



Pressure & Gas Equilibrium

Mastering Le Chatelier's Principle for Gaseous Systems

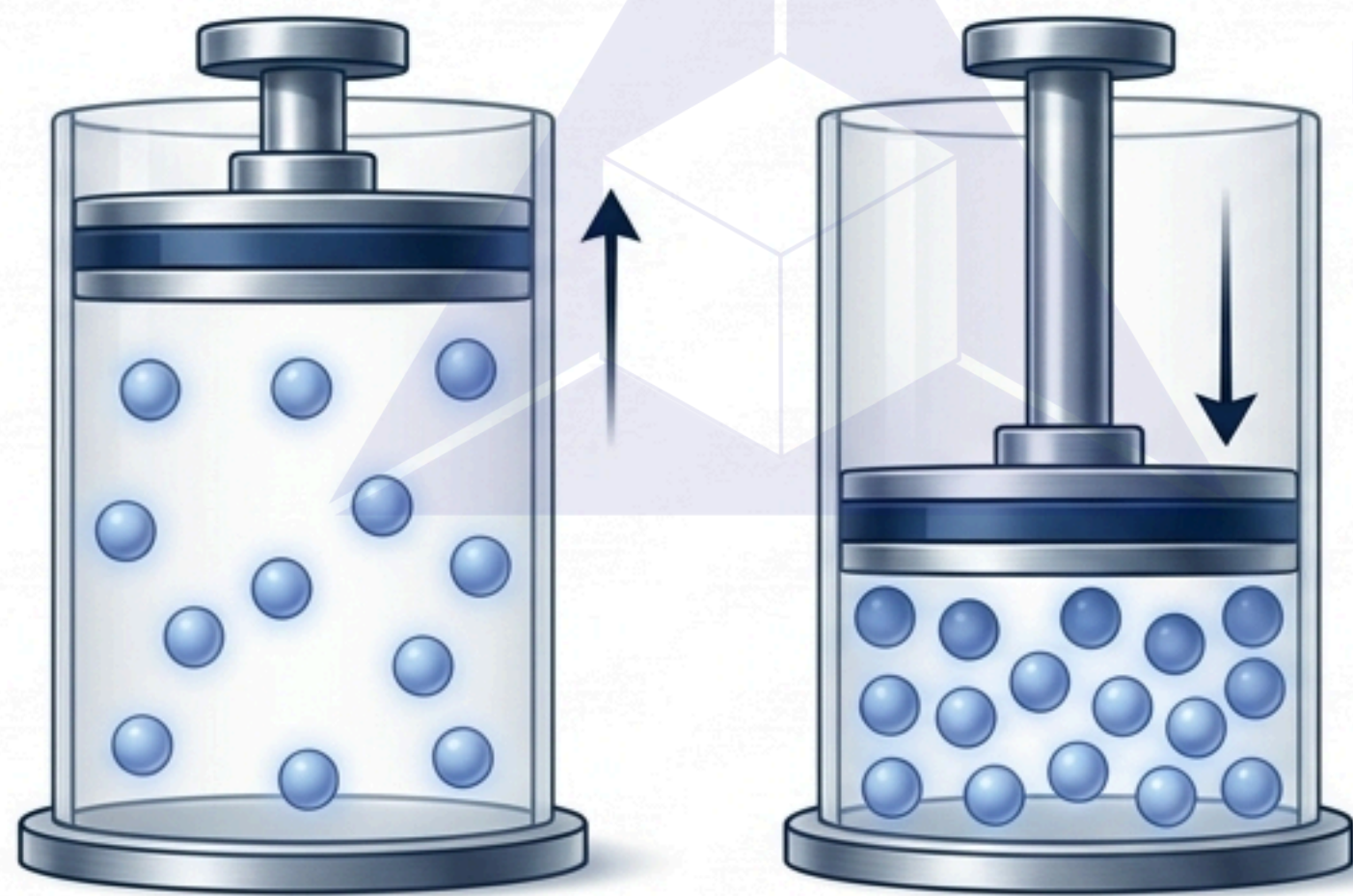
Exam Snapshot

Weightage: **High Yield**

Question Type: Conceptual & Predictive

How do we change equilibrium pressure?

In a closed system, pressure changes are achieved mechanically by altering the volume of the reaction vessel.



