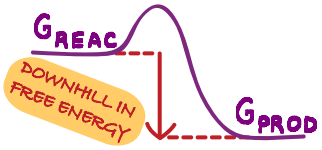
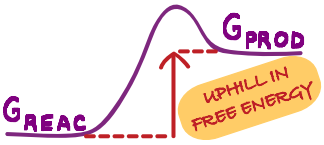
EQUILIBRIUM AND THERMODYNAMICS: RELATING K TO ΔG

$$\text{REAC} \rightleftharpoons \text{PROD} \qquad K = \frac{[\text{PROD}]}{[\text{REAC}]} \qquad \Delta G^\circ = G_{PROD} - G_{REAC}$$

$$K = e^{-\Delta G^\circ / RT}$$

				ΔG°	$K = e^{-\Delta G^\circ/RT}$
REAC ⇀ PROD	$K > 1$		$\Delta G^\circ < 0$	$-30RT$	$e^{30} = 10^{13}$
				$-3RT$	$e^{3} = 20$
				$-RT$	$e^{1} = 2.7$
REAC ⇌ PROD	$K = 1$		$\Delta G^\circ = 0$	0	$e^{0} = 1$
				RT	$e^{-1} = \frac{1}{2.7} = 0.37$
				$3RT$	$e^{-3} = \frac{1}{20} = 0.05$
REAC ↽ PROD	$K < 1$		$\Delta G^\circ > 0$	$30RT$	$e^{-30} = 10^{-13}$

AT ROOM TEMPERATURE ($T = 25^\circ C = 298\,K$)

$$RT = \left(8.314 \tfrac{J}{mol\,K}\right)(298\,K) = 2479 \tfrac{J}{mol} = 2.5 \tfrac{kJ}{mol}$$

	ΔG°	$K_{FORMATION} = e^{-\Delta G^\circ/RT}$
COVALENT BOND	$\approx 400 \tfrac{kJ}{mol} = 160\,RT$	$e^{5} = 10^{70}$
HYDROGEN BOND	$\approx 25 \tfrac{kJ}{mol} = 5\,RT$	$e^{2} = 150$
VAN DER WAALS CONTACT	$\approx 5 \tfrac{kJ}{mol} = 2\,RT$	$e = 7$