

Ihsan Barin

**Thermochemical Data  
of Pure Substances**



**H2[g]****HYDROGEN (GAS)**

2.016

Phase	T [ K ]	C <sub>p</sub> [ — ]	S J / (K mol)	-(G-H298)/T [ — ]	H [ — ]	H-H298 [ — ]	G kJ / mol	ΔH <sub>f</sub> [ — ]	ΔG <sub>f</sub> [ — ]	log K <sub>f</sub> [ — ]
GAS	298.15	28.836	130.680	130.680	0.000	0.000	-38.962	0.000	0.000	0.000
	300.00	28.849	130.858	130.681	0.053	0.053	-39.204	0.000	0.000	0.000
	400.00	29.182	139.216	131.818	2.959	2.959	-52.727	0.000	0.000	0.000
	500.00	29.260	145.737	133.974	5.882	5.882	-66.987	0.000	0.000	0.000
	600.00	29.326	151.077	136.393	8.811	8.811	-81.836	0.000	0.000	0.000
	700.00	29.442	155.606	138.822	11.749	11.749	-97.175	0.000	0.000	0.000
	800.00	29.625	159.549	141.172	14.702	14.702	-112.937	0.000	0.000	0.000
	900.00	29.880	163.052	143.412	17.676	17.676	-129.070	0.000	0.000	0.000
	1000.00	30.205	166.216	145.536	20.680	20.680	-145.536	0.000	0.000	0.000
	1100.00	30.579	169.112	147.550	23.719	23.719	-162.305	0.000	0.000	0.000
	1200.00	30.992	171.790	149.460	26.797	26.797	-179.352	0.000	0.000	0.000
	1300.00	31.424	174.288	151.275	29.918	29.918	-196.657	0.000	0.000	0.000
	1400.00	31.863	176.633	153.003	33.082	33.082	-214.204	0.000	0.000	0.000
	1500.00	32.298	178.846	154.653	36.290	36.290	-231.979	0.000	0.000	0.000
	1600.00	32.725	180.944	156.231	39.541	39.541	-249.970	0.000	0.000	0.000
	1700.00	33.138	182.941	157.744	42.835	42.835	-268.165	0.000	0.000	0.000
	1800.00	33.536	184.846	159.197	46.168	46.168	-286.555	0.000	0.000	0.000
	1900.00	33.916	186.670	160.595	49.541	49.541	-305.131	0.000	0.000	0.000
	2000.00	34.279	188.419	161.943	52.951	52.951	-323.886	0.000	0.000	0.000
	2100.00	34.625	190.100	163.244	56.396	56.396	-342.813	0.000	0.000	0.000
	2200.00	34.953	191.718	164.502	59.875	59.875	-361.904	0.000	0.000	0.000
	2300.00	35.264	193.279	165.719	63.386	63.386	-381.154	0.000	0.000	0.000
	2400.00	35.560	194.786	166.899	66.928	66.928	-400.558	0.000	0.000	0.000
	2500.00	35.842	196.243	168.044	70.498	70.498	-420.110	0.000	0.000	0.000
	2600.00	36.111	197.654	169.156	74.096	74.096	-439.805	0.000	0.000	0.000
	2700.00	36.369	199.022	170.237	77.720	77.720	-459.639	0.000	0.000	0.000
	2800.00	36.616	200.349	171.289	81.369	81.369	-479.608	0.000	0.000	0.000
	2900.00	36.856	201.638	172.313	85.043	85.043	-499.708	0.000	0.000	0.000
	3000.00	37.089	202.891	173.311	88.740	88.740	-519.934	0.000	0.000	0.000
	3100.00	37.311	204.111	174.285	92.460	92.460	-540.285	0.000	0.000	0.000
	3200.00	37.529	205.299	175.236	96.202	96.202	-560.756	0.000	0.000	0.000
	3300.00	37.740	206.457	176.165	99.966	99.966	-581.344	0.000	0.000	0.000
	3400.00	37.946	207.587	177.072	103.750	103.750	-602.046	0.000	0.000	0.000
	3500.00	38.149	208.690	177.960	107.555	107.555	-622.860	0.000	0.000	0.000
	3600.00	38.348	209.767	178.829	111.380	111.380	-643.783	0.000	0.000	0.000
	3700.00	38.544	210.821	179.679	115.224	115.224	-664.813	0.000	0.000	0.000
	3800.00	38.737	211.851	180.512	119.088	119.088	-685.947	0.000	0.000	0.000
	3900.00	38.928	212.860	181.329	122.971	122.971	-707.182	0.000	0.000	0.000
	4000.00	39.116	213.848	182.129	126.874	126.874	-728.518	0.000	0.000	0.000
	4100.00	39.302	214.816	182.915	130.795	130.795	-749.951	0.000	0.000	0.000
	4200.00	39.485	215.765	183.686	134.734	134.734	-771.480	0.000	0.000	0.000
	4300.00	39.665	216.697	184.443	138.691	138.691	-793.104	0.000	0.000	0.000
	4400.00	39.843	217.610	185.186	142.667	142.667	-814.819	0.000	0.000	0.000
	4500.00	40.017	218.508	185.917	146.660	146.660	-836.625	0.000	0.000	0.000
	4600.00	40.188	219.389	186.635	150.670	150.670	-858.520	0.000	0.000	0.000
	4700.00	40.355	220.255	187.341	154.697	154.697	-880.503	0.000	0.000	0.000
	4800.00	40.518	221.107	188.036	158.741	158.741	-902.571	0.000	0.000	0.000
	4900.00	40.676	221.944	188.719	162.801	162.801	-924.723	0.000	0.000	0.000
	5000.00	40.828	222.767	189.392	166.876	166.876	-946.959	0.000	0.000	0.000