High Volume,
Low Pressure

Low Volume,
High Pressure

Volume is Halved → Pressure is Doubled → Concentrations Double

Ideal Gas Law & Concentration

$$P = \left(\frac{n}{V}\right)RT$$

$$P = [\text{gas}]RT$$

$$[\text{gas}] \propto P \text{ (at constant Temperature)}$$

The Disruption:

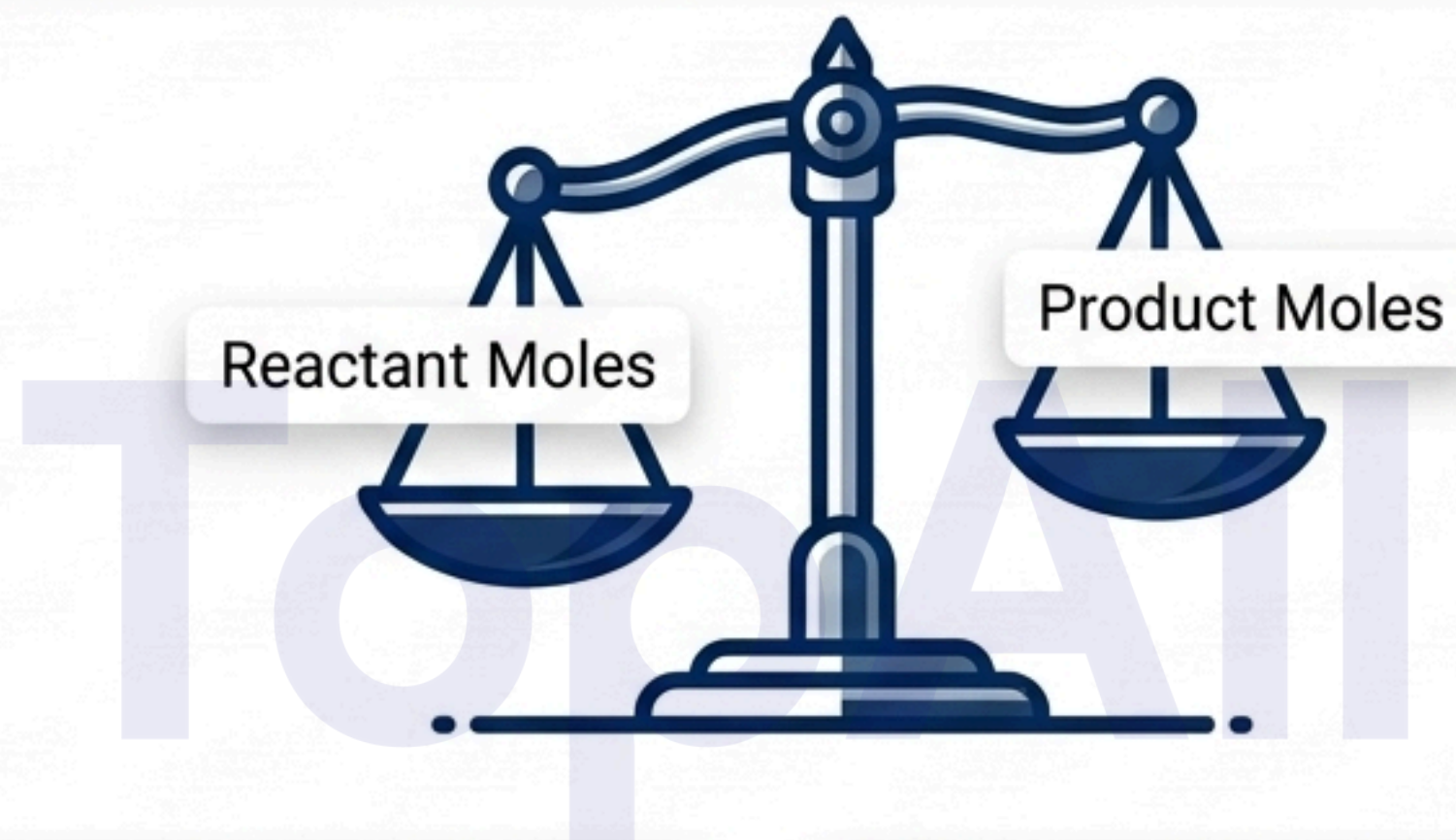
When volume decreases, the molar concentration ($c = n/V$) of every reacting gas increases simultaneously. The system is no longer at equilibrium ($Q_c \neq K_c$).

