

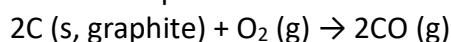
Question #77042, Chemistry / Physical Chemistry

Using tabulated thermodynamic data, the value of ΔS° for the oxidation of carbon to carbon monoxide, $2\text{C (s, graphite)} + \text{O}_2 \text{ (g)} \rightarrow 2\text{CO (g)}$ is _____ J/K.

- A) -12.8
- B) +179.4
- C) +395.8
- D) +408.6
- E) -408.6

Solution:

Chemical equation:



$$\Delta S^\circ = \sum \Delta S^\circ(\text{products}) - \sum \Delta S^\circ(\text{reagents})$$

Using table below:

Thermodynamic Quantities for Selected Substances at 298.15 K (25°C)

Substance	ΔH°_f (kJ/mol)	ΔG°_f (kJ/mol)	S (J/K-mol)
Carbon			
C (s, diamond)	1.88	2.84	2.43
C (s, graphite)	0	0	5.69
C ₂ H ₂ (g)	226.7	209.2	200.8
C ₂ H ₄ (g)	52.30	68.11	219.4
C ₂ H ₄ (g)	-84.68	-32.89	229.5
CO (g)	-110.5	-137.2	197.9
CO ₂ (g)	-393.5	-394.4	213.6
Hydrogen			
H ₂ (g)	0	0	130.58
Oxygen			
O ₂ (g)	0	0	205.0
H ₂ O (l)	-285.83	-237.13	69.91

$$\begin{aligned}\Delta S^\circ &= 2 \text{ mol} \times 197.9 \frac{\text{J}}{\text{K} \times \text{mol}} - \left(2 \text{ mol} \times 5.69 \frac{\text{J}}{\text{K} \times \text{mol}} + 1 \text{ mol} \times 205.0 \frac{\text{J}}{\text{K} \times \text{mol}} \right) \\ &= 395.8 \frac{\text{J}}{\text{K}} - \left(11.38 \frac{\text{J}}{\text{K}} + 205.0 \frac{\text{J}}{\text{K}} \right) = 395.8 \frac{\text{J}}{\text{K}} - 216.38 \frac{\text{J}}{\text{K}} = 179.42 \frac{\text{J}}{\text{K}}\end{aligned}$$

Answer:

B) +179.4