Q1 - 1997

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

	$PCl_5(g)$	$PCl_3(g)$	$Cl_2(g)$
	n_o	–	–
	$n_o(1-\alpha)$	$n_o\alpha$	$n_o\alpha$
ΔH (J/mol)	$-3.99 \cdot 10^5$	$-3.06 \cdot 10^5$	—
S (J/K)	352.7	311.7	222.9

$P_T = 1$ atm.

$P_T = n_o(1-\alpha) + n_o\alpha + n_o\alpha$

$P_T = n_o(1+\alpha) = 1.$

$\Delta H^\circ = -3.06 \cdot 10^5 + 3.99 \cdot 10^5 = 93000$ J/mol

$\Delta S^\circ = 181'9$ J/K.

$\Delta G = \Delta H - T\Delta S = 93000 - 523 \cdot 181'9$

$\Delta G = -2133{,}7$ J/mol

$\Delta G = -RT \ln K_p$

$\Big\} K_p = 1'63$

$$K_p = \frac{P_{Cl_2} P_{PCl_3}}{P_{PCl_5}} = \frac{P_T^2 \chi_{Cl_2} \chi_{PCl_3}}{P_T \chi_{PCl_5}}$$ como $P_T = 1$.

$$K_p = \frac{\left[\frac{n_o\alpha}{n_o(1+\alpha)}\right]^2}{\frac{n_o(1-\alpha)}{n_o(1+\alpha)}} = \frac{\alpha^2(1+\alpha)}{(1+\alpha)^2(1-\alpha)} = \frac{\alpha^2}{1-\alpha^2} = 1.63.$$

$\alpha^2 = 1'63 - 1'63\alpha^2$

$2{,}63\alpha^2 = 1.63$

$\alpha = 0.78$ 78%.