The Deciding Variable

The Role of Gaseous Moles (Δn_g)

Pressure changes only affect an equilibrium if the reaction produces a change in the total number of gaseous molecules.

$$\Delta n_g = (\text{Total moles of gaseous products}) - (\text{Total moles of gaseous reactants})$$



1

$$\Delta n_g > 0$$

Products have more moles.
(e.g., $1 \text{ mol} \rightleftharpoons 2 \text{ mol}$)

System favors expansion.

2

$$\Delta n_g < 0$$

Reactants have more moles.
(e.g., $4 \text{ mol} \rightleftharpoons 2 \text{ mol}$)

System favors compression.

3

$$\Delta n_g = 0$$

Equal moles on both sides.
(e.g., $2 \text{ mol} \rightleftharpoons 2 \text{ mol}$)

Pressure has ZERO effect.



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

$$E=mc^2$$



Turn theory into marks with **unlimited MCQs, smart analysis, and focused revision.**

Practice Now



At prep.topall.app

Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



Effect of Compression (Pressure Increases)

Le Chatelier's Principle: The system shifts to counteract the increased pressure by moving in the direction that produces fewer gaseous moles.



The Math Proof

Reaction: $\text{CO(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons \text{CH}_4\text{(g)} + \text{H}_2\text{O(g)}$ ($\Delta n_g = -2$)

Initial: $Q_c = \frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}][\text{H}_2]^3}$

If volume is halved, all concentrations double (2x):

New $Q_c = \frac{(2)(2)}{(2)(2)^3} = \frac{4}{16} = \frac{1}{4}$ of original

Since $Q_c < K_c$, the reaction must shift **FORWARD**.



Key Takeaway Card

Compression Rule: Increase Pressure (Decrease Volume) → Equilibrium shifts toward the side with **FEWER** gaseous moles.

Scenario B

Effect of Expansion (Pressure Decreases)

Le Chatelier's Principle: The system shifts to restore the lost pressure by moving in the direction that produces more gaseous moles.

The Math Proof

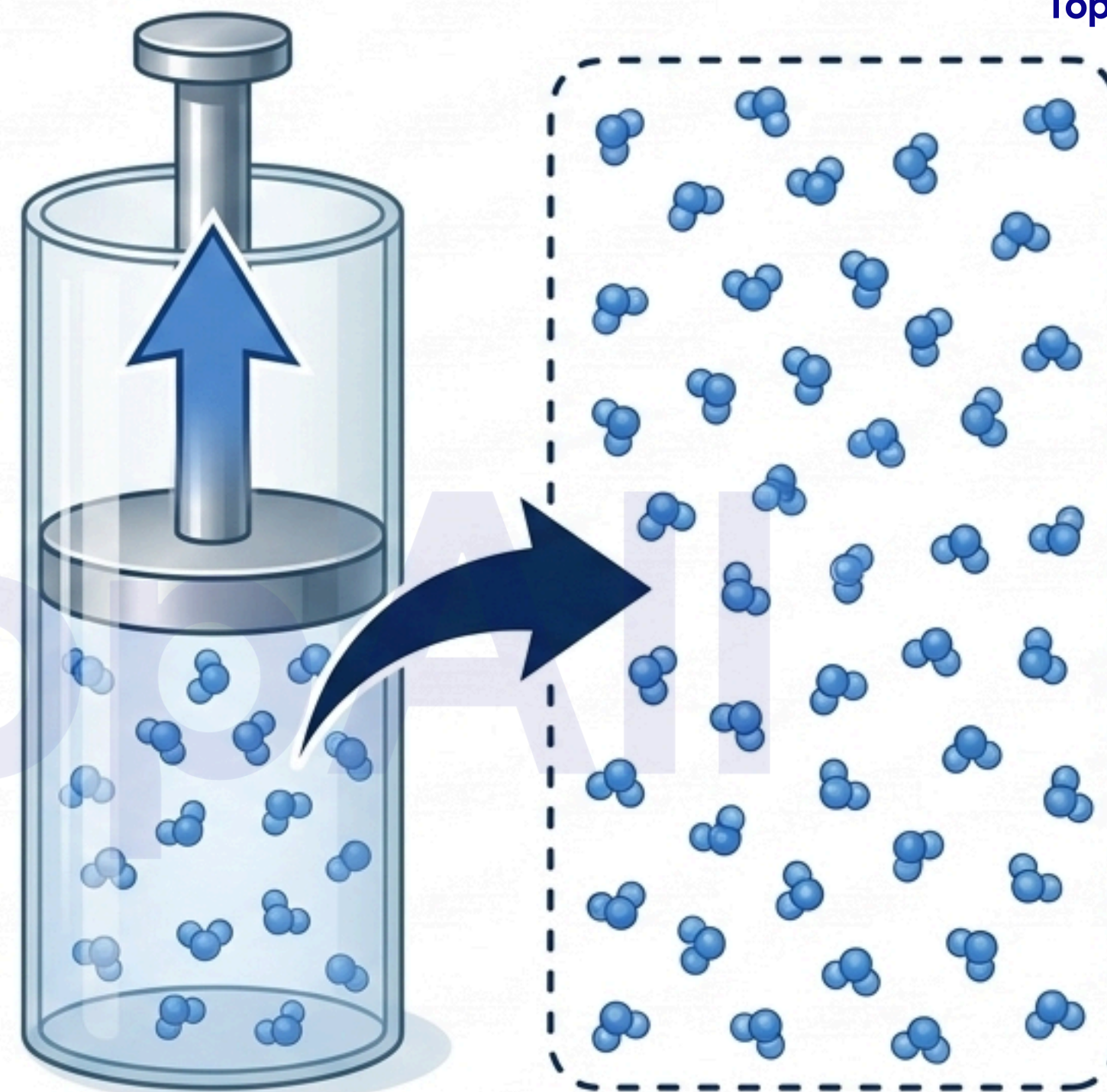
Reaction: $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ ($\Delta n_{\text{g}} = +1$)

