

## GIBBS FREE ENERGY

substance	$G_f^\circ$ (kJ/mol)	$H_f^\circ$ (kJ/mol)	$S^\circ$ (J/mol·K)	substance	$G_f^\circ$ (kJ/mol)	$H_f^\circ$ (kJ/mol)	$S^\circ$ (J/mol·K)
N <sub>2</sub> (g)	0	0	191.6	CH <sub>4</sub> (g)	-50.7	-74.8	186.3
NH <sub>3</sub> (aq)	-26.5	-80.3	111.3	C <sub>2</sub> H <sub>6</sub> (g)	-32.8	-84.7	229.6
NH <sub>4</sub> <sup>+</sup> (aq)	-79.3	-132.5	113.4	C <sub>4</sub> H <sub>10</sub> (g)	-17.0	-126.2	310.1
O <sub>2</sub> (g)	0	0	205.1	C <sub>8</sub> H <sub>18</sub> (l)	6.4	-249.9	358
OH <sup>-</sup> (aq)	-157.2	-230.0	-10.8	C <sub>6</sub> H <sub>6</sub> (l)	124.3	49.0	173.3
H <sub>2</sub> (g)	0	0	130.7	C <sub>2</sub> H <sub>5</sub> OH(l)	-174.8	-277.7	160.7
H <sup>+</sup> (aq)	0	0	0	CH <sub>3</sub> COOH(aq)	-396.5	-485.8	86.6
H <sub>2</sub> O(l)	-237.1	-285.8	69.9	C <sub>6</sub> H <sub>5</sub> COOH(s)	-245.3	-385.1	167.6
H <sub>2</sub> O(g)	-228.6	-241.8	188.8	butanedioic acid(s)	-747.5	-940.6	175.7
K <sup>+</sup> (aq)	-283.3	-252.4	102.5	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> (l)	149.1	31.6	191.3
Na <sup>+</sup> (aq)	-261.9	-240.1	59.0	CH <sub>3</sub> NH <sub>2</sub> (g)	32.2	-23.0	243.4
P <sub>4</sub> O <sub>10</sub> (s)	-2697	-2984	228.9	threonine(s)	-514.6		
NaHCO <sub>3</sub> (s)	-851.1	-950.9	101.7	alanine(s)	-372.1	-563.0	132.2
NaOH(s)	-379.5	-425.6	64.5	octadecanoic acid(s)	-146.0		
KOH(s)	-379.1	-424.8	78.9	octadecenoic acid(l)	-9.9		
SO <sub>4</sub> <sup>2-</sup> (aq)	-744.5	-909.3	20.1	octadecadienoic(l)	126.2		
CO <sub>2</sub> (g)	-394.4	-393.5	213.7	glucose(s)	-910.5	-1273.1	212.1
CO <sub>3</sub> <sup>2-</sup> (aq)	-527.8	-677.1	-56.9	PO <sub>4</sub> <sup>3-</sup> (aq)	-1018.9	-1277.4	-221.8
C(graph)	0	0	5.7	ATP(aq)	-2534		
Cl <sup>-</sup> (aq)	-131.2	-167.2	56.5	ADP(aq)	-1784		

**G Gibbs Free Energy** - maximum amount of useful work at constant T and P

$G^\circ$  - **standard state** Gibbs Free Energy; all concs = 1 M, partial pressures = 1 atm

$$G^\circ = -RT \ln K_{eq} \quad R = 0.008314 \text{ kJ/mole} \cdot \text{K}$$

$$K_{eq} = \frac{[\text{products}]_{eq}^j}{[\text{reactants}]_{eq}^i} \quad K_{eq} = e^{(-G^\circ/RT)}$$

$$G = G^\circ + RT \ln Q \quad Q = \frac{[\text{products}]^j}{[\text{reactants}]^i}$$