

TABLE 1. Changes of Gibbs free energies under standard conditions in hydrogen-releasing and hydrogen-consuming reactions and corresponding redox potentials^a

Reaction	$\Delta G^{\circ'}$ (kJ per mol)	No. of electron pairs	$E^{\circ'}$ of electron-releasing redox reactions (mV)
Hydrogen-releasing reactions			
Primary alcohols			
$\text{CH}_3\text{CH}_2\text{OH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{H}^+ + 2\text{H}_2$	+9.6	2	-190, -375
Fatty acids			
$\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}^- + 2\text{H}_2\text{O} \rightarrow 2\text{CH}_3\text{COO}^- + 2\text{H}^+ + 2\text{H}_2$	+48.3	2	-125, -250
$\text{CH}_3\text{CH}_2\text{COO}^- + 2\text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{CO}_2 + 3\text{H}_2$	+76.0	3	+30, -176, -470
$\text{CH}_3\text{COO}^- + \text{H}^+ + 2\text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 4\text{H}_2$	+94.9	4	-200, -300, -430, -520
$\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{COO}^- + \text{CO}_2 + 2\text{H}_2\text{O} \rightarrow 3\text{CH}_3\text{COO}^- + 2\text{H}^+ + \text{H}_2$	+25.2	1	
Glycolic acid			
$\text{CH}_2\text{OHCOO}^- + \text{H}^+ + \text{H}_2\text{O} \rightarrow 2\text{CO}_2 + 3\text{H}_2$	+19.3	3	-92, -331, -470
Aromatic compounds			
$\text{C}_6\text{H}_5\text{COO}^- + 6\text{H}_2\text{O} \rightarrow 3\text{CH}_3\text{COO}^- + 2\text{H}^+ + \text{CO}_2 + 3\text{H}_2$	+49.5	3	
$\text{C}_6\text{H}_5\text{OH} + 5\text{H}_2\text{O} \rightarrow 3\text{CH}_3\text{COO}^- + 3\text{H}^+ + 2\text{H}_2$	+10.2	2	
Amino acids			
$\text{CH}_3\text{CH}(\text{NH}_3^+)\text{COO}^- + 2\text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{NH}_4^+ + \text{CO}_2 + 2\text{H}_2$	+2.7	2	-115, -375
Hydrogen-consuming reactions			
$4\text{H}_2 + 2\text{CO}_2 \rightarrow \text{CH}_3\text{COO}^- + \text{H}^+ + 2\text{H}_2\text{O}$	-94.9		
$4\text{H}_2 + \text{CO}_2 \rightarrow \text{CH}_4 + 2\text{H}_2\text{O}$	-131.0		
$\text{H}_2 + \text{S}^{\circ} \rightarrow \text{H}_2\text{S}$	-33.9		
$4\text{H}_2 + \text{SO}_4^{2-} + \text{H}^+ \rightarrow \text{HS} + 4 \text{H}_2\text{O}$	-151.0		
$\text{H}_2\text{C}(\text{NH}_3^+)\text{COO}^- + \text{H}_2 \rightarrow \text{CH}_3\text{COO}^- + \text{NH}_4^+$	-78.0		
Fumarate + $\text{H}_2 \rightarrow$ succinate	-86.0		

^a All calculations are based on published tables (28, 119). For H_2S and CO_2 , values for the gaseous state were used.