Simple Step-by-Step Guides to Solving Chemistry Problems

Interconverting Kc & Kp

Nigel Freestone
www.chemtextbook.com

Converting Between K_c and K_p

To convert between K_c to K_p use the following equation which is based on the relationship between molarities and gas pressures.

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

Δn is the difference in the number of **moles of gases** on each side of the balanced equation for the reaction.

Δn = (number of moles of gaseous products - number of moles of gaseous reactants)

Converting K_c to K_p

Step 1: calculate the difference in the number of moles of gases.

Step 2: substitute Δn, R, and T into the equation and solve.

Example 1: Calculate the value of K_p for the following reaction, at 333 K.

$$PH_3BCl_{3(s)} \rightleftharpoons PH_{3(g)} + BCl_{3(g)} \quad K_c = 6.96 \times 10^5 \text{ at } 333K$$

Calculate the difference in the number of moles of gases, Δn.

Δn = (2 moles of gaseous products - 0 moles of gaseous reactants) = 2

Substitute the values into the equation and calculate K_p.

$$K_p = (6.96 \times 10^{-5}) \times (0.0821 \times 333)^2 = 0.052$$

Note: because we do not choose to use units for K_c and K_p , we cannot cancel units for R and T. However, be careful to use the value of R consistent with the units of pressure used in the problem, and T in Kelvin.

Converting K_p to K_c

Step 1: Calculate the change in the number of moles of gases.

Step 2: Substitute Δn, R, and T into the equation and solve.

Example 2: Calculate the value of K_c at 373 K for the following reaction:

$$2NO_{(g)} + Br_{2(g)} \rightleftharpoons 2NOBr_{(g)} \quad K_p = 2.4 \text{ at } 373K$$

Calculate the change in the number of moles of gases, Δn.

$$\Delta n = (2 \text{ moles of gaseous products} - 3 \text{ moles of gaseous reactants}) = -1$$

Substitute the values into the equation and calculate K_c.

$$2.40 = K_c x\ (0.0821 \times 373)^{-1}$$

$$K_c = 73.5$$

Note: *because we do not choose to use units for K_c and K_p, we cannot cancel units for R and T. However, be careful to use the value of R consistent with the units of pressure used in the problem, and T in Kelvin.*