

constant T;  $K_c = 5.67$

If 0.100 mol CO and 0.100 mol H<sub>2</sub>O are placed into an empty 2.00 L container and allowed to come to EQ, what are all the EQ conc's?

	CO	H <sub>2</sub> O	CO <sub>2</sub>	H <sub>2</sub>
Initial	0.0500	0.0500	0.0	0.0
$\Delta$ [ ]	-x	-x	+x	+x
EQ [ ]	0.0500-x	0.0500-x	x	x

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

$$x = 0.0350 \text{ M} = [\text{CO}_2] = [\text{H}_2]$$

$$[\text{CO}] = [\text{H}_2\text{O}] = 0.015 \text{ M}$$

PREDICTING THE DIRECTION OF A REACTION MIXTURE (Q TEST)



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

if  $Q > K$  faster in reverse direction  $\begin{matrix} [A], [B] \uparrow \\ [C], [D] \downarrow \end{matrix}$

if  $Q < K$  faster in forward direction  $\begin{matrix} [A], [B] \downarrow \\ [C], [D] \uparrow \end{matrix}$



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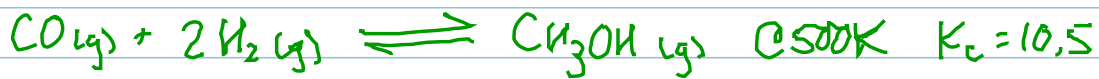
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You determine  $[\text{CO}] = [\text{H}_2] = 0,10\text{M}$  ;  $[\text{CH}_3\text{OH}] = 0,020\text{M}$

@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)

LeChatelier's Principle



add A  $\Rightarrow$  EQ shifts to right

" " " product side  $[\text{C}], [\text{D}] \uparrow$   
 " " " forward reaction  $[\text{B}] \downarrow$

remove A  $\Rightarrow$  EQ shifts to left

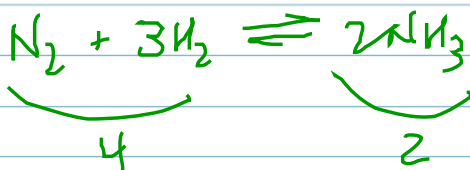
" " " reactant side  $[\text{C}], [\text{D}] \downarrow$   
 " " " reverse reaction  $[\text{B}] \uparrow$

$\Delta P, \Delta V$   
 (happens we do)

const. T

P, V inversely related

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



$$K_p = \frac{P_{\text{NH}_3}^2}{P_{\text{N}_2} \cdot P_{\text{H}_2}^3}$$

\* ADD AN INERT GAS ( $\text{He}, \text{Ne}$ )  $\Rightarrow$  NO EQ SHIFT

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

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DT ( $K_c$  is different once EQ re-established)

\* treat heat as if it is a substance



add heat  $\Rightarrow$  shift left  $[A], [B] \uparrow \Rightarrow \Delta K$   
 $[C], [D] \downarrow$

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ADD / REMOVE A CATALYST

$\rightarrow$  NO EQ SHIFT

$\rightarrow$  REACH EQ SOONER