.0040*	*−0.0081*	*−0.0161*	*−0.0323*	*−0.0484*	*−0.0645*	−0.0806
0.35	*−0.0009*	*−0.0046*	*−0.0093*	*−0.0185*	*−0.0370*	*−0.0554*	*−0.0738*	−0.0921
0.40	*−0.0010*	*−0.0048*	*−0.0095*	*−0.0190*	*−0.0380*	*−0.0570*	*−0.0758*	−0.0946
0.45	*−0.0009*	*−0.0047*	*−0.0094*	*−0.0187*	*−0.0374*	*−0.0560*	*−0.0745*	−0.0929
0.50	*−0.0009*	*−0.0045*	*−0.0090*	*−0.0181*	*−0.0360*	*−0.0539*	*−0.0716*	−0.0893
0.55	−0.0314	*−0.0043*	*−0.0086*	*−0.0172*	*−0.0343*	*−0.0513*	*−0.0682*	−0.0849
0.60	−0.0205	*−0.0041*	*−0.0082*	*−0.0164*	*−0.0326*	*−0.0487*	*−0.0646*	−0.0803
0.65	−0.0137	−0.0772	*−0.0078*	*−0.0156*	*−0.0309*	*−0.0461*	*−0.0611*	−0.0759
0.70	−0.0093	−0.0507	−0.1161	*−0.0148*	*−0.0294*	*−0.0438*	*−0.0579*	−0.0718
0.75	−0.0064	−0.0339	−0.0744	*−0.0143*	*−0.0282*	*−0.0417*	*−0.0550*	−0.0681
0.80	−0.0044	−0.0228	−0.0487	−0.1160	*−0.0272*	*−0.0401*	*−0.0526*	−0.0648
0.85	−0.0029	−0.0152	−0.0319	−0.0715	*−0.0268*	*−0.0391*	*−0.0509*	−0.0622
0.90	−0.0019	−0.0099	−0.0205	−0.0442	−0.1118	*−0.0396*	*−0.0503*	−0.0604
0.93	−0.0015	−0.0075	−0.0154	−0.0326	−0.0763	−0.1662	*−0.0514*	−0.0602
0.95	−0.0012	−0.0062	−0.0126	−0.0262	−0.0589	−0.1110	*−0.0540*	−0.0607
0.97	−0.0010	−0.0050	−0.0101	−0.0208	−0.0450	−0.0770	−0.1647	−0.0623
0.98	−0.0009	−0.0044	−0.0090	−0.0184	−0.0390	−0.0641	−0.1100	−0.0641
0.99	−0.0008	−0.0039	−0.0079	−0.0161	−0.0335	−0.0531	−0.0796	−0.0680
1.00	−0.0007	−0.0034	−0.0069	−0.0140	−0.0285	−0.0435	−0.0588	−0.0879
1.01	−0.0006	−0.0030	−0.0060	−0.0120	−0.0240	−0.0351	−0.0429	−0.0223
1.02	−0.0005	−0.0026	−0.0051	−0.0102	−0.0198	−0.0277	−0.0303	−0.0062
1.05	−0.0003	−0.0015	−0.0029	−0.0054	−0.0092	−0.0097	−0.0032	0.0220
1.10	0.0000	0.0000	0.0001	0.0007	0.0038	0.0106	0.0236	0.0476
1.15	0.0002	0.0011	0.0023	0.0052	0.0127	0.0237	0.0396	0.0625
1.20	0.0004	0.0019	0.0039	0.0084	0.0190	0.0326	0.0499	0.0719
1.30	0.0006	0.0030	0.0061	0.0125	0.0267	0.0429	0.0612	0.0819
1.40	0.0007	0.0036	0.0072	0.0147	0.0306	0.0477	0.0661	0.0857
1.50	0.0008	0.0039	0.0078	0.0158	0.0323	0.0497	0.0677	0.0864
1.60	0.0008	0.0040	0.0080	0.0162	0.0330	0.0501	0.0677	0.0855
1.70	0.0008	0.0040	0.0081	0.0163	0.0329	0.0497	0.0667	0.0838
1.80	0.0008	0.0040	0.0081	0.0162	0.0325	0.0488	0.0652	0.0814
1.90	0.0008	0.0040	0.0079	0.0159	0.0318	0.0477	0.0635	0.0792
2.00	0.0008	0.0039	0.0078	0.0155	0.0310	0.0464	0.0617	0.0767
2.20	0.0007	0.0037	0.0074	0.0147	0.0293	0.0437	0.0579	0.0719
2.40	0.0007	0.0035	0.0070	0.0139	0.0276	0.0411	0.0544	0.0675
2.60	0.0007	0.0033	0.0066	0.0131	0.0260	0.0387	0.0512	0.0634
2.80	0.0006	0.0031	0.0062	0.0124	0.0245	0.0365	0.0483	0.0598
3.00	0.0006	0.0029	0.0059	0.0117	0.0232	0.0345	0.0456	0.0565
3.50	0.0005	0.0026	0.0052	0.0103	0.0204	0.0303	0.0401	0.0497
4.00	0.0005	0.0023	0.0046	0.0091	0.0182	0.0270	0.0357	0.0443

Table D.3: Values of Z^0

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	0.2892	0.3479	0.4335	0.5775	0.8648	1.4366	2.0048	2.8507
0.35	0.2604	0.3123	0.3901	0.5195	0.7775	1.2902	1.7987	2.5539
0.40	0.2379	0.2853	0.3563	0.4744	0.7095	1.1758	1.6373	2.3211
0.45	0.2200	0.2638	0.3294	0.4384	0.6551	1.0841	1.5077	2.1338
0.50	0.2056	0.2465	0.3077	0.4092	0.6110	1.0094	1.4017	1.9801
0.55	0.1939	0.2323	0.2899	0.3853	0.5747	0.9475	1.3137	1.8520
0.60	0.1842	0.2207	0.2753	0.3657	0.5446	0.8959	1.2398	1.7440
0.65	0.1765	0.2113	0.2634	0.3495	0.5197	0.8526	1.1773	1.6519
0.70	0.1703	0.2038	0.2538	0.3364	0.4991	0.8161	1.1341	1.5729
0.75	0.1656	0.1981	0.2464	0.3260	0.4823	0.7854	1.0787	1.5047
0.80	0.1626	0.1942	0.2411	0.3182	0.4690	0.7598	1.0400	1.4456
0.85	0.1614	0.1924	0.2382	0.3132	0.4591	0.7388	1.0071	1.3943
0.90	0.1630	0.1935	0.2383	0.3114	0.4527	0.7220	0.9793	1.3496
0.93	0.1664	0.1963	0.2405	0.3122	0.4507	0.7138	0.9648	1.3257
0.95	0.1705	0.1998	0.2432	0.3138	0.4501	0.7092	0.9561	1.3108
0.97	0.1779	0.2055	0.2474	0.3164	0.4504	0.7052	0.9480	1.2968
0.98	0.1844	0.2097	0.2503	0.3182	0.4508	0.7035	0.9442	1.2901
0.99	0.1959	0.2154	0.2538	0.3204	0.4514	0.7018	0.9406	1.2835
1.00	0.2901	0.2237	0.2583	0.3229	0.4522	0.7004	0.9372	1.2772
1.01	0.4648	0.2370	0.2640	0.3260	0.4533	0.6991	0.9339	1.2710
1.02	0.5146	0.2629	0.2715	0.3297	0.4547	0.6980	0.9307	1.2650
1.05	0.6026	0.4437	0.3131	0.3452	0.4604	0.6956	0.9222	1.2481
1.10	0.6880	0.5984	0.4580	0.3953	0.4770	0.6950	0.9110	1.2232
1.15	0.7443	0.6803	0.5798	0.4760	0.5042	0.6987	0.9033	1.2021
1.20	0.7858	0.7363	0.6605	0.5605	0.5425	0.7069	0.8990	1.1844
1.30	0.8438	0.8111	0.7624	0.6908	0.6344	0.7358	0.8998	1.1580
1.40	0.8827	0.8595	0.8256	0.7753	0.7202	0.7761	0.9112	1.1419
1.50	0.9103	0.8933	0.8689	0.8328	0.7887	0.8200	0.9297	1.1339
1.60	0.9308	0.9180	0.9000	0.8738	0.8410	0.8617	0.9518	1.1320
1.70	0.9463	0.9367	0.9234	0.9043	0.8809	0.8984	0.9745	1.1343
1.80	0.9583	0.9511	0.9413	0.9275	0.9118	0.9297	0.9961	1.1391
1.90	0.9678	0.9624	0.9552	0.9456	0.9359	0.9557	1.0157	1.1452
2.00	0.9754	0.9715	0.9664	0.9599	0.9550	0.9772	1.0328	1.1516
2.20	0.9856	0.9847	0.9826	0.9806	0.9827	1.0094	1.0600	1.1635
2.40	0.9941	0.9936	0.9935	0.9945	1.0011	1.0313	1.0793	1.1728
2.60	0.9993	0.9998	1.0010	1.0040	1.0137	1.0463	1.0926	1.1792
2.80	1.0031	1.0042	1.0063	1.0106	1.0223	1.0565	1.1016	1.1830
3.00	1.0057	1.0074	1.0101	1.0153	1.0284	1.0635	1.1075	1.1848
3.50	1.0097	1.0120	1.0156	1.0221	1.0368	1.0723	1.1138	1.1834
4.00	1.0115	1.0140	1.0179	1.0249	1.0401	1.0747	1.1136	1.1773

