$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

constant T ; $K_c = 5.67$

If 0.100 mol CO and 0.100 mol H_2O are placed into an empty 2.00 L container and allowed to come to EQ, what are all the EQ conc's?

	CO	H_2O	CO_2	H_2
[initial]	0.0500	0.0500	0.0	0.0
Δ[ ]	$-x$	$-x$	$+x$	$+x$
EQ [ ]	$0.0500 - x$	$0.0500 - x$	x	x

$$\sqrt{K_c} = \sqrt{\frac{x^2}{(0.0500 - x)^2}} \qquad \sqrt{5.67} = \frac{x}{0.0500 - x}$$

$x = 0.0350\,M = [CO_2] = [H_2]$

$[CO] = [H_2O] = 0.015\,M$

PREDICTING THE DIRECTION OF A REACTION MIXTURE (Q TEST)

$aA + bB \rightleftharpoons cC + dD$

$$Q = \frac{[C]^c[D]^d}{[A]^a[B]^b} \qquad Q = K_c \text{ @ EQ}$$

if $Q > K$ faster in reverse direction [A], [B] ↑ [C], [D] ↓

if $Q < K$ faster in forward direction [A], [B] ↓ [C], [D] ↑

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if $Q > K$ faster in reverse direction — $[A], [B] \uparrow$ $[C], [D] \downarrow$

if $Q < K$ faster in forward direction — $[A], [B] \downarrow$ $[C], [D] \uparrow$

$CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$ @500K $K_c = 10,5$

You determine $[CO] = [H_2] = 0.10M$; $[CH_3OH] = 0.020M$

@EQ? if not, which direction is faster?

$$Q = \frac{0.020}{(0.10)(0.10)^2} = 20 \neq 10,5$$

REVERSE DIRECTION IS FAVORED (FASTER)

Le Chatelier's Principle

$$A + B \rightleftharpoons C + D \qquad K_c = \frac{[C][D]}{[A][B]}$$

add A ⇒ EQ shifts to right
" " " product side $[C], [D] \uparrow$
" " " forward reaction $[B] \downarrow$

remove A ⇒ EQ shifts to left
" " " reactant side $[C], [D] \downarrow$
" " " reverse reaction $[B] \uparrow$

ΔP, ΔV (happens we do) const. T P, V inversely related

$V \downarrow \Rightarrow P \uparrow$ EQ will shift to whichever side has LESS GAS

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

4 2

$$K_p = \frac{P_{NH_3}^2}{P_{N_2} \cdot P_{H_2}^3}$$

* ADD AN INERT GAS (He, Ne) ⇒ NO EQ SHIFT

$$K_{reverse} = \frac{1}{K_{FWD}}$$

ΔT (K_c is different once EQ re-established)

* treat heat as if it is a substance

$$A + B \rightleftharpoons C + D + \text{heat}$$

add heat ⇒ shift left [A], [B] ↑ ⇒ ΔK
[C], [D] ↓

ADD / REMOVE A CATALYST

⟶ NO EQ SHIFT

⟶ REACH EQ SOONER