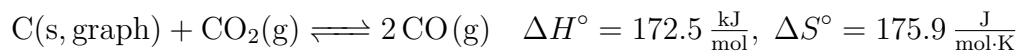


1.



At 298 K, a reaction flask is set up with 100 g of C(s, graphite),  $P_{\text{CO}_2} = 75$  bar, and  $P_{\text{CO}} = 2$  bar.

Fill in the blanks with  $>$ ,  $<$ ,  $=$ , or X for cannot be determined

(a)  $Q$  \_\_\_\_\_  $K$

(b)  $\Delta G_T$  \_\_\_\_\_ 0

(c)  $K$  \_\_\_\_\_ 1

2.



(a) A constant-pressure vessel is assembled at 753 K with initial concentrations:

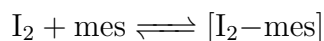
$$[\text{Cl}_2] = 7.94 \times 10^{-3} \text{ mol} \quad [\text{H}_2\text{O}] = 6.35 \times 10^{-3} \text{ mol}$$

$$[\text{HCl}] = 9.53 \times 10^{-3} \text{ mol} \quad [\text{O}_2] = 3.17 \times 10^{-3} \text{ mol}$$

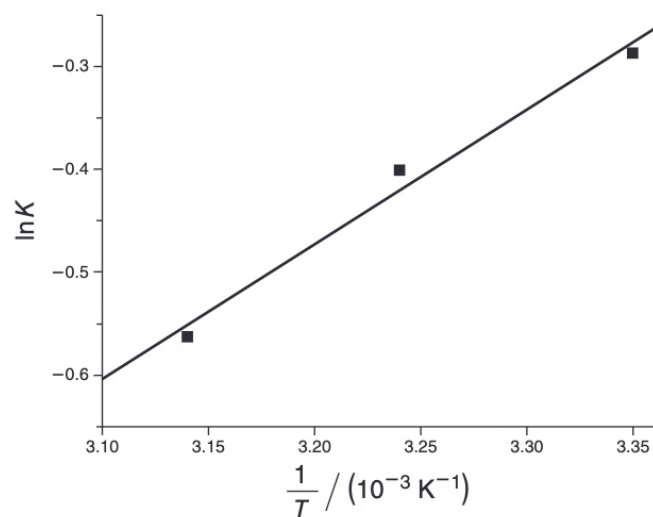
When equilibrium is reached, does the volume increase, decrease, stay the same, or cannot be determined?

- (b) Suppose the vessel was assembled under standard conditions instead, with the same concentrations and allowed to reach equilibrium. Compare the reaction quotient to the equilibrium constant to determine what happens to the volume.  $\Delta H_{\text{rxn}}^{\circ} = 114,400 \text{ J}$ .

3. (J. Chem. Educ. 2009, 86, 1330.)

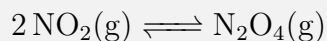


Equilibrium constants for the complexation reaction were determined over a range of temperatures. A plot of  $\ln K$  (where  $K$  is the equilibrium constant) vs.  $1/T$  was compiled from the data. The data points form a line with a slope of 1299 Kelvin and a y-intercept of -4.69. Determine  $\Delta H^{\circ}$ ,  $\Delta S^{\circ}$ ,  $\Delta G^{\circ}$ , and determine the conditions under which the reaction is spontaneous (i.e., at low vs. high temperatures).



**Homework Problem 24**

1. For the chemical equilibrium:



first determine  $K_c$  at standard conditions. Experimentally, it is measured at  $K_c$  is 215. Was this experiment conducted above, at, or below standard conditions?

	$\Delta H_f^\circ$ ( $\frac{\text{kJ}}{\text{mol}}$ )	$S_m^\circ$ ( $\frac{\text{J}}{\text{mol}\cdot\text{K}}$ )
$\text{NO}_2(\text{g})$	$33.18 \frac{\text{kJ}}{\text{mol}}$	$240.06 \frac{\text{J}}{\text{mol}\cdot\text{K}}$
$\text{N}_2\text{O}_4(\text{g})$	$9.16 \frac{\text{kJ}}{\text{mol}}$	$304.29 \frac{\text{J}}{\text{mol}\cdot\text{K}}$