Table D.4: Values of Z^1

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	−0.0806	−0.0966	−0.1207	−0.1608	−0.2407	−0.3996	−0.5572	−0.7915
0.35	−0.0921	−0.1105	−0.1379	−0.1834	−0.2738	−0.4523	−0.6279	−0.8863
0.40	−0.0946	−0.1134	−0.1414	−0.1879	−0.2799	−0.4603	−0.6365	−0.8936
0.45	−0.0929	−0.1113	−0.1387	−0.1840	−0.2734	−0.4475	−0.6162	−0.8608
0.50	−0.0893	−0.1069	−0.1330	−0.1762	−0.2611	−0.4253	−0.5831	−0.8099
0.55	−0.0849	−0.1015	−0.1263	−0.1669	−0.2465	−0.3991	−0.5446	−0.7521
0.60	−0.0803	−0.0960	−0.1192	−0.1572	−0.2312	−0.3718	−0.5047	−0.6928
0.65	−0.0759	−0.0906	−0.1122	−0.1476	−0.2160	−0.3447	−0.4653	−0.6346
0.70	−0.0718	−0.0855	−0.1057	−0.1385	−0.2013	−0.3184	−0.4270	−0.5785
0.75	−0.0681	−0.0808	−0.0996	−0.1298	−0.1872	−0.2929	−0.3901	−0.5250
0.80	−0.0648	−0.0767	−0.0940	−0.1217	−0.1736	−0.2682	−0.3545	−0.4740
0.85	−0.0622	−0.0731	−0.0888	−0.1138	−0.1602	−0.2439	−0.3201	−0.4254
0.90	−0.0604	−0.0701	−0.0840	−0.1059	−0.1463	−0.2195	−0.2862	−0.3788
0.93	−0.0602	−0.0687	−0.0810	−0.1007	−0.1374	−0.2045	−0.2661	−0.3516
0.95	−0.0607	−0.0678	−0.0788	−0.0967	−0.1310	−0.1943	−0.2526	−0.3339
0.97	−0.0623	−0.0669	−0.0759	−0.0921	−0.1240	−0.1837	−0.2391	−0.3163
0.98	−0.0641	−0.0661	−0.0740	−0.0893	−0.1202	−0.1783	−0.2322	−0.3075
0.99	−0.0680	−0.0646	−0.0715	−0.0861	−0.1162	−0.1728	−0.2254	−0.2989
1.00	−0.0879	−0.0609	−0.0678	−0.0824	−0.1118	−0.1672	−0.2185	−0.2902
1.01	−0.0223	−0.0473	−0.0621	−0.0778	−0.1072	−0.1615	−0.2116	−0.2816
1.02	−0.0062	−0.0227	−0.0524	−0.0722	−0.1021	−0.1556	−0.2047	−0.2731
1.05	0.0220	0.1059	0.0451	−0.0432	−0.0838	−0.1370	−0.1835	−0.2476
1.10	0.0476	0.0897	0.1630	0.0698	−0.0373	−0.1021	−0.1469	−0.2056
1.15	0.0625	0.0943	0.1548	0.1667	0.0332	−0.0611	−0.1084	−0.1642
1.20	0.0719	0.0991	0.1477	0.1990	0.1095	−0.0141	−0.0678	−0.1231
1.30	0.0819	0.1048	0.1420	0.1991	0.2079	0.0875	0.0176	−0.0423
1.40	0.0857	0.1063	0.1383	0.1894	0.2397	0.1737	0.1008	0.0350
1.50	0.0854	0.1055	0.1345	0.1806	0.2433	0.2309	0.1717	0.1058
1.60	0.0855	0.1035	0.1303	0.1729	0.2381	0.2631	0.2255	0.1673
1.70	0.0838	0.1008	0.1259	0.1658	0.2305	0.2788	0.2628	0.2179
1.80	0.0816	0.0978	0.1216	0.1593	0.2224	0.2846	0.2871	0.2576
1.90	0.0792	0.0947	0.1173	0.1532	0.2144	0.2848	0.3017	0.2876
2.00	0.0767	0.0916	0.1133	0.1476	0.2069	0.2819	0.3097	0.3096
2.20	0.0719	0.0857	0.1057	0.1374	0.1932	0.2720	0.3135	0.3355
2.40	0.0675	0.0803	0.0989	0.1285	0.1812	0.2602	0.3089	0.3459
2.60	0.0634	0.0754	0.0929	0.1207	0.1706	0.2484	0.3009	0.3475
2.80	0.0598	0.0711	0.0876	0.1138	0.1613	0.2372	0.2915	0.3443
3.00	0.0535	0.0672	0.0828	0.1076	0.1529	0.2268	0.2817	0.3385
3.50	0.0497	0.0591	0.0728	0.0949	0.1356	0.2042	0.2584	0.3194
4.00	0.0443	0.0527	0.0651	0.0849	0.1219	0.1857	0.2378	0.2994

Table D.5: Values of $(H^R)^0/RT_c$

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*−6.045*	*−6.043*	*−6.040*	*−6.034*	*−6.022*	*−6.011*	*−5.999*	−5.987
0.35	*−5.906*	*−5.904*	*−5.901*	*−5.895*	*−5.882*	*−5.870*	*−5.858*	−5.845
0.40	*−5.763*	*−5.761*	*−5.757*	*−5.751*	*−5.738*	*−5.726*	*−5.713*	−5.700
0.45	*−5.615*	*−5.612*	*−5.609*	*−5.603*	*−5.590*	*−5.577*	*−5.564*	−5.551
0.50	*−5.465*	*−5.463*	*−5.459*	*−5.453*	*−5.440*	*−5.427*	*−5.414*	−5.401
0.55	−0.032	*−5.312*	*−5.309*	*−5.303*	*−5.290*	*−5.278*	*−5.265*	−5.252
0.60	−0.027	*−5.162*	*−5.159*	*−5.153*	*−5.141*	*−5.129*	*−5.116*	−5.104
0.65	−0.023	−0.118	*−5.008*	*−5.002*	*−4.991*	*−4.980*	*−4.968*	−4.956
0.70	−0.020	−0.101	−0.213	*−4.848*	*−4.838*	*−4.828*	*−4.818*	−4.808
0.75	−0.017	−0.088	−0.183	*−4.687*	*−4.679*	*−4.672*	*−4.664*	−4.655
0.80	−0.015	−0.078	−0.160	−0.345	*−4.507*	*−4.504*	*−4.499*	−4.494
0.85	−0.014	−0.069	−0.141	−0.300	*−4.309*	*−4.313*	*−4.316*	−4.316
0.90	−0.012	−0.062	−0.126	−0.264	−0.596	*−4.074*	*−4.094*	−4.108
0.93	−0.011	−0.058	−0.118	−0.246	−0.545	−0.960	*−3.920*	−3.953
0.95	−0.011	−0.056	−0.113	−0.235	−0.516	−0.885	*−3.763*	−3.825
0.97	−0.011	−0.054	−0.109	−0.225	−0.490	−0.824	−1.356	−3.658
0.98	−0.010	−0.053	−0.107	−0.221	−0.478	−0.797	−1.273	−3.544
0.99	−0.010	−0.052	−0.105	−0.216	−0.466	−0.773	−1.206	−3.376
1.00	−0.010	−0.051	−0.103	−0.212	−0.455	−0.750	−1.151	−2.584
1.01	−0.010	−0.050	−0.101	−0.208	−0.445	−0.721	−1.102	−1.796
1.02	−0.010	−0.049	−0.099	−0.203	−0.434	−0.708	−1.060	−1.627
1.05	−0.009	−0.046	−0.094	−0.192	−0.407	−0.654	−0.955	−1.359
1.10	−0.008	−0.042	−0.086	−0.175	−0.367	−0.581	−0.827	−1.120
1.15	−0.008	−0.039	−0.079	−0.160	−0.334	−0.523	−0.732	−0.968
1.20	−0.007	−0.036	−0.073	−0.148	−0.305	−0.474	−0.657	−0.857
1.30	−0.006	−0.031	−0.063	−0.127	−0.259	−0.399	−0.545	−0.698
1.40	−0.005	−0.027	−0.055	−0.110	−0.224	−0.341	−0.463	−0.588
1.50	−0.005	−0.024	−0.048	−0.097	−0.196	−0.297	−0.400	−0.505
1.60	−0.004	−0.021	−0.043	−0.086	−0.173	−0.261	−0.350	−0.440
1.70	−0.004	−0.019	−0.038	−0.076	−0.153	−0.231	−0.309	−0.387
1.80	−0.003	−0.017	−0.034	−0.068	−0.137	−0.206	−0.275	−0.344
1.90	−0.003	−0.015	−0.031	−0.062	−0.123	−0.185	−0.246	−0.307
2.00	−0.003	−0.014	−0.028	−0.056	−0.111	−0.167	−0.222	−0.276
2.20	−0.002	−0.012	−0.023	−0.046	−0.092	−0.137	−0.182	−0.226
2.40	−0.002	−0.010	−0.019	−0.038	−0.076	−0.114	−0.150	−0.187
2.60	−0.002	−0.008	−0.016	−0.032	−0.064	−0.095	−0.125	−0.155
2.80	−0.001	−0.007	−0.014	−0.027	−0.054	−0.080	−0.105	−0.130
3.00	−0.001	−0.006	−0.011	−0.023	−0.045	−0.067	−0.088	−0.109
3.50	−0.001	−0.004	−0.007	−0.015	−0.029	−0.043	−0.056	−0.069
4.00	−0.000	−0.002	−0.005	−0.009	−0.017	−0.026	−0.033	−0.041

