#3

Equilibrium Calculations (Cont.) = More Advanced

Ex: A closed system Initially containing:

1.000×10^{-3} M H_2
2.000×10^{-3} M I_2

At 448°C, EQ is established. Analysis of EQ mixture shows a concentration of $HI = 1.87 \times 10^{-3}$ M

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

Calculate the K_c at 448°C:

ICE Box

	$[H_2]$ M	$[I_2]$ M	$[HI]$ M
Initial [ ]	1.000×10^{-3}	2.000×10^{-3}	0
Change	-0.935×10^{-3}	-0.935×10^{-3}	$+1.87 \times 10^{-3}$
Equilibrium	* 0.065×10^{-3}	* 1.065×10^{-3}	1.87×10^{-3}

← What changed

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(1.87 \times 10^{-3})^2}{(0.065 \times 10^{-3})(1.065 \times 10^{-3})} = 50.5$$

Ex2 Starting concentrations of $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$,

$[H_2] = 1.00M$

$[I_2] = 2.00M$

Value of K_c at 448°C $= 50.5$

What are the concentrations of H_2, I_2, & HI in the flask at EQ?

	H_2	I_2	2 HI
I			
C			
E			

$K_c = 50.5$

	H_2	I_2	2 HI
I	1.00M	2.00 M	0 M
C	$-X$	$-X$	$+2X$
E	$1.00-X$	$2.00-X$	$2X$

① $K_c = \frac{[HI]^2}{[H_2][I_2]}$ → ② $50.5 = \frac{(2x)^2}{(1.00-x)(2.00-x)}$

③ $50.5 = \frac{4x^2}{2.00 - 3x + x^2}$

④ $50.5(2.00 - 3x + x^2) = 4x^2$

⑤ $101 - 151.5x + 50.5x^2 = 4x^2$

$\rightarrow 46.5x^2 - 151.5x + 101 = 0$

(a = 46.5, b = −151.5, c = 101)

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

$$X = \frac{151.5 \pm \sqrt{(-151.5)^2 - 4(46.5)(101)}}{}$$

$$X = \frac{151.5 \pm \sqrt{22952 - 18786}}{93}$$

$$X = \frac{151.5 \pm \sqrt{4166}}{93} = \frac{151.5 \pm 64.5}{93}$$

$X = 2.32$ $\qquad$ $0.93 = X$

	H_2	I_2	$2HI$
I			
C			
E	$1.00 - X$	$2.00 - x$	$2x$

$H_2 = 1.00 - 0.93$ $\qquad$ $I_2 = 2.00 - 0.93$ $\qquad$ $HI = 2(0.93)$

$H_2 = 0.07M$ $\qquad$ $I_2 = 1.07$ $\qquad$ $HI = 1.86M$