

Vypočítejte bod tání a bod varu H₂O. K dispozici jsou následující termodynamické údaje

fáze	H kJ/mol	S J/K mol	G kJ/mol	V cm ³	cp J/K mol	M g/mol	r g/ccm
led	-291.84	48.06	-236.62	19.65	37.89	18.015	0.917
voda	-285.83	69.91	-237.13	18.07	75.19	18.015	0.997
pára	-241.82	188.83	-228.57	24789	33.58	18.015	0.00073

Řešení

Bez závislosti H a S na teplotě

$$G = H - TS$$

Za rovnováhy

$$G_{\text{led}} = G_{\text{voda}}$$

$$H_{\text{led}} - T_r S_{\text{led}} = H_{\text{voda}} - T_r S_{\text{voda}}$$

$$T_r = (H_{\text{voda}} - H_{\text{led}}) / (S_{\text{voda}} - S_{\text{led}})$$

$$T_r = \Delta H / \Delta S$$

voda-led $T_r = 275.1 \text{ K}$

1.9 °C

Obdobně voda-pára

voda-pára $T_r = 370.1 \text{ K}$

96.9 °C

Diagram

T °C
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120

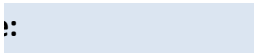
Se závislostí H a S na teplotě

$$H_{T_2} = H_{T_1} + c_p (T_2 - T_1)$$

$$S_{T_2} = S_{T_1} + c_p \ln (T_2 / T_1)$$

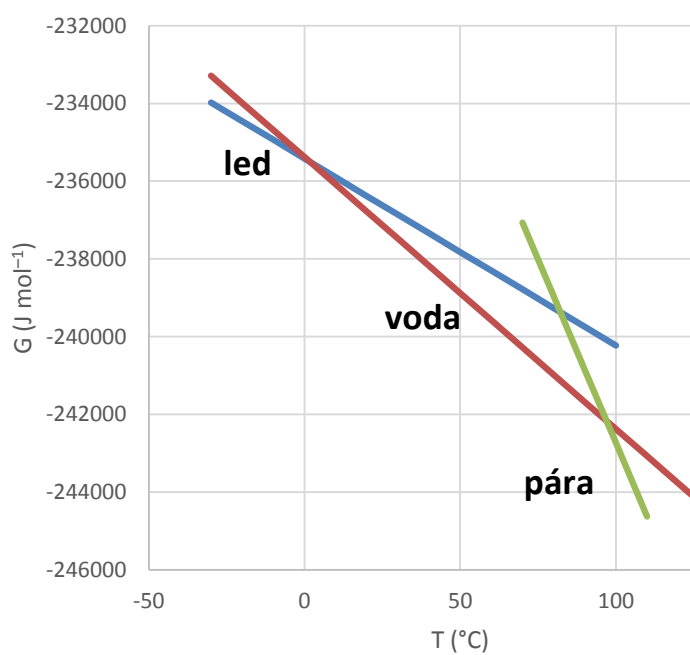
$$T^\circ = 298.15 \text{ K}$$

				Termodyna
				T
				°C
odhad	$G_{\text{led}} = G_{\text{voda}}$			
	$T_r =$	273.2273 K	0.08 °C	-60
	$G_{\text{led}} =$	-305011.9		-50
	$G_{\text{voda}} =$	-305011.9		-40
	$\Delta G =$	-2.11E-08		-30
				-20
odhad	$G_{\text{voda}} = G_{\text{pára}}$			-10
	$T_r =$	373.1336 K	99.98 °C	0.08
	$G_{\text{voda}} =$	-312571.8		10
	$G_{\text{pára}} =$	-312571.8		20
	$\Delta G =$	3.78E-07		25
				30
				40
				50
				60



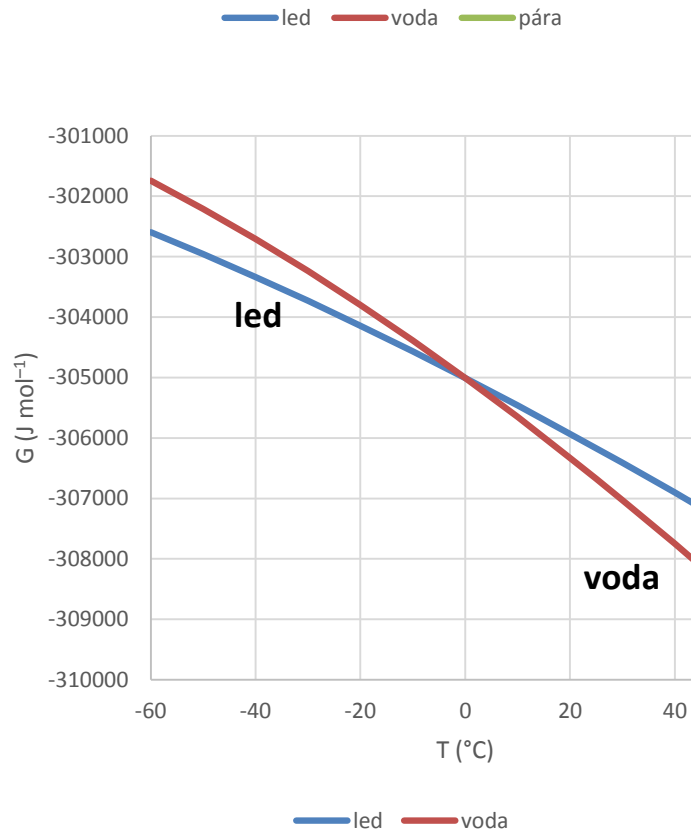
$T^\circ = 298.15$
 $T_a = 273.15$

	led	voda	pára
T	G_s	G_l	G_g
K	J/mol	J/mol	J/mol
243.15	-233976.7	-233285	-218184.4
253.15	-234457.3	-233984.1	-220072.7
263.15	-234937.9	-234683.2	-221961
273.15	-235418.5	-235382.3	-223849.3
283.15	-235899.1	-236081.4	-225737.6
293.15	-236379.7	-236780.5	-227625.9
303.15	-236860.3	-237479.6	-229514.2
313.15	-237340.9	-238178.7	-231402.5
323.15	-237821.5	-238877.8	-233290.8
333.15	-238302.1	-239576.9	-235179.1
343.15	-238782.7	-240276	-237067.4
353.15	-239263.3	-240975.1	-238955.7
363.15	-239743.9	-241674.2	-240844
373.15	-240224.5	-242373.3	-242732.3
383.15	-240705.1	-243072.4	-244620.6
393.15	-241185.7	-243771.5	-246508.9



403.15 -241666.3 -244470.6 -248397.2

mika	led	voda	
T	Gled	Gvoda	
K	J/mol	J/mol	
213.15	-302594.2	-301743.9	850
223.15	-302956.4	-302208	748
233.15	-303335.6	-302705.8	630
243.15	-303731.1	-303235.9	495
253.15	-304142.1	-303797	345
263.15	-304568.1	-304387.7	180
273.23	-305012	-305012.1	0
283.15	-305462.7	-305653.9	-191
293.15	-305930.4	-306327.3	-397
298.15	-306169.1	-306673.7	-505
303.15	-306411	-307026.4	-615
313.15	-306904.1	-307750.2	-846
323.15	-307409.2	-308498.1	-1089
333.15	-307926.1	-309269.3	-1343







60