

# The Equation JEE Loves: Relationship Between $K_p$ and $K_c$

Mastering the core formula, decoding  $\Delta n$ ,  
and dodging negative marking traps.



## FORMULA BANK

Equilibrium constant in terms of partial pressure

Equilibrium constant in terms of molar concentration

Gas Constant  
(Typically 0.0831 L·bar/K·mol)

Absolute Temperature  
(in Kelvin)

The Game-Changer Variable  
(Focus of next slide)

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

# Decoding $\Delta n$ : The Heart of the Equation

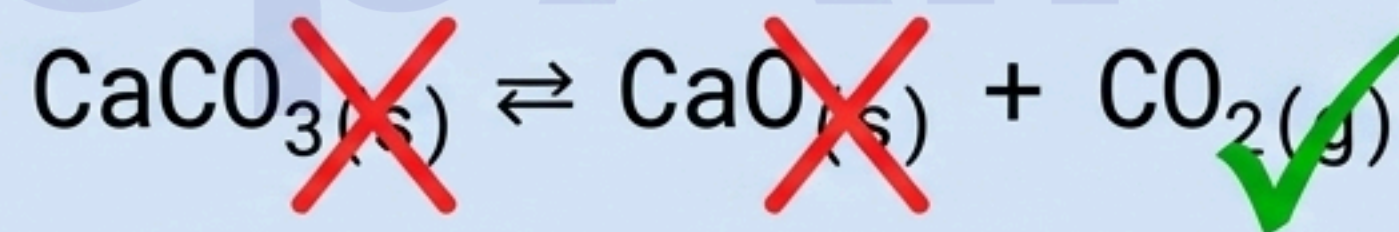
## What is $\Delta n$ ?

Sum of stoichiometric coefficients of gaseous products minus the sum of stoichiometric coefficients of gaseous reactants.

$$\Delta n = n_{p(\text{gas})} - n_{r(\text{gas})}$$

## The Golden Rule for Heterogeneous Equilibria

IGNORE solids (s) and liquids (l). Only count species with the (g) phase tag!



$$\Delta n = 1 - 0 = 1$$



# You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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# The 3 Conceptual Cases

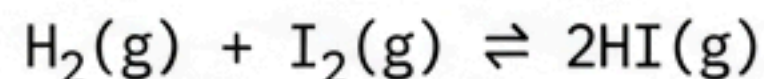
Direct MCQs are frequently framed from these boundary conditions (assuming standard T where  $RT > 1$ ).

## Case 1: $\Delta n = 0$

$$(RT)^0 = 1$$

**Result:  $K_p = K_c$**

NCERT Example:

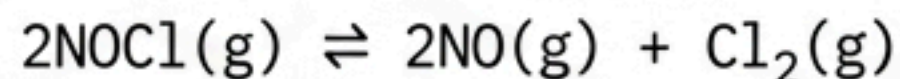


## Case 2: $\Delta n > 0$

$$(RT)^x > 1$$

**Result:  $K_p > K_c$**

NCERT Example:

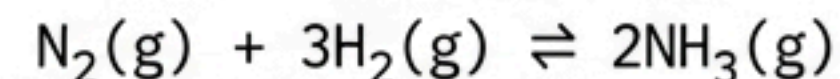


## Case 3: $\Delta n < 0$

$$(RT)^{-x} < 1$$

**Result:  $K_p < K_c$**

NCERT Example:



# Application: Solving NCERT Problem 6.5

## PROBLEM

For the equilibrium,  
 $2\text{NOCl}(g) \rightleftharpoons 2\text{NO}(g) + \text{Cl}_2(g)$ ,  
the value of  $K_c$  is  $3.75 \times 10^{-6}$  at  
1069 K.  
Calculate  $K_p$ .

Step 1 (Find  $\Delta n$ ):  
 $(2 + 1) - 2 = 1$

Step 2 (Choose R):  
Pressure in bar  $\rightarrow R = 0.0831$

Step 3 (Plug in):  
 $K_p = (3.75 \times 10^{-6}) \times (0.0831 \times 1069)^1$

Step 4 (Solve):  
 $K_p = 0.033$

## ⚠ JEE Trap Alert

- ⚠ 1. **Phase Blindness:** Blindly including moles of solids/liquids in your  $\Delta n$  calculation. Always check phase tags!
- ⚠ 2. **R-Value Roulette:** Using  $R = 8.314$  (Joules) instead of  $R = 0.0831$  (bar) or  $0.0821$  (atm). Match your units.

## Final Revision Snapshot

Core Rule:

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

Shortcut:

If  $\Delta n = 0$ , units cancel entirely, and  $K_p = K_c$ .

Advanced Concept:

**Dimensionality:**  $K_p$  and  $K_c$  are technically dimensionless if referenced to their standard state (1 bar), but numerical values still differ based on  $\Delta n$ .



# You've Learned the Theory.

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