Table D.6: Values of $(H^R)^1/RT_c$

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*−11.098*	*−11.096*	*−11.095*	*−11.091*	*−11.083*	*−11.076*	*−11.069*	−11.062
0.35	*−10.656*	*−10.655*	*−10.654*	*−10.653*	*−10.650*	*−10.646*	*−10.643*	−10.640
0.40	*−10.121*	*−10.121*	*−10.121*	*−10.120*	*−10.121*	*−10.121*	*−10.121*	−10.121
0.45	*−9.515*	*−9.515*	*−9.516*	*−9.517*	*−9.519*	*−9.521*	*−9.523*	−9.525
0.50	*−8.868*	*−8.869*	*−8.870*	*−8.872*	*−8.876*	*−8.880*	*−8.884*	−8.888
0.55	−0.080	*−8.211*	*−8.212*	*−8.215*	*−8.221*	*−8.226*	*−8.232*	−8.238
0.60	−0.059	*−7.568*	*−7.570*	*−7.573*	*−7.579*	*−7.585*	*−7.591*	−7.596
0.65	−0.045	−0.247	*−6.949*	*−6.952*	*−6.959*	*−6.966*	*−6.973*	−6.980
0.70	−0.034	−0.185	−0.415	*−6.360*	*−6.367*	*−6.373*	*−6.381*	−6.388
0.75	−0.027	−0.142	−0.306	*−5.796*	*−5.802*	*−5.809*	*−5.816*	−5.824
0.80	−0.021	−0.110	−0.234	−0.542	*−5.266*	*−5.271*	*−5.278*	−5.285
0.85	−0.017	−0.087	−0.182	−0.401	*−4.753*	*−4.754*	*−4.758*	−4.763
0.90	−0.014	−0.070	−0.144	−0.308	−0.751	*−4.254*	*−4.248*	−4.249
0.93	−0.012	−0.061	−0.126	−0.265	−0.612	−1.236	*−3.942*	−3.934
0.95	−0.011	−0.056	−0.115	−0.241	−0.542	−0.994	*−3.737*	−3.712
0.97	−0.010	−0.052	−0.105	−0.219	−0.483	−0.837	−1.616	−3.470
0.98	−0.010	−0.050	−0.101	−0.209	−0.457	−0.776	−1.324	−3.332
0.99	−0.009	−0.048	−0.097	−0.200	−0.433	−0.722	−1.154	−3.164
1.00	−0.009	−0.046	−0.093	−0.191	−0.410	−0.675	−1.034	−2.471
1.01	−0.009	−0.044	−0.089	−0.183	−0.389	−0.632	−0.940	−1.375
1.02	−0.008	−0.042	−0.085	−0.175	−0.370	−0.594	−0.863	−1.180
1.05	−0.007	−0.037	−0.075	−0.153	−0.318	−0.498	−0.691	−0.877
1.10	−0.006	−0.030	−0.061	−0.123	−0.251	−0.381	−0.507	−0.617
1.15	−0.005	−0.025	−0.050	−0.099	−0.199	−0.296	−0.385	−0.459
1.20	−0.004	−0.020	−0.040	−0.080	−0.158	−0.232	−0.297	−0.349
1.30	−0.003	−0.013	−0.026	−0.052	−0.100	−0.142	−0.177	−0.203
1.40	−0.002	−0.008	−0.016	−0.032	−0.060	−0.083	−0.100	−0.111
1.50	−0.001	−0.005	−0.009	−0.018	−0.032	−0.042	−0.048	−0.049
1.60	−0.000	−0.002	−0.004	−0.007	−0.012	−0.013	−0.011	−0.005
1.70	−0.000	−0.000	−0.000	−0.000	0.003	0.009	0.017	0.027
1.80	0.000	0.001	0.003	0.006	0.015	0.025	0.037	0.051
1.90	0.001	0.003	0.005	0.011	0.023	0.037	0.053	0.070
2.00	0.001	0.003	0.007	0.015	0.030	0.047	0.065	0.085
2.20	0.001	0.005	0.010	0.020	0.040	0.062	0.083	0.106
2.40	0.001	0.006	0.012	0.023	0.047	0.071	0.095	0.120
2.60	0.001	0.006	0.013	0.026	0.052	0.078	0.104	0.130
2.80	0.001	0.007	0.014	0.028	0.055	0.082	0.110	0.137
3.00	0.001	0.007	0.014	0.029	0.058	0.086	0.114	0.142
3.50	0.002	0.008	0.016	0.031	0.062	0.092	0.122	0.152
4.00	0.002	0.008	0.016	0.032	0.064	0.096	0.127	0.158