**References**

Phase	H / S	C <sub>p</sub>
GAS	Ja2	Ja2

31.999

## OXYGEN (GAS)

O<sub>2</sub>[g]

Phase	T [ K ]	C <sub>p</sub> [ ————— J / (K mol) ————— ]	S	-(G-H298)/T [ ————— ]	H	H-H298	G	ΔH <sub>f</sub>	ΔG <sub>f</sub>	log K <sub>f</sub> [ - ]
GAS	298.15	29.376	205.147	205.147	0.000	0.000	-61.165	0.000	0.000	0.000
	300.00	29.385	205.329	205.148	0.054	0.054	-61.544	0.000	0.000	0.000
	400.00	30.106	213.871	206.307	3.025	3.025	-82.523	0.000	0.000	0.000
	500.00	31.091	220.693	208.524	6.084	6.084	-104.262	0.000	0.000	0.000
	600.00	32.089	226.451	211.044	9.244	9.244	-126.626	0.000	0.000	0.000
	700.00	32.981	231.466	213.611	12.499	12.499	-149.528	0.000	0.000	0.000
	800.00	33.734	235.921	216.126	15.836	15.836	-172.901	0.000	0.000	0.000
	900.00	34.354	239.931	218.552	19.241	19.241	-196.697	0.000	0.000	0.000
	1000.00	34.870	243.578	220.875	22.703	22.703	-220.875	0.000	0.000	0.000
	1100.00	35.302	246.922	223.093	26.212	26.212	-245.402	0.000	0.000	0.000
	1200.00	35.667	250.010	225.209	29.761	29.761	-270.251	0.000	0.000	0.000
	1300.00	35.987	252.878	227.228	33.344	33.344	-295.397	0.000	0.000	0.000
	1400.00	36.276	255.555	229.157	36.957	36.957	-320.820	0.000	0.000	0.000
	1500.00	36.543	258.067	231.002	40.598	40.598	-346.503	0.000	0.000	0.000
	1600.00	36.797	260.434	232.768	44.266	44.266	-372.429	0.000	0.000	0.000
	1700.00	37.041	262.672	234.462	47.957	47.957	-398.585	0.000	0.000	0.000
	1800.00	37.278	264.796	236.089	51.673	51.673	-424.959	0.000	0.000	0.000
	1900.00	37.511	266.818	237.653	55.413	55.413	-451.541	0.000	0.000	0.000
	2000.00	37.741	268.748	239.160	59.176	59.176	-478.320	0.000	0.000	0.000
	2100.00	37.969	270.595	240.613	62.961	62.961	-505.288	0.000	0.000	0.000
	2200.00	38.194	272.366	242.017	66.769	66.769	-532.436	0.000	0.000	0.000
	2300.00	38.418	274.069	243.373	70.600	70.600	-559.759	0.000	0.000	0.000
	2400.00	38.638	275.709	244.687	74.453	74.453	-587.248	0.000	0.000	0.000
	2500.00	38.855	277.290	245.959	78.327	78.327	-614.898	0.000	0.000	0.000
	2600.00	39.069	278.818	247.194	82.224	82.224	-642.704	0.000	0.000	0.000
	2700.00	39.277	280.297	248.393	86.141	86.141	-670.660	0.000	0.000	0.000
	2800.00	39.479	281.729	249.558	90.079	90.079	-698.762	0.000	0.000	0.000
	2900.00	39.675	283.118	250.691	94.037	94.037	-727.005	0.000	0.000	0.000
	3000.00	39.862	284.466	251.795	98.013	98.013	-755.384	0.000	0.000	0.000
	3100.00	40.047	285.776	252.870	102.009	102.009	-783.897	0.000	0.000	0.000
	3200.00	40.224	287.050	253.918	106.023	106.023	-812.538	0.000	0.000	0.000
	3300.00	40.395	288.291	254.941	110.054	110.054	-841.306	0.000	0.000	0.000
	3400.00	40.559	289.499	255.940	114.101	114.101	-870.195	0.000	0.000	0.000
	3500.00	40.717	290.677	256.916	118.165	118.165	-899.204	0.000	0.000	0.000
	3600.00	40.868	291.826	257.869	122.245	122.245	-928.330	0.000	0.000	0.000
	3700.00	41.014	292.948	258.802	126.339	126.339	-957.569	0.000	0.000	0.000
	3800.00	41.154	294.044	259.715	130.447	130.447	-986.919	0.000	0.000	0.000
	3900.00	41.290	295.114	260.609	134.569	134.569	-1016.377	0.000	0.000	0.000
	4000.00	41.421	296.161	261.485	138.705	138.705	-1045.941	0.000	0.000	0.000
	4100.00	41.549	297.186	262.343	142.854	142.854	-1075.608	0.000	0.000	0.000
	4200.00	41.674	298.189	263.185	147.015	147.015	-1105.377	0.000	0.000	0.000
	4300.00	41.797	299.171	264.011	151.188	151.188	-1135.245	0.000	0.000	0.000
	4400.00	41.919	300.133	264.821	155.374	155.374	-1165.211	0.000	0.000	0.000
	4500.00	42.041	301.076	265.616	159.572	159.572	-1195.271	0.000	0.000	0.000
	4600.00	42.164	302.002	266.397	163.782	163.782	-1225.425	0.000	0.000	0.000
	4700.00	42.288	302.910	267.164	168.005	168.005	-1255.671	0.000	0.000	0.000
	4800.00	42.414	303.801	267.918	172.240	172.240	-1286.007	0.000	0.000	0.000
	4900.00	42.543	304.677	268.659	176.488	176.488	-1316.431	0.000	0.000	0.000
	5000.00	42.676	305.538	269.388	180.748	180.748	-1346.942	0.000	0.000	0.000

