

WATER BOILING POINT VS PRESSURE

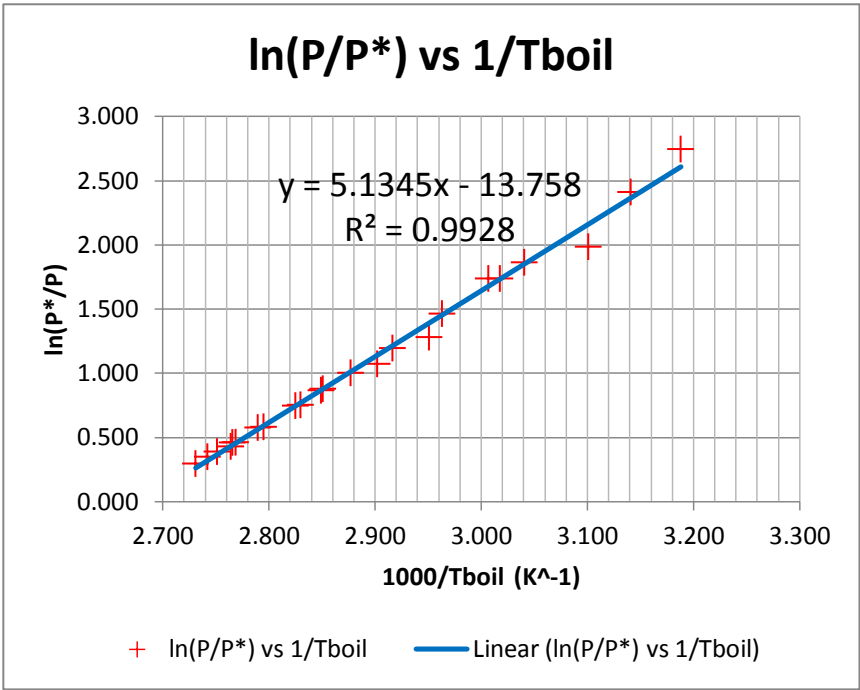
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errors: about +/- 0.3 degC and about +/-0.2Pa. (By eye from fluctuating readings).

Known data for water

P* /kPa	101.325
T* /K	373
Lvap (kJ/mol) at 30degC	43.78
R J/mol/K	8.314

Water temperature at boiling /degC	Bell jar pressure /kPa	Air temperature inside bell jar /degC	Notes	1000/Tboil (K^-1)	ln(P*/P)	Model P
40.7	6.5	28.9	** - explosive onset of boiling!	3.188	2.747	7.51
			* Water at 18.1degC, reduce pressure to 2.7kPa, bell jar temp 17.6degC. Note spontaneous boiling, but ceased when turned pump off. Heated continuously (about 12V DC, 4.5A), and increased pressure in stages, and waited for boiling to commence	3.141	2.412	9.56
45.4	9.08	21.7		3.101	1.986	11.74
49.5	13.9	27.4	**	3.040	1.865	16.00
55.9	15.7	26.7	**	3.018	1.739	18.00
58.4	17.8	23.5	*	3.007	1.739	19.04
59.6	17.8	30.9	**	2.963	1.466	23.82
64.5	23.4	23.6	*	2.951	1.283	25.36
65.9	28.1	27.4	**	2.916	1.197	30.27
69.9	30.6	31.8	**	2.902	1.074	32.59
71.6	34.6	28.7	**	2.877	1.005	37.06
74.6	37.1	30.3	*	2.851	0.881	42.40
77.8	42	29.9	**	2.849	0.869	42.76
78	42.5	33.4	**	2.830	0.756	47.22
80.4	47.6	33.4	*	2.825	0.749	48.40
81	47.9	32.2	**	2.795	0.584	56.46
84.8	56.5	34.9	*	2.789	0.579	58.07
85.5	56.8	34.1	**			
			** Set temperature via heating or temperary immersion in a cold (or boiling) water bath. Atmospheric temperature, and bell jar periodically wiped of condensation. Then reduce pressure till boiling. Turn off pump, take measurement, increase pressure back to atmospheric and repeat. Easiest progression is to heat water to about 40degC, then start this process while heating constantly. Record boiling temp via lower pressure every 5degC or so from 40degC.	2.769	0.464	64.63
88.2	63.7	36.12		2.765	0.463	65.65
88.6	63.8	36.7	**	2.764	0.432	66.17
88.8	65.8	35.7	*	2.751	0.391	70.71
90.5	68.5	38.2	**	2.742	0.351	74.07
91.7	71.3	40.2	**	2.731	0.298	78.47
93.2	75.2	42.3	**			



Lvap from gradient (/kJ/mol)

42.7

Lvap from intercept (/kJ/mol)

42.7

Clausius Clapeyron equation

$$T_{boil} = \left(\frac{1}{T_*} - \frac{R}{L_{vap}} \ln \left(\frac{P}{P_*} \right) \right)^{-1}$$
$$\frac{1}{T_{boil}} = \frac{1}{T_*} - \frac{R}{L_{vap}} \ln \left(\frac{P}{P_*} \right)$$
$$\frac{1}{T_{boil}} - \frac{1}{T_*} = \frac{R}{L_{vap}} \ln \left(\frac{P_*}{P} \right)$$
$$\therefore \ln \left(\frac{P_*}{P} \right) = \frac{L_{vap}}{R} \frac{1}{T_{boil}} - \frac{L_{vap}}{R} \frac{1}{T_*}$$
$$\therefore P = P_* e^{\frac{L_{vap}}{RT_*}} e^{-\frac{L_{vap}}{RT_{boil}}}$$