Table D.7: Values of $(H^R)^0/RT_c$

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	−5.987	−5.975	−5.957	−5.927	−5.868	−5.748	−5.628	−5.446
0.35	−5.845	−5.833	−5.814	−5.783	−5.721	−5.595	−5.469	−5.278
0.40	−5.700	−5.687	−5.668	−5.636	−5.572	−5.442	−5.311	−5.113
0.45	−5.551	−5.538	−5.519	−5.486	−5.421	−5.288	−5.154	−5.950
0.50	−5.401	−5.388	−5.369	−5.336	−5.279	−5.135	−4.999	−4.791
0.55	−5.252	−5.239	−5.220	−5.187	−5.121	−4.986	−4.849	−4.638
0.60	−5.104	−5.091	−5.073	−5.041	−4.976	−4.842	−4.794	−4.492
0.65	−4.956	−4.949	−4.927	−4.896	−4.833	−4.702	−4.565	−4.353
0.70	−4.808	−4.797	−4.781	−4.752	−4.693	−4.566	−4.432	−4.221
0.75	−4.655	−4.646	−4.632	−4.607	−4.554	−4.434	−4.393	−4.095
0.80	−4.494	−4.488	−4.478	−4.459	−4.413	−4.303	−4.178	−3.974
0.85	−4.316	−4.316	−4.312	−4.302	−4.269	−4.173	−4.056	−3.857
0.90	−4.108	−4.118	−4.127	−4.132	−4.119	−4.043	−3.935	−3.744
0.93	−3.953	−3.976	−4.000	−4.020	−4.024	−3.963	−3.863	−3.678
0.95	−3.825	−3.865	−3.904	−3.940	−3.958	−3.910	−3.815	−3.634
0.97	−3.658	−3.732	−3.796	−3.853	−3.890	−3.856	−3.767	−3.591
0.98	−3.544	−3.652	−3.736	−3.806	−3.854	−3.829	−3.743	−3.569
0.99	−3.376	−3.558	−3.670	−3.758	−3.818	−3.801	−3.719	−3.548
1.00	−2.584	−3.441	−3.598	−3.706	−3.782	−3.774	−3.695	−3.526
1.01	−1.796	−3.283	−3.516	−3.652	−3.744	−3.746	−3.671	−3.505
1.02	−1.627	−3.039	−3.422	−3.595	−3.705	−3.718	−3.647	−3.484
1.05	−1.359	−2.034	−3.030	−3.398	−3.583	−3.632	−3.575	−3.420
1.10	−1.120	−1.487	−2.203	−2.965	−3.353	−3.484	−3.453	−3.315
1.15	−0.968	−1.239	−1.719	−2.479	−3.091	−3.329	−3.329	−3.211
1.20	−0.857	−1.076	−1.443	−2.079	−2.801	−3.166	−3.202	−3.107
1.30	−0.698	−0.860	−1.116	−1.560	−2.274	−2.825	−2.942	−2.899
1.40	−0.588	−0.716	−0.915	−1.253	−1.857	−2.486	−2.679	−2.692
1.50	−0.505	−0.611	−0.774	−1.046	−1.549	−2.175	−2.421	−2.486
1.60	−0.440	−0.531	−0.667	−0.894	−1.318	−1.904	−2.177	−2.285
1.70	−0.387	−0.446	−0.583	−0.777	−1.139	−1.672	−1.953	−2.091
1.80	−0.344	−0.413	−0.515	−0.683	−0.996	−1.476	−1.751	−1.908
1.90	−0.307	−0.368	−0.458	−0.606	−0.880	−1.309	−1.571	−1.736
2.00	−0.276	−0.330	−0.411	−0.541	−0.782	−1.167	−1.411	−1.577
2.20	−0.226	−0.269	−0.334	−0.437	−0.629	−0.937	−1.143	−1.295
2.40	−0.187	−0.222	−0.275	−0.359	−0.513	−0.761	−0.929	−1.058
2.60	−0.155	−0.185	−0.228	−0.297	−0.422	−0.621	−0.756	−0.858
2.80	−0.130	−0.154	−0.190	−0.246	−0.348	−0.508	−0.614	−0.689
3.00	−0.109	−0.129	−0.159	−0.205	−0.288	−0.415	−0.495	−0.545
3.50	−0.069	−0.081	−0.099	−0.127	−0.174	−0.239	−0.270	−0.264
4.00	−0.041	−0.048	−0.058	−0.072	−0.095	−0.116	−0.110	−0.061

Table D.8: Values of $(H^R)^1/RT_c$

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	−11.062	−11.055	−11.044	−11.027	−10.992	−10.935	−10.872	−10.781
0.35	−10.640	−10.637	−10.632	−10.624	−10.609	−10.581	−10.554	−10.529
0.40	−10.121	−10.121	−10.121	−10.122	−10.123	−10.128	−10.135	−10.150
0.45	−9.525	−9.527	−9.531	−9.537	−9.549	−9.576	−9.611	−9.663
0.50	−8.888	−8.892	−8.899	−8.909	−8.932	−8.978	−9.030	−9.111
0.55	−8.238	−8.243	−8.252	−8.267	−8.298	−8.360	−8.425	−8.531
0.60	−7.596	−7.603	−7.614	−7.632	−7.669	−7.745	−7.824	−7.950
0.65	−6.980	−6.987	−6.997	−7.017	−7.059	−7.147	−7.239	−7.381
0.70	−6.388	−6.395	−6.407	−6.429	−6.475	−6.574	−6.677	−6.837
0.75	−5.824	−5.832	−5.845	−5.868	−5.918	−6.027	−6.142	−6.318
0.80	−5.285	−5.293	−5.306	−5.330	−5.385	−5.506	−5.632	−5.824
0.85	−4.763	−4.771	−4.784	−4.810	−4.872	−5.000	−5.149	−5.358
0.90	−4.249	−4.255	−4.268	−4.298	−4.371	−4.530	−4.688	−4.916
0.93	−3.934	−3.937	−3.951	−3.987	−4.073	−4.251	−4.422	−4.662
0.95	−3.712	−3.713	−3.730	−3.773	−3.873	−4.068	−4.248	−4.497
0.97	−3.470	−3.467	−3.492	−3.551	−3.670	−3.885	−4.077	−4.336
0.98	−3.332	−3.327	−3.363	−3.434	−3.568	−3.795	−3.992	−4.257
0.99	−3.164	−3.164	−3.223	−3.313	−3.464	−3.705	−3.909	−4.178
1.00	−2.471	−2.952	−3.065	−3.186	−3.358	−3.615	−3.825	−4.100
1.01	−1.375	−2.595	−2.880	−3.051	−3.251	−3.525	−3.742	−4.023
1.02	−1.180	−1.723	−2.650	−2.906	−3.142	−3.435	−3.661	−3.947
1.05	−0.877	−0.878	−1.496	−2.381	−2.800	−3.167	−3.418	−3.722
1.10	−0.617	−0.673	−0.617	−1.261	−2.167	−2.720	−3.023	−3.362
1.15	−0.459	−0.503	−0.487	−0.604	−1.497	−2.275	−2.641	−3.019
1.20	−0.349	−0.381	−0.381	−0.361	−0.934	−1.840	−2.273	−2.692
1.30	−0.203	−0.218	−0.218	−0.178	−0.300	−1.066	−1.592	−2.086
1.40	−0.111	−0.115	−0.128	−0.070	−0.044	−0.504	−1.012	−1.547
1.50	−0.049	−0.046	−0.032	0.008	0.078	−0.142	−0.556	−1.080
1.60	−0.005	0.004	0.023	0.065	0.151	0.082	−0.217	−0.689
1.70	0.027	0.040	0.063	0.109	0.202	0.223	0.028	−0.369
1.80	0.051	0.067	0.094	0.143	0.241	0.317	0.203	−0.112
1.90	0.070	0.088	0.117	0.169	0.271	0.381	0.330	0.092
2.00	0.085	0.105	0.136	0.190	0.295	0.428	0.424	0.255
2.20	0.106	0.128	0.163	0.221	0.331	0.493	0.551	0.489
2.40	0.120	0.144	0.181	0.242	0.356	0.535	0.631	0.645
2.60	0.130	0.156	0.194	0.257	0.376	0.567	0.687	0.754
2.80	0.137	0.164	0.204	0.269	0.391	0.591	0.729	0.836
3.00	0.142	0.170	0.211	0.278	0.403	0.611	0.763	0.899
3.50	0.152	0.181	0.224	0.294	0.425	0.650	0.827	1.015
4.00	0.158	0.188	0.233	0.306	0.442	0.680	0.874	1.097