## References

Phase	H / S	C <sub>p</sub>
GAS	Ja2	Ja2

H<sub>2</sub>O[g]

## WATER (GAS)

18.015

Phase	T [ K ]	C <sub>p</sub> [ ————— ]	S J / (K mol)	-(G-H298)/T [ ————— ]	H [ ————— ]	H-H298 kJ / mol	G kJ / mol	ΔH <sub>f</sub> [ ————— ]	ΔG <sub>f</sub> [ ————— ]	log K <sub>f</sub> [ - ]
GAS	298.15	33.590	188.959	188.959	-241.826	0.000	-298.164	-241.826	-228.620	40.053
	300.00	33.596	189.167	188.960	-241.764	0.062	-298.514	-241.844	-228.538	39.792
	400.00	34.261	198.910	190.284	-238.375	3.451	-317.939	-242.847	-223.951	29.245
	500.00	35.230	206.656	192.809	-234.902	6.924	-338.230	-243.826	-219.113	22.891
	600.00	36.322	213.174	195.673	-231.326	10.500	-359.230	-244.758	-214.081	18.637
	700.00	37.494	218.860	198.588	-227.635	14.191	-380.838	-245.633	-208.898	15.588
	800.00	38.723	223.947	201.445	-223.825	18.001	-402.982	-246.444	-203.595	13.293
	900.00	39.988	228.580	204.207	-219.889	21.937	-425.612	-247.186	-198.193	11.503
	1000.00	41.267	232.860	206.861	-215.827	25.999	-448.687	-247.858	-192.713	10.066
	1100.00	42.535	236.853	209.408	-211.636	30.190	-472.174	-248.461	-187.168	8.888
	1200.00	43.769	240.607	211.853	-207.321	34.505	-496.049	-248.998	-181.572	7.904
	1300.00	44.943	244.157	214.202	-202.885	38.941	-520.289	-249.475	-175.934	7.069
	1400.00	46.055	247.529	216.463	-198.334	43.492	-544.875	-249.895	-170.260	6.352
	1500.00	47.091	250.742	218.642	-193.676	48.150	-569.789	-250.266	-164.559	5.730
	1600.00	48.050	253.812	220.745	-188.919	52.907	-595.018	-250.593	-158.834	5.185
	1700.00	48.934	256.752	222.777	-184.069	57.757	-620.548	-250.882	-153.090	4.704
	1800.00	49.747	259.572	224.744	-179.134	62.692	-646.365	-251.139	-147.330	4.275
	1900.00	50.496	262.282	226.649	-174.122	67.704	-672.458	-251.369	-141.557	3.892
	2000.00	51.185	264.890	228.496	-169.037	72.789	-698.818	-251.576	-135.772	3.546
	2100.00	51.821	267.403	230.289	-163.886	77.940	-725.433	-251.763	-129.977	3.233
	2200.00	52.407	269.828	232.032	-158.675	83.151	-752.296	-251.935	-124.173	2.948
	2300.00	52.947	272.169	233.726	-153.407	88.419	-779.396	-252.093	-118.363	2.688
	2400.00	53.445	274.433	235.375	-148.087	93.739	-806.727	-252.241	-112.545	2.449