Initial: $Q_c = [\text{NO}_2]^2 / [\text{N}_2\text{O}_4]$

If volume is doubled, all concentrations halve ($0.5x$):

New $Q_c = (0.5)^2 / (0.5) = 0.25 / 0.5 = 0.5$ of original

Since $Q_c < K_c$, system must generate particles. Shifts FORWARD.



Key Takeaway Card

Expansion Rule: Decrease Pressure (Increase Volume) → Equilibrium shifts toward the side with MORE gaseous moles.



Beware of Heterogeneous Equilibria!

Examiners will trick you by including solids or pure liquids.
Pressure changes **ONLY** affect gaseous species.



Pure solids and liquids are essentially incompressible.
They do not appear in the K_p or K_c expressions and contribute exactly 0 to Δn_g .

Question: Predict the effect of increasing pressure on:



Common Mistake: Calculating $\Delta n_g = 2 - 2 = 0$ (Assuming no shift).

Correct Approach: Ignore the solid Carbon!

$$\Delta n_g = 2 \text{ (products)} - 1 \text{ (reactants)} = +1$$

Because $\Delta n_g > 0$, increasing pressure shifts the reaction BACKWARD (towards fewer gas moles).

Pressure Effects Cheat Sheet

Action applied to System	$\Delta n_g < 0$ (e.g., $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$)	$\Delta n_g = 0$ (e.g., $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$)	$\Delta n_g > 0$ (e.g., $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$)
Increase Pressure (Decrease Volume)	Shifts Forward (Yield $\uparrow$)	No Effect (No shift)	Shifts Backward (Yield $\downarrow$)
Decrease Pressure (Increase Volume)	Shifts Backward (Yield $\downarrow$)	No Effect (No shift)	Shifts Forward (Yield $\uparrow$)

Mental Checklist before answering:

- ☑ 1. Is the system closed?
- ☑ 2. Is it at a constant temperature?
- ☑ 3. Did I cross out all (s) and (l) phases?
- ☑ 4. Did I calculate Δn_g correctly?



You've Learned the Theory.

Now Let's Test It.

Reading notes gets you knowledge.

Practicing MCQs gets you marks.

That's exactly what TopAll Pro is built for.

Try TopAll Pro Now

What TopAll Pro Does Differently

-  **Stuck? Snap it. Solve it. — Doubts AI**
Photo → step-by-step solution in seconds, 24/7
-  **Your AI Coach finds your blind spots**
Concept-level weakness detection — not just chapter-level
-  **4.5 Lakh+ questions. Never run out.**
13× more content than any other prep app in India
-  **Build your own test in 60 seconds**
Pick a chapter, set difficulty — AI does the rest instantly.
-  **AI Recommendation that helps you improve**
AI Recommendation Analysis your Tests and tell you where you need to improve.



Practice the moment you finish studying
Jump in while the concept is still fresh in your head

4.5L+
MCQs

1.5L+
Students

AI Powered
In-Depth Analysis