Table D.9: Values of $(S^R)^0/R$

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*−11.614*	*−10.008*	*−9.319*	*−8.635*	*−7.961*	*−7.574*	*−7.304*	−7.099
0.35	*−11.185*	*−9.579*	*−8.890*	*−8.205*	*−7.529*	*−7.140*	*−6.869*	−6.663
0.40	*−10.802*	*−9.196*	*−8.506*	*−7.821*	*−7.144*	*−6.755*	*−6.483*	−6.275
0.45	*−10.453*	*−8.847*	*−8.157*	*−7.472*	*−6.794*	*−6.404*	*−6.132*	−5.924
0.50	*−10.137*	*−8.531*	*−7.841*	*−7.156*	*−6.479*	*−6.089*	*−5.816*	−5.608
0.55	−0.038	*−8.245*	*−7.555*	*−6.870*	*−6.193*	*−5.803*	*−5.531*	−5.324
0.60	−0.029	*−7.983*	*−7.294*	*−6.610*	*−5.933*	*−5.544*	*−5.273*	−5.066
0.65	−0.023	−0.122	*−7.052*	*−6.368*	*−5.694*	*−5.306*	*−5.036*	−4.830
0.70	−0.018	−0.096	−0.206	*−6.140*	*−5.467*	*−5.082*	*−4.814*	−4.610
0.75	−0.015	−0.078	−0.164	*−5.917*	*−5.248*	*−4.866*	*−4.600*	−4.399
0.80	−0.013	−0.064	−0.134	−0.294	*−5.026*	*−4.694*	*−4.388*	−4.191
0.85	−0.011	−0.054	−0.111	−0.239	*−4.785*	*−4.418*	*−4.166*	−3.976
0.90	−0.009	−0.046	−0.094	−0.199	−0.463	*−4.145*	*−3.912*	−3.738
0.93	−0.008	−0.042	−0.085	−0.179	−0.408	−0.750	*−3.723*	−3.569
0.95	−0.008	−0.039	−0.080	−0.168	−0.377	−0.671	*−3.556*	−3.433
0.97	−0.007	−0.037	−0.075	−0.157	−0.350	−0.607	−1.056	−3.259
0.98	−0.007	−0.036	−0.073	−0.153	−0.337	−0.580	−0.971	−3.142
0.99	−0.007	−0.035	−0.071	−0.148	−0.326	−0.555	−0.903	−2.972
1.00	−0.007	−0.034	−0.069	−0.144	−0.315	−0.532	−0.847	−2.178
1.01	−0.007	−0.033	−0.067	−0.139	−0.304	−0.510	−0.799	−1.391
1.02	−0.006	−0.032	−0.065	−0.135	−0.294	−0.491	−0.757	−1.225
1.05	−0.006	−0.030	−0.060	−0.124	−0.267	−0.439	−0.656	−0.965
1.10	−0.005	−0.026	−0.053	−0.108	−0.230	−0.371	−0.537	−0.742
1.15	−0.005	−0.023	−0.047	−0.096	−0.201	−0.319	−0.452	−0.607
1.20	−0.004	−0.021	−0.042	−0.085	−0.177	−0.277	−0.389	−0.512
1.30	−0.003	−0.017	−0.033	−0.068	−0.140	−0.217	−0.298	−0.385
1.40	−0.003	−0.014	−0.027	−0.056	−0.114	−0.174	−0.237	−0.303
1.50	−0.002	−0.011	−0.023	−0.046	−0.094	−0.143	−0.194	−0.246
1.60	−0.002	−0.010	−0.019	−0.039	−0.079	−0.120	−0.162	−0.204
1.70	−0.002	−0.008	−0.017	−0.033	−0.067	−0.102	−0.137	−0.172
1.80	−0.001	−0.007	−0.014	−0.029	−0.058	−0.088	−0.117	−0.147
1.90	−0.001	−0.006	−0.013	−0.025	−0.051	−0.076	−0.102	−0.127
2.00	−0.001	−0.006	−0.011	−0.022	−0.044	−0.067	−0.089	−0.111
2.20	−0.001	−0.004	−0.009	−0.018	−0.035	−0.053	−0.070	−0.087
2.40	−0.001	−0.004	−0.007	−0.014	−0.028	−0.042	−0.056	−0.070
2.60	−0.001	−0.003	−0.006	−0.012	−0.023	−0.035	−0.046	−0.058
2.80	−0.000	−0.002	−0.005	−0.010	−0.020	−0.029	−0.039	−0.048
3.00	−0.000	−0.002	−0.004	−0.008	−0.017	−0.025	−0.033	−0.041
3.50	−0.000	−0.001	−0.003	−0.006	−0.012	−0.017	−0.023	−0.029
4.00	−0.000	−0.001	−0.002	−0.004	−0.009	−0.013	−0.017	−0.021

Table D.10: Values of $(S^R)^1/R$

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*−16.782*	*−16.774*	*−16.764*	*−16.744*	*−16.705*	*−16.665*	*−16.626*	−16.586
0.35	*−15.413*	*−15.408*	*−15.401*	*−15.387*	*−15.359*	*−15.333*	*−15.305*	−15.278
0.40	*−13.990*	*−13.986*	*−13.981*	*−13.972*	*−13.953*	*−13.934*	*−13.915*	−13.896
0.45	*−12.564*	*−12.561*	*−12.558*	*−12.551*	*−12.537*	*−12.523*	*−12.509*	−12.496
0.50	*−11.202*	*−11.200*	*−11.197*	*−11.092*	*−11.082*	*−11.172*	*−11.162*	−11.153
0.55	−0.115	*−9.948*	*−9.946*	*−9.942*	*−9.935*	*−9.928*	*−9.921*	−9.914
0.60	−0.078	*−8.828*	*−8.826*	*−8.823*	*−8.817*	*−8.811*	*−8.806*	−8.799
0.65	−0.055	−0.309	*−7.832*	*−7.829*	*−7.824*	*−7.819*	*−7.815*	−7.510
0.70	−0.040	−0.216	−0.491	*−6.951*	*−6.945*	*−6.941*	*−6.937*	−6.933
0.75	−0.029	−0.156	−0.340	*−6.173*	*−6.167*	*−6.162*	*−6.158*	−6.155
0.80	−0.022	−0.116	−0.246	−0.578	*−5.475*	*−5.468*	*−5.462*	−5.458
0.85	−0.017	−0.088	−0.183	−0.400	*−4.853*	*−4.841*	*−4.832*	−4.826
0.90	−0.013	−0.068	−0.140	−0.301	−0.744	*−4.269*	*−4.249*	−4.238
0.93	−0.011	−0.058	−0.120	−0.254	−0.593	−1.219	*−3.914*	−3.894
0.95	−0.010	−0.053	−0.109	−0.228	−0.517	−0.961	*−3.697*	−3.658
0.97	−0.010	−0.048	−0.099	−0.206	−0.456	−0.797	−1.570	−3.406
0.98	−0.009	−0.046	−0.094	−0.196	−0.429	−0.734	−1.270	−3.264
0.99	−0.009	−0.044	−0.090	−0.186	−0.405	−0.680	−1.098	−3.093
1.00	−0.008	−0.042	−0.086	−0.177	−0.382	−0.632	−0.977	−2.399
1.01	−0.008	−0.040	−0.082	−0.169	−0.361	−0.590	−0.883	−1.306
1.02	−0.008	−0.039	−0.078	−0.161	−0.342	−0.552	−0.807	−1.113
1.05	−0.007	−0.034	−0.069	−0.140	−0.292	−0.460	−0.642	−0.820
1.10	−0.005	−0.028	−0.055	−0.112	−0.229	−0.350	−0.470	−0.577
1.15	−0.005	−0.023	−0.045	−0.091	−0.183	−0.275	−0.361	−0.437
1.20	−0.004	−0.019	−0.037	−0.075	−0.149	−0.220	−0.286	−0.343
1.30	−0.003	−0.013	−0.026	−0.052	−0.102	−0.148	−0.190	−0.226
1.40	−0.002	−0.010	−0.019	−0.037	−0.072	−0.104	−0.133	−0.158
1.50	−0.001	−0.007	−0.014	−0.027	−0.053	−0.076	−0.097	−0.115
1.60	−0.001	−0.005	−0.011	−0.021	−0.040	−0.057	−0.073	−0.086
1.70	−0.001	−0.004	−0.008	−0.016	−0.031	−0.044	−0.056	−0.067
1.80	−0.001	−0.003	−0.006	−0.013	−0.024	−0.035	−0.044	−0.053
1.90	−0.001	−0.003	−0.005	−0.010	−0.019	−0.028	−0.036	−0.043
2.00	−0.000	−0.002	−0.004	−0.008	−0.016	−0.023	−0.029	−0.035
2.20	−0.000	−0.001	−0.003	−0.006	−0.011	−0.016	−0.021	−0.025
2.40	−0.000	−0.001	−0.002	−0.004	−0.008	−0.012	−0.015	−0.019
2.60	−0.000	−0.001	−0.002	−0.003	−0.006	−0.009	−0.012	−0.015
2.80	−0.000	−0.001	−0.001	−0.003	−0.005	−0.008	−0.010	−0.012
3.00	−0.000	−0.001	−0.001	−0.002	−0.004	−0.006	−0.008	−0.010
3.50	−0.000	−0.000	−0.001	−0.001	−0.003	−0.004	−0.006	−0.007
4.00	−0.000	−0.000	−0.001	−0.001	−0.002	−0.003	−0.005	−0.006

