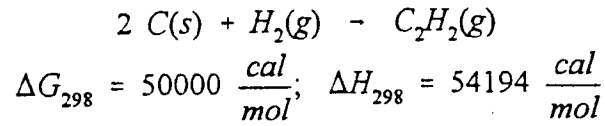


Problem 2.6.2 Acetylene can be made by the reaction of carbon and hydrogen. Calculate the equilibrium constant at 2573 °K. Use the following data:



i	Comp	$a_i, \text{J}/(\text{mol}\cdot\text{K})$	ν_i
1	C(s)	20.934	-2
2	H ₂	26.231	-1
3	C ₂ H ₂	70.188	1

Solution: $a = \sum \nu_i a_i = -2(20.934) - 1(26.231) + 1(70.188) = 2.089 \text{ J}/(\text{mol}\cdot\text{K})$

$$@T = 298^\circ\text{K}$$

$$\Delta H_o = \Delta H - aT = 2.2628 \times 10^5 \frac{\text{J}}{\text{mol}}$$

$$\Delta S = \frac{\Delta H - \Delta G}{T} = 58.294 \frac{\text{J}}{\text{mol}\cdot^\circ\text{K}}$$

$$\Delta S_o = \Delta S - a \ln T = 47.023 \frac{\text{J}}{\text{mol}\cdot^\circ\text{K}}$$

$$C = \Delta S_o - a = 44.934 \frac{\text{J}}{\text{mol}\cdot^\circ\text{K}}$$

$$@T = 2573^\circ\text{K}$$

$$\Delta G = \Delta H_o - [CT + aT \ln T] = 6.845 \times 10^4 \frac{\text{J}}{\text{mol}}$$

$$K = \exp\left(\frac{-\Delta G}{RT}\right)$$

$$R = 8.32 \frac{\text{J}}{\text{mol}\cdot^\circ\text{K}} \Rightarrow K = 0.0409$$