(c) $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$

@1500°C, $K = 5.67$

If, at EQ, $[CH_4] = 0.50M$, $[H_2O] = 0.40M$, $[CO] = 0.60M$, what is $[H_2]$?

$$K = \frac{[CO][H_2]^3}{[CH_4][H_2O]} \qquad [H_2]^3 = \frac{K[CH_4][H_2O]}{[CO]}$$

$$= \frac{(5.67)(0.50)(0.40)}{0.60}$$

$$\sqrt[3]{[H_2]^3} = \sqrt[3]{1.89}$$

$$[H_2] = 1.24M$$

(D) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

0.10 mol N_2 and 0.10 mol H_2 are mixed in an empty ~~flask~~ 2.0L container. At EQ, $[N_2] = 0.035M$. What is K?

$$K = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

mol / M/L

	$[N_2]$	$[H_2]$	$[NH_3]$
[initial]	0.050	0.050	0.0
Δ[ ]	-0.015	-0.045	+0.030
[EQ]	0.035	0.005	0.030

$$K = \frac{(0.030)^2}{(0.035)(0.005)^3} = 2.06 \times 10^5$$

(C) $CH_{4(g)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + 3H_{2(g)}$

@ 1500°C, $K = 5.67$

If, at EQ, $[CH_4] = 0.50M$, $[H_2O] = 0.40M$, $[CO] = 0.60M$, what is $[H_2]$?

$$K = \frac{[CO][H_2]^3}{[CH_4][H_2O]} \qquad [H_2]^3 = \frac{K[CH_4][H_2O]}{[CO]}$$

$$= \frac{(5.67)(0.50)(0.40)}{0.60}$$

$$\sqrt[3]{[H_2]^3} = \sqrt[3]{1.89}$$

$$[H_2] \approx 1.24M$$

(D) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

0.10 mol N_2 and 0.10 mol H_2 are united in an empty ~~SOL~~ 2.0L container. At EQ, $[N_2] = 0.035M$. What is K?

$$K = \frac{[NH_3]^2}{[N_2][H_3]^3}$$

	$[N_2]$	$[H_2]$	$[NH_3]$
[initial]	0.050	0.050	0.0
Δ[]	-0.015	-0.045	+0.030
[EQ]	0.035	0.005	0.030

mol / M / L

$$K = \frac{(0.030)^2}{(0.035)(0.005)^3} = 2.06 \times 10^5$$

(E) $H_{2(g)} + Br_{2(g)} \rightleftharpoons 2\,HBr_{(g)}$

110g of HBr is added to to an empty 5.0L container at constant T. If, at EQ, it is found there are 0.182g of H_2, what is K at this T?

	H_2	Br_2	HBr
[initial]	0	0	0.272
Δ[]	+0.018	+0.018	−0.036
EQ[]	0.018	0.018	0.236

$$110\,g\,HBr \times \frac{1\,mol}{80.91\,g} = 1.36\,mol$$

$$\frac{1.36\,mol}{5.0L} = [HBr] = 0.272M$$

$$K = \frac{[0.236]^2}{(0.018)(0.018)} = 172$$

$$0.182\,g \times \frac{1\,mol}{2.02\,g} = 0.09\,mol$$

$$\frac{0.09\,mol}{5.0L} = 0.018M$$

(F) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$ $K = 5.67$

0.10 mol CO and 0.10 mol H_2O are placed in an empty 2.0 L flask. What are all the EQ [ ]'s?

	CO	H_2O	CO_2	H_2
[initial]	0.05	0.05	0.0	0.0
Δ[ ]	$-x$	$-x$	$+x$	$+x$
[EQ]	$0.05-x$	$0.05-x$	x	x

$$K = \frac{[CO_2][H_2]}{[CO][H_2O]} \qquad 5.67 = \frac{(x)(x)}{(0.05-x)(0.05-x)}$$

$$\frac{5.67}{1} = \frac{x^2}{0.0025 - 0.05x - 0.05x + x^2}$$

$$x^2 = 5.67x^2 - 0.567x + 0.0142$$

$$-x \qquad -x^2$$

$$0 = \underbrace{4.67}_{a}x^2 \underbrace{- 0.567}_{b}x \underbrace{+ 0.0142}_{c}$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$x = 0.0829$ ~~$= 0.082$~~

$= 0.034$

$[CO] = [H_2O] = 0.016M$

$[CO_2] = [H_2] = 0.034M$

$$\sqrt{5.67} = \sqrt{\frac{x^2}{(0.05-x)^2}}$$

$$2.38 = \frac{x}{(0.05-x)}$$

$$x = 0.119 - 2.38x$$

$$x = 0.035$$