Table D.11: Values of $(S^R)^0/R$

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	−7.099	−6.935	−6.740	−6.497	−6.180	−5.847	−5.683	−5.578
0.35	−6.663	−6.497	−6.299	−6.052	−5.728	−5.376	−5.194	−5.060
0.40	−6.275	−6.109	−5.909	−5.660	−5.330	−4.967	−4.772	−4.619
0.45	−5.924	−5.757	−5.557	−5.306	−4.974	−4.603	−4.401	−4.234
0.50	−5.608	−5.441	−5.240	−4.989	−4.656	−4.282	−4.074	−3.899
0.55	−5.324	−5.157	−4.956	−4.706	−4.373	−3.998	−3.788	−3.607
0.60	−5.066	−4.900	−4.700	−4.451	−4.120	−3.747	−3.537	−3.353
0.65	−4.830	−4.665	−4.467	−4.220	−3.892	−3.523	−3.315	−3.131
0.70	−4.610	−4.446	−4.250	−4.007	−3.684	−3.322	−3.117	−2.935
0.75	−4.399	−4.238	−4.045	−3.807	−3.491	−3.138	−2.939	−2.761
0.80	−4.191	−4.034	−3.846	−3.615	−3.310	−2.970	−2.777	−2.605
0.85	−3.976	−3.825	−3.646	−3.425	−3.135	−2.812	−2.629	−2.463
0.90	−3.738	−3.599	−3.434	−3.231	−2.964	−2.663	−2.491	−2.334
0.93	−3.569	−3.444	−3.295	−3.108	−2.860	−2.577	−2.412	−2.262
0.95	−3.433	−3.326	−3.193	−3.023	−2.790	−2.520	−2.362	−2.215
0.97	−3.259	−3.188	−3.081	−2.932	−2.719	−2.463	−2.312	−2.170
0.98	−3.142	−3.106	−3.019	−2.884	−2.682	−2.436	−2.287	−2.148
0.99	−2.972	−3.010	−2.953	−2.835	−2.646	−2.408	−2.263	−2.126
1.00	−2.178	−2.893	−2.879	−2.784	−2.609	−2.380	−2.239	−2.105
1.01	−1.391	−2.736	−2.798	−2.730	−2.571	−2.352	−2.215	−2.083
1.02	−1.225	−2.495	−2.706	−2.673	−2.533	−2.325	−2.191	−2.062
1.05	−0.965	−1.523	−2.328	−2.483	−2.415	−2.242	−2.121	−2.001
1.10	−0.742	−1.012	−1.557	−2.081	−2.202	−2.104	−2.007	−1.903
1.15	−0.607	−0.790	−1.126	−1.649	−1.968	−1.966	−1.897	−1.810
1.20	−0.512	−0.651	−0.890	−1.308	−1.727	−1.827	−1.789	−1.722
1.30	−0.385	−0.478	−0.628	−0.891	−1.299	−1.554	−1.581	−1.556
1.40	−0.303	−0.375	−0.478	−0.663	−0.990	−1.303	−1.386	−1.402
1.50	−0.246	−0.299	−0.381	−0.520	−0.777	−1.088	−1.208	−1.260
1.60	−0.204	−0.247	−0.312	−0.421	−0.628	−0.913	−1.050	−1.130
1.70	−0.172	−0.208	−0.261	−0.350	−0.519	−0.773	−0.915	−1.013
1.80	−0.147	−0.177	−0.222	−0.296	−0.438	−0.661	−0.799	−0.908
1.90	−0.127	−0.153	−0.191	−0.255	−0.375	−0.570	−0.702	−0.815
2.00	−0.111	−0.134	−0.167	−0.221	−0.625	−0.497	−0.620	−0.733
2.20	−0.087	−0.105	−0.130	−0.172	−0.251	−0.388	−0.492	−0.599
2.40	−0.070	−0.084	−0.104	−0.138	−0.201	−0.311	−0.399	−0.496
2.60	−0.058	−0.069	−0.086	−0.113	−0.164	−0.255	−0.329	−0.416
2.80	−0.048	−0.058	−0.072	−0.094	−0.137	−0.213	−0.277	−0.353
3.00	−0.041	−0.049	−0.061	−0.080	−0.116	−0.181	−0.236	−0.303
3.50	−0.029	−0.034	−0.042	−0.056	−0.081	−0.126	−0.166	−0.216
4.00	−0.021	−0.025	−0.031	−0.041	−0.059	−0.093	−0.123	−0.162

Table D.12: Values of $(S^R)^1/R$

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	−16.586	−16.547	−16.488	−16.390	−16.195	−15.837	−15.468	−14.925
0.35	−15.278	−15.251	−15.211	−15.144	−15.011	−14.751	−14.496	−14.153
0.40	−13.896	−13.877	−13.849	−13.803	−13.714	−13.541	−13.376	−13.144
0.45	−12.496	−12.482	−12.462	−12.430	−12.367	−12.248	−12.145	−11.999
0.50	−11.153	−11.143	−11.129	−11.107	−11.063	−10.985	−10.920	−10.836
0.55	−9.914	−9.907	−9.897	−9.882	−9.853	−9.806	−9.769	−9.732
0.60	−8.799	−8.794	−8.787	−8.777	−8.760	−8.736	−8.723	−8.720
0.65	−7.810	−7.807	−7.801	−7.794	−7.784	−7.779	−7.785	−7.811
0.70	−6.933	−6.930	−6.926	−6.922	−6.919	−6.929	−6.952	−7.002
0.75	−6.155	−6.152	−6.149	−6.147	−6.149	−6.174	−6.213	−6.285
0.80	−5.458	−5.455	−5.453	−5.452	−5.461	−5.501	−5.555	−5.648
0.85	−4.826	−4.822	−4.820	−4.822	−4.839	−4.898	−4.969	−5.082
0.90	−4.238	−4.232	−4.230	−4.236	−4.267	−4.351	−4.442	−4.578
0.93	−3.894	−3.885	−3.884	−3.896	−3.941	−4.046	−4.151	−4.300
0.95	−3.658	−3.647	−3.648	−3.669	−3.728	−3.851	−3.966	−4.125
0.97	−3.406	−3.391	−3.401	−3.437	−3.517	−3.661	−3.788	−3.957
0.98	−3.264	−3.247	−3.268	−3.318	−3.412	−3.569	−3.701	−3.875
0.99	−3.093	−3.082	−3.126	−3.195	−3.306	−3.477	−3.616	−3.796
1.00	−2.399	−2.868	−2.967	−3.067	−3.200	−3.387	−3.532	−3.717
1.01	−1.306	−2.513	−2.784	−2.933	−3.094	−3.297	−3.450	−3.640
1.02	−1.113	−1.655	−2.557	−2.790	−2.986	−3.209	−3.369	−3.565
1.05	−0.820	−0.831	−1.443	−2.283	−2.655	−2.949	−3.134	−3.348
1.10	−0.577	−0.640	−0.618	−1.241	−2.067	−2.534	−2.767	−3.013
1.15	−0.437	−0.489	−0.502	−0.654	−1.471	−2.138	−2.428	−2.708
1.20	−0.343	−0.385	−0.412	−0.447	−0.991	−1.767	−2.115	−2.430
1.30	−0.226	−0.254	−0.282	−0.300	−0.481	−1.147	−1.569	−1.944
1.40	−0.158	−0.178	−0.200	−0.220	−0.290	−0.730	−1.138	−1.544
1.50	−0.115	−0.130	−0.147	−0.166	−0.206	−0.479	−0.823	−1.222
1.60	−0.086	−0.098	−0.112	−0.129	−0.159	−0.334	−0.604	−0.969
1.70	−0.067	−0.076	−0.087	−0.102	−0.127	−0.248	−0.456	−0.775
1.80	−0.053	−0.060	−0.070	−0.083	−0.105	−0.195	−0.355	−0.628
1.90	−0.043	−0.049	−0.057	−0.069	−0.089	−0.160	−0.286	−0.518
2.00	−0.035	−0.040	−0.048	−0.058	−0.077	−0.136	−0.238	−0.434
2.20	−0.025	−0.029	−0.035	−0.043	−0.060	−0.105	−0.178	−0.322
2.40	−0.019	−0.022	−0.027	−0.034	−0.048	−0.086	−0.143	−0.254
2.60	−0.015	−0.018	−0.021	−0.028	−0.041	−0.074	−0.120	−0.210
2.80	−0.012	−0.014	−0.018	−0.023	−0.025	−0.065	−0.104	−0.180
3.00	−0.010	−0.012	−0.015	−0.020	−0.031	−0.058	−0.093	−0.158
3.50	−0.007	−0.009	−0.011	−0.015	−0.024	−0.046	−0.073	−0.122
4.00	−0.006	−0.007	−0.009	−0.012	−0.020	−0.038	−0.060	−0.100

