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:

$$aA + bB \rightleftharpoons cC + dD$$

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 !!!

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

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

Examples:

1) The reaction for the formation of sulfur trioxide:

$$O_{2\,(g)} + 2\,SO_{2\,(g)} \rightleftharpoons 2\,SO_{3\,(g)}$$

At 25 ^{0}C, the pressures at equilibrium where found to be:

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

calculate the value of K_p for this reaction at 25 ^{0}C

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

246.9 atm^{-1}

2) Using the K_p from the above equation, calculate the value of K_c at 25 ^{0}C.

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

$$T = 25 + 273 = 298K$$

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

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

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

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

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