

Let's now discuss the equation, $K_p = K_c (RT)^{\Delta n}$, on your equation and constants sheet (in the equilibrium section).

For the general reaction:



the relationship between K_c and K_p is:

$$K_p = K_c (RT)^{\Delta n}$$

where Δn is the sum of the coefficients of the *gaseous products* minus the sum of the coefficients of the *gaseous reactants*.

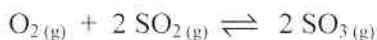
As seen on the previous page, here is how K_p is derived for the relationship between pressure and concentration: Do NOT STRESS out, you will not be asked how to derive these equations... Know how to USE this equation !!!

$$K_p = \frac{(P_C^c)(P_D^d)}{(P_A^a)(P_B^b)} = \frac{\left[\left(\frac{n}{V} \right)_C \times RT \right]^c \left[\left(\frac{n}{V} \right)_D \times RT \right]^d}{\left[\left(\frac{n}{V} \right)_A \times RT \right]^a \left[\left(\frac{n}{V} \right)_B \times RT \right]^b} = \frac{\left[\left(\frac{n}{V} \right)_C \right]^c \left[\left(\frac{n}{V} \right)_D \right]^d}{\left[\left(\frac{n}{V} \right)_A \right]^a \left[\left(\frac{n}{V} \right)_B \right]^b} \times \frac{(RT)^{c+d}}{(RT)^{a+b}} = K_c (RT)^{(c+d) - (a+b)}$$

$$K_p = K_c (RT)^{\Delta n}$$

Examples:

1) The reaction for the formation of sulfur trioxide:



At 25 °C, the pressures at equilibrium were found to be:

$$P_{SO_3} = 2.5 \text{ atm}, P_{O_2} = 0.045 \text{ atm}, P_{SO_2} = 0.75 \text{ atm}$$

calculate the value of K_p for this reaction at 25 °C

$$K_p = \frac{P_{SO_3}}{(P_{O_2})(P_{SO_2})^2} = \frac{(2.5 \text{ atm})^2}{(0.045 \text{ atm})(0.75 \text{ atm})^2} = \boxed{250 \text{ atm}^{-1}}$$

246.9 atm⁻¹

2) Using the K_p from the above equation, calculate the value of K_c at 25 °C.

$$K_p = K_c (RT)^{\Delta n}$$

$$T = 25 + 273 = 298 \text{ K}$$

$$\Delta n = 2 - (1 + 2) = -1$$

$$K_p = K_c (RT)^{-1} = \frac{K_c}{RT}$$

$$\frac{K_c}{RT} = K_p \quad ; \quad K_c = K_p (RT)$$

$$K_c = \left(\frac{246.9}{\text{atm}} \right) \left(\frac{0.0821 \text{ atm} \cdot \text{L}}{\text{mol} \cdot \text{K}} \right) (298 \text{ K}) =$$

$$\boxed{K_c = 6.04 \times 10^3 \frac{\text{L}}{\text{mol}}}$$