	2500.00	53.904	276.625	236.982	-142.719	99.107	-834.280	-252.381	-106.721	2.230
	2600.00	54.329	278.747	238.547	-137.307	104.519	-862.049	-252.515	-100.892	2.027
	2700.00	54.722	280.805	240.075	-131.854	109.972	-890.028	-252.644	-95.058	1.839
	2800.00	55.088	282.802	241.565	-126.363	115.463	-918.208	-252.772	-89.219	1.664
	2900.00	55.429	284.741	243.021	-120.837	120.989	-946.586	-252.898	-83.376	1.502
	3000.00	55.747	286.625	244.443	-115.278	126.548	-975.155	-253.025	-77.528	1.350
	3100.00	56.044	288.458	245.833	-109.689	132.137	-1003.909	-253.153	-71.676	1.208
	3200.00	56.323	290.242	247.193	-104.070	137.756	-1032.845	-253.284	-65.820	1.074
	3300.00	56.584	291.979	248.524	-98.425	143.401	-1061.956	-253.417	-59.960	0.949
	3400.00	56.830	293.672	249.827	-92.754	149.072	-1091.239	-253.555	-54.095	0.831
	3500.00	57.060	295.323	251.104	-87.059	154.767	-1120.689	-253.697	-48.227	0.720
	3600.00	57.278	296.933	252.355	-81.342	160.484	-1150.302	-253.844	-42.354	0.615
	3700.00	57.483	298.506	253.581	-75.604	166.222	-1180.075	-253.998	-36.477	0.515
	3800.00	57.676	300.041	254.783	-69.846	171.980	-1210.002	-254.158	-30.596	0.421
	3900.00	57.859	301.542	255.963	-64.069	177.757	-1240.082	-254.325	-24.711	0.331
	4000.00	58.033	303.009	257.121	-58.275	183.551	-1270.309	-254.501	-18.821	0.246
	4100.00	58.197	304.444	258.258	-52.463	189.363	-1300.682	-254.684	-12.927	0.165
	4200.00	58.354	305.848	259.374	-46.635	195.191	-1331.197	-254.877	-7.028	0.087
	4300.00	58.503	307.223	260.471	-40.793	201.033	-1361.851	-255.078	-1.125	0.014
	4400.00	58.645	308.569	261.549	-34.935	206.891	-1392.641	-255.289	4.784	-0.057
	4500.00	58.782	309.889	262.608	-29.064	212.762	-1423.564	-255.510	10.697	-0.124
	4600.00	58.914	311.182	263.650	-23.179	218.647	-1454.618	-255.740	16.615	-0.189
	4700.00	59.041	312.451	264.675	-17.281	224.545	-1485.800	-255.981	22.538	-0.250
	4800.00	59.164	313.695	265.684	-11.371	230.455	-1517.107	-256.232	28.467	-0.310
	4900.00	59.285	314.916	266.676	-5.448	236.378	-1548.538	-256.493	34.401	-0.367
	5000.00	59.402	316.115	267.653	0.486	242.312	-1580.090	-256.764	40.340	-0.421

## References

Phase	H / S	C <sub>p</sub>
GAS	Co1,e	Ja2