Table D.13: Values of ϕ^0

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*0.0002*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	0.0000
0.35	*0.0034*	*0.0007*	*0.0003*	*0.0002*	*0.0001*	*0.0001*	*0.0001*	0.0000
0.40	*0.0272*	*0.0055*	*0.0028*	*0.0014*	*0.0007*	*0.0005*	*0.0004*	0.0003
0.45	*0.1321*	*0.0266*	*0.0135*	*0.0069*	*0.0036*	*0.0025*	*0.0020*	0.0016
0.50	*0.4529*	*0.0912*	*0.0461*	*0.0235*	*0.0122*	*0.0085*	*0.0067*	0.0055
0.55	0.9817	*0.2432*	*0.1227*	*0.0625*	*0.0325*	*0.0225*	*0.0176*	0.0146
0.60	0.9840	*0.5383*	*0.2716*	*0.1384*	*0.0718*	*0.0497*	*0.0386*	0.0321
0.65	0.9886	0.9419	*0.5212*	*0.2655*	*0.1374*	*0.0948*	*0.0738*	0.0611
0.70	0.9908	0.9528	0.9057	*0.4560*	*0.2360*	*0.1626*	*0.1262*	0.1045
0.75	0.9931	0.9616	0.9226	*0.7178*	*0.3715*	*0.2559*	*0.1982*	0.1641
0.80	0.9931	0.9683	0.9354	0.8730	*0.5445*	*0.3750*	*0.2904*	0.2404
0.85	0.9954	0.9727	0.9462	0.8933	*0.7534*	*0.5188*	*0.4018*	0.3319
0.90	0.9954	0.9772	0.9550	0.9099	0.8204	*0.6823*	*0.5297*	0.4375
0.93	0.9954	0.9795	0.9594	0.9183	0.8375	0.7551	*0.6109*	0.5058
0.95	0.9954	0.9817	0.9616	0.9226	0.8472	0.7709	*0.6668*	0.5521
0.97	0.9954	0.9817	0.9638	0.9268	0.8570	0.7852	0.7112	0.5984
0.98	0.9954	0.9817	0.9638	0.9290	0.8610	0.7925	0.7211	0.6223
0.99	0.9977	0.9840	0.9661	0.9311	0.8650	0.7980	0.7295	0.6442
1.00	0.9977	0.9840	0.9661	0.9333	0.8690	0.8035	0.7379	0.6668
1.01	0.9977	0.9840	0.9683	0.9354	0.8730	0.8110	0.7464	0.6792
1.02	0.9977	0.9840	0.9683	0.9376	0.8770	0.8166	0.7551	0.6902
1.05	0.9977	0.9863	0.9705	0.9441	0.8872	0.8318	0.7762	0.7194
1.10	0.9977	0.9886	0.9750	0.9506	0.9016	0.8531	0.8072	0.7586
1.15	0.9977	0.9886	0.9795	0.9572	0.9141	0.8730	0.8318	0.7907
1.20	0.9977	0.9908	0.9817	0.9616	0.9247	0.8892	0.8531	0.8166
1.30	0.9977	0.9931	0.9863	0.9705	0.9419	0.9141	0.8872	0.8590
1.40	0.9977	0.9931	0.9886	0.9772	0.9550	0.9333	0.9120	0.8892
1.50	1.0000	0.9954	0.9908	0.9817	0.9638	0.9462	0.9290	0.9141
1.60	1.0000	0.9954	0.9931	0.9863	0.9727	0.9572	0.9441	0.9311
1.70	1.0000	0.9977	0.9954	0.9886	0.9772	0.9661	0.9550	0.9462
1.80	1.0000	0.9977	0.9954	0.9908	0.9817	0.9727	0.9661	0.9572
1.90	1.0000	0.9977	0.9954	0.9931	0.9863	0.9795	0.9727	0.9661
2.00	1.0000	0.9977	0.9977	0.9954	0.9886	0.9840	0.9795	0.9727
2.20	1.0000	1.0000	0.9977	0.9977	0.9931	0.9908	0.9886	0.9840
2.40	1.0000	1.0000	1.0000	0.9977	0.9977	0.9954	0.9931	0.9931
2.60	1.0000	1.0000	1.0000	1.0000	1.0000	0.9977	0.9977	0.9977
2.80	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0023	1.0023
3.00	1.0000	1.0000	1.0000	1.0000	1.0023	1.0023	1.0046	1.0046
3.50	1.0000	1.0000	1.0000	1.0023	1.0023	1.0046	1.0069	1.0093
4.00	1.0000	1.0000	1.0000	1.0023	1.0046	1.0069	1.0093	1.0116

Table D.14: Values of ϕ^1

$P_r =$	0.0100	0.0500	0.1000	0.2000	0.4000	0.6000	0.8000	1.0000
T_r								
0.30	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	0.0000
0.35	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	0.0000
0.40	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	0.0000
0.45	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	*0.0002*	0.0002
0.50	*0.0014*	*0.0014*	*0.0014*	*0.0014*	*0.0014*	*0.0014*	*0.0013*	0.0013
0.55	0.9705	*0.0069*	*0.0068*	*0.0068*	*0.0066*	*0.0065*	*0.0064*	0.0063
0.60	0.9795	*0.0227*	*0.0226*	*0.0223*	*0.0220*	*0.0216*	*0.0213*	0.0210
0.65	0.9863	0.9311	*0.0572*	*0.0568*	*0.0559*	*0.0551*	*0.0543*	0.0535
0.70	0.9908	0.9528	0.9036	*0.1182*	*0.1163*	*0.1147*	*0.1131*	0.1116
0.75	0.9931	0.9683	0.9332	*0.2112*	*0.2078*	*0.2050*	*0.2022*	0.1994
0.80	0.9954	0.9772	0.9550	0.9057	*0.3302*	*0.3257*	*0.3212*	0.3168
0.85	0.9977	0.9863	0.9705	0.9375	*0.4774*	*0.4708*	*0.4654*	0.4590
0.90	0.9977	0.9908	0.9795	0.9594	0.9141	*0.6323*	*0.6250*	0.6165
0.93	0.9977	0.9931	0.9840	0.9705	0.9354	0.8953	*0.7227*	0.7144
0.95	0.9977	0.9931	0.9885	0.9750	0.9484	0.9183	*0.7888*	0.7797
0.97	1.0000	0.9954	0.9908	0.9795	0.9594	0.9354	0.9078	0.8413
0.98	1.0000	0.9954	0.9908	0.9817	0.9638	0.9440	0.9225	0.8729
0.99	1.0000	0.9954	0.9931	0.9840	0.9683	0.9528	0.9332	0.9036
1.00	1.0000	0.9977	0.9931	0.9863	0.9727	0.9594	0.9440	0.9311
1.01	1.0000	0.9977	0.9931	0.9885	0.9772	0.9638	0.9528	0.9462
1.02	1.0000	0.9977	0.9954	0.9908	0.9795	0.9705	0.9616	0.9572
1.05	1.0000	0.9977	0.9977	0.9954	0.9885	0.9863	0.9840	0.9840
1.10	1.0000	1.0000	1.0000	1.0000	1.0023	1.0046	1.0093	1.0163
1.15	1.0000	1.0000	1.0023	1.0046	1.0116	1.0186	1.0257	1.0375
1.20	1.0000	1.0023	1.0046	1.0069	1.0163	1.0280	1.0399	1.0544
1.30	1.0000	1.0023	1.0069	1.0116	1.0257	1.0399	1.0544	1.0716
1.40	1.0000	1.0046	1.0069	1.0139	1.0304	1.0471	1.0642	1.0815
1.50	1.0000	1.0046	1.0069	1.0163	1.0328	1.0496	1.0666	1.0865
1.60	1.0000	1.0046	1.0069	1.0163	1.0328	1.0496	1.0691	1.0865
1.70	1.0000	1.0046	1.0093	1.0163	1.0328	1.0496	1.0691	1.0865
1.80	1.0000	1.0046	1.0069	1.0163	1.0328	1.0496	1.0666	1.0840
1.90	1.0000	1.0046	1.0069	1.0163	1.0328	1.0496	1.0666	1.0815
2.00	1.0000	1.0046	1.0069	1.0163	1.0304	1.0471	1.0642	1.0815
2.20	1.0000	1.0046	1.0069	1.0139	1.0304	1.0447	1.0593	1.0765
2.40	1.0000	1.0046	1.0069	1.0139	1.0280	1.0423	1.0568	1.0716
2.60	1.0000	1.0023	1.0069	1.0139	1.0257	1.0399	1.0544	1.0666
2.80	1.0000	1.0023	1.0069	1.0116	1.0257	1.0375	1.0496	1.0642
3.00	1.0000	1.0023	1.0069	1.0116	1.0233	1.0352	1.0471	1.0593
3.50	1.0000	1.0023	1.0046	1.0023	1.0209	1.0304	1.0423	1.0520
4.00	1.0000	1.0023	1.0046	1.0093	1.0186	1.0280	1.0375	1.0471

