IONIZATION CONSTANT OF WATER

Serguei N. Lvov and Allan H. Harvey

This table gives values of $pK_w = -\log_{10}(K_w)$, where K_w is the equilibrium constant of the reaction $2H_2O = H_3O^+(aq) + OH^-(aq)$. K_w is defined as $K_w = a_{H_3O^+} a_{OH^-} / a_{H_2O}^2$, where a_i is the dimensionless activity of species *i*. The activities are on the molality basis for ions and mole fraction basis for water molecules. It is assumed that the activity of $H_3O^+(aq)$ is the same as the activity of $H^+(aq)$, so that K_w is numerically equal to $a_{H^+} a_{OH^-} / a_{H_2O}^2$, the equilibrium constant for the ionization reaction of water, $H_2O = H^+(aq) + OH^-(aq)$, that is most commonly used in the literature. Values in the table are calculated using an analytical equation given in Refs. 1 and 2 where K_w is presented as a function of temperature and density from 0 °C to 800 °C and 0 g cm^{-3} to 1.25 g cm^{-3}.

References

1. International Association for the Properties of Water and Steam, *Release on the Ionization Constant of H_2O* (2007), available from www.iapws.org.
2. Bandura, A.V., and Lvov, S.N., *J. Phys. Chem. Ref. Data* 35, 15, 2006.

Pressure, MPa	Temperature, °C								
	0	**25**	**50**	**75**	**100**	**150**	**200**	**250**	**300**
0.1 or p_s	14.946	13.995	13.264	12.696	12.252	11.641	11.310	11.205	11.339
25	14.848	13.908	13.181	12.613	12.165	11.543	11.189	11.050	11.125
50	14.754	13.824	13.102	12.533	12.084	11.450	11.076	10.898	10.893
75	14.665	13.745	13.026	12.458	12.006	11.364	10.974	10.769	10.715
100	14.580	13.668	12.953	12.385	11.933	11.283	10.880	10.655	10.568
150	14.422	13.524	12.815	12.249	11.795	11.135	10.713	10.458	10.327
200	14.278	13.390	12.687	12.123	11.668	11.000	10.564	10.289	10.131
250	14.145	13.265	12.567	12.004	11.549	10.876	10.430	10.140	9.963
300	14.021	13.148	12.453	11.892	11.437	10.760	10.306	10.005	9.814
350	13.906	13.037	12.346	11.786	11.331	10.651	10.191	9.881	9.679
400	13.797	12.932	12.243	11.685	11.230	10.548	10.083	9.766	9.555
500	13.595	12.736	12.052	11.496	11.042	10.356	9.884	9.557	9.332
600	13.411	12.556	11.875	11.322	10.868	10.181	9.703	9.369	9.135
700	13.240	12.389	11.710	11.159	10.705	10.018	9.537	9.197	8.956
800	13.080	12.233	11.556	11.006	10.553	9.865	9.381	9.037	8.791
900	12.930	12.085	11.410	10.861	10.410	9.721	9.236	8.888	8.638
1000	12.788	11.946	11.272	10.725	10.273	9.585	9.098	8.748	8.495

Pressure, MPa	Temperature, °C						
	350	**400**	**450**	**500**	**600**	**700**	**800**
0.1 or p_s	11.920	47.961	47.873	47.638	46.384	43.925	40.785
25	11.551	16.566	18.135	18.758	19.425	19.829	20.113
50	11.076	11.557	12.710	14.195	15.621	16.279	16.693
75	10.802	11.045	11.491	12.162	13.507	14.301	14.791
100	10.600	10.744	11.005	11.381	12.296	13.040	13.544
150	10.295	10.345	10.464	10.642	11.117	11.613	12.032
200	10.062	10.063	10.119	10.220	10.513	10.853	11.171
250	9.869	9.839	9.859	9.917	10.112	10.360	10.609
300	9.702	9.651	9.646	9.677	9.810	9.998	10.199
350	9.554	9.487	9.465	9.476	9.567	9.712	9.877
400	9.420	9.341	9.305	9.302	9.361	9.475	9.613
500	9.182	9.086	9.031	9.007	9.024	9.094	9.191
600	8.974	8.866	8.798	8.761	8.749	8.790	8.861
700	8.787	8.670	8.593	8.546	8.514	8.536	8.587
800	8.616	8.493	8.409	8.354	8.308	8.314	8.352
900	8.458	8.330	8.240	8.180	8.122	8.117	8.144
1000	8.311	8.178	8.084	8.019	7.952	7.939	7.957

Note: Pressure for first row is 0.1 MPa at $t < 100$ °C and $t \geq 400$ °C, or p_s (saturated liquid) for 100 °C $\leq t \leq 350$ °C