Table D.15: Values of ϕ^0

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.40	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002	0.0003
0.45	0.0016	0.0014	0.0012	0.0010	0.0008	0.0008	0.0009	0.0012
0.50	0.0055	0.0048	0.0041	0.0034	0.0028	0.0025	0.0027	0.0034
0.55	0.0146	0.0127	0.0107	0.0089	0.0072	0.0063	0.0066	0.0080
0.60	0.0321	0.0277	0.0234	0.0193	0.0154	0.0132	0.0135	0.0160
0.65	0.0611	0.0527	0.0445	0.0364	0.0289	0.0244	0.0245	0.0282
0.70	0.1045	0.0902	0.0759	0.0619	0.0488	0.0406	0.0402	0.0453
0.75	0.1641	0.1413	0.1188	0.0966	0.0757	0.0625	0.0610	0.0673
0.80	0.2404	0.2065	0.1738	0.1409	0.1102	0.0899	0.0867	0.0942
0.85	0.3319	0.2858	0.2399	0.1945	0.1517	0.1227	0.1175	0.1256
0.90	0.4375	0.3767	0.3162	0.2564	0.1995	0.1607	0.1524	0.1611
0.93	0.5058	0.4355	0.3656	0.2972	0.2307	0.1854	0.1754	0.1841
0.95	0.5521	0.4764	0.3999	0.3251	0.2523	0.2028	0.1910	0.2000
0.97	0.5984	0.5164	0.4345	0.3532	0.2748	0.2203	0.2075	0.2163
0.98	0.6223	0.5370	0.4529	0.3681	0.2864	0.2296	0.2158	0.2244
0.99	0.6442	0.5572	0.4699	0.3828	0.2978	0.2388	0.2244	0.2328
1.00	0.6668	0.5781	0.4875	0.3972	0.3097	0.2483	0.2328	0.2415
1.01	0.6792	0.5970	0.5047	0.4121	0.3214	0.2576	0.2415	0.2500
1.02	0.6902	0.6166	0.5224	0.4266	0.3334	0.2673	0.2506	0.2582
1.05	0.7194	0.6607	0.5728	0.4710	0.3690	0.2958	0.2773	0.2844
1.10	0.7586	0.7112	0.6412	0.5408	0.4285	0.3451	0.3228	0.3296
1.15	0.7907	0.7499	0.6918	0.6026	0.4875	0.3954	0.3690	0.3750
1.20	0.8166	0.7834	0.7328	0.6546	0.5420	0.4446	0.4150	0.4198
1.30	0.8590	0.8318	0.7943	0.7345	0.6383	0.5383	0.5058	0.5093
1.40	0.8892	0.8690	0.8395	0.7925	0.7145	0.6237	0.5902	0.5943
1.50	0.9141	0.8974	0.8730	0.8375	0.7745	0.6966	0.6668	0.6714
1.60	0.9311	0.9183	0.8995	0.8710	0.8222	0.7586	0.7328	0.7430
1.70	0.9462	0.9354	0.9204	0.8995	0.8610	0.8091	0.7907	0.8054
1.80	0.9572	0.9484	0.9376	0.9204	0.8913	0.8531	0.8414	0.8590
1.90	0.9661	0.9594	0.9506	0.9376	0.9162	0.8872	0.8831	0.9057
2.00	0.9727	0.9683	0.9616	0.9528	0.9354	0.9183	0.9183	0.9462
2.20	0.9840	0.9817	0.9795	0.9727	0.9661	0.9616	0.9727	1.0093
2.40	0.9931	0.9908	0.9908	0.9886	0.9863	0.9931	1.0116	1.0568
2.60	0.9977	0.9977	0.9977	0.9977	1.0023	1.0162	1.0399	1.0889
2.80	1.0023	1.0023	1.0046	1.0069	1.0116	1.0328	1.0593	1.1117
3.00	1.0046	1.0069	1.0069	1.0116	1.0209	1.0423	1.0740	1.1298
3.50	1.0093	1.0116	1.0139	1.0186	1.0304	1.0593	1.0914	1.1508
4.00	1.0116	1.0139	1.0162	1.0233	1.0375	1.0666	1.0990	1.1588

Table D.16: Values of ϕ^1

$P_r =$	1.0000	1.2000	1.5000	2.0000	3.0000	5.0000	7.0000	10.000
T_r								
0.30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.45	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001
0.50	0.0013	0.0013	0.0013	0.0012	0.0011	0.0009	0.0008	0.0006
0.55	0.0063	0.0062	0.0061	0.0058	0.0053	0.0045	0.0039	0.0031
0.60	0.0210	0.0207	0.0202	0.0194	0.0179	0.0154	0.0133	0.0108
0.65	0.0536	0.0527	0.0516	0.0497	0.0461	0.0401	0.0350	0.0289
0.70	0.1117	0.1102	0.1079	0.1040	0.0970	0.0851	0.0752	0.0629
0.75	0.1995	0.1972	0.1932	0.1871	0.1754	0.1552	0.1387	0.1178
0.80	0.3170	0.3133	0.3076	0.2978	0.2812	0.2512	0.2265	0.1954
0.85	0.4592	0.4539	0.4457	0.4325	0.4093	0.3698	0.3365	0.2951
0.90	0.6166	0.6095	0.5998	0.5834	0.5546	0.5058	0.4645	0.4130
0.93	0.7145	0.7063	0.6950	0.6761	0.6457	0.5916	0.5470	0.4898
0.95	0.7798	0.7691	0.7568	0.7379	0.7063	0.6501	0.6026	0.5432
0.97	0.8414	0.8318	0.8185	0.7998	0.7656	0.7096	0.6607	0.5984
0.98	0.8730	0.8630	0.8492	0.8298	0.7962	0.7379	0.6887	0.6266
0.99	0.9036	0.8913	0.8790	0.8590	0.8241	0.7674	0.7178	0.6546
1.00	0.9311	0.9204	0.9078	0.8872	0.8531	0.7962	0.7464	0.6823
1.01	0.9462	0.9462	0.9333	0.9162	0.8831	0.8241	0.7745	0.7096
1.02	0.9572	0.9661	0.9594	0.9419	0.9099	0.8531	0.8035	0.7379
1.05	0.9840	0.9954	1.0186	1.0162	0.9886	0.9354	0.8872	0.8222
1.10	1.0162	1.0280	1.0593	1.0990	1.1015	1.0617	1.0186	0.9572
1.15	1.0375	1.0520	1.0814	1.1376	1.1858	1.1722	1.1403	1.0864
1.20	1.0544	1.0691	1.0990	1.1588	1.2388	1.2647	1.2474	1.2050
1.30	1.0715	1.0914	1.1194	1.1776	1.2853	1.3868	1.4125	1.4061
1.40	1.0814	1.0990	1.1298	1.1858	1.2942	1.4488	1.5171	1.5524
1.50	1.0864	1.1041	1.1350	1.1858	1.2942	1.4689	1.5740	1.6520
1.60	1.0864	1.1041	1.1350	1.1858	1.2883	1.4689	1.5996	1.7140
1.70	1.0864	1.1041	1.1324	1.1803	1.2794	1.4622	1.6033	1.7458
1.80	1.0839	1.1015	1.1298	1.1749	1.2706	1.4488	1.5959	1.7620
1.90	1.0814	1.0990	1.1272	1.1695	1.2618	1.4355	1.5849	1.7620
2.00	1.0814	1.0965	1.1220	1.1641	1.2503	1.4191	1.5704	1.7539
2.20	1.0765	1.0914	1.1143	1.1535	1.2331	1.3900	1.5346	1.7219
2.40	1.0715	1.0864	1.1066	1.1429	1.2190	1.3614	1.4997	1.6866
2.60	1.0666	1.0814	1.1015	1.1350	1.2023	1.3397	1.4689	1.6482
2.80	1.0641	1.0765	1.0940	1.1272	1.1912	1.3183	1.4388	1.6144
3.00	1.0593	1.0715	1.0889	1.1194	1.1803	1.3002	1.4158	1.5813
3.50	1.0520	1.0617	1.0789	1.1041	1.1561	1.2618	1.3614	1.5101
4.00	1.0471	1.0544	1.0691	1.0914	1.1403	1.2303	1.3213	1.4555