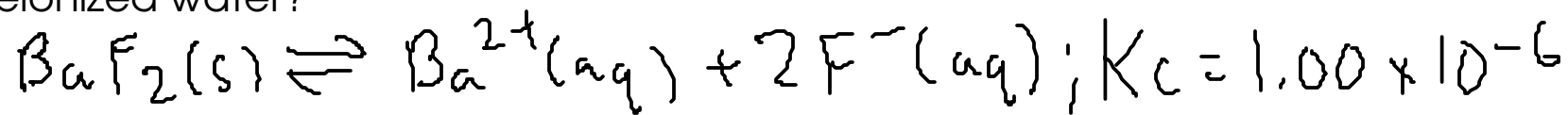


1
What is the concentration of barium ion at equilibrium if solid barium fluoride is mixed with deionized water?



$$K_c = [\text{Ba}^{2+}][\text{F}^{-}]^2 = 1.00 \times 10^{-6}$$

Make a chart to relate all the concentrations to a single variable.

Species	[Initial]	Δ	[Equilibrium]
Ba^{2+}	0	+x	x
F^{-}	0	+2x	2x

Assign "x" to be the change in barium ion concentration.

Plug (Equilibrium) expressions back into the K_c equation.

$$(x)(2x)^2 = 1.00 \times 10^{-6}$$

$$4x^3 = 1.00 \times 10^{-6}$$

$$x^3 = 2.5 \times 10^{-7}$$

$$x = 0.0062996052 = [\text{Ba}^{2+}]$$

$$\text{So, } [\text{Ba}^{2+}] = \boxed{0.00630 \text{ M Ba}^{2+}}$$

A 6.00 L reaction vessel contains 0.488 mol hydrogen gas, 0.206 mol iodine vapor, and 2.250 mol HI at equilibrium at 491 C. . What is the value of K_c at 491 C?



We're being asked to find K_c for a reaction that's already at equilibrium. To do that, we'll just need to write the K_c equation out and plug in concentrations.

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = ?$$

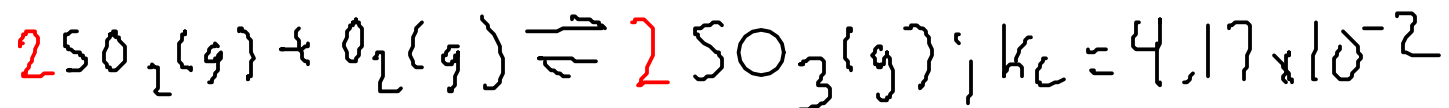
$$[\text{HI}] = \frac{2.250 \text{ mol}}{6.00 \text{ L}} = 0.375 \text{ M HI}$$

$$[\text{H}_2] = \frac{0.488 \text{ mol}}{6.00 \text{ L}} = 0.0813333333 \text{ M H}_2$$

$$[\text{I}_2] = \frac{0.206 \text{ mol}}{6.00 \text{ L}} = 0.0343333333 \text{ M I}_2$$

$$K_c = \frac{(0.375)^2}{(0.0813333333)(0.0343333333)} = \boxed{50.4 = K_c}$$

What is the direction of reaction when a mixture of 0.20 M sulfur dioxide, 0.10 M oxygen gas, and 0.40 M sulfur trioxide approaches equilibrium?



Use the reaction quotient, Q . (same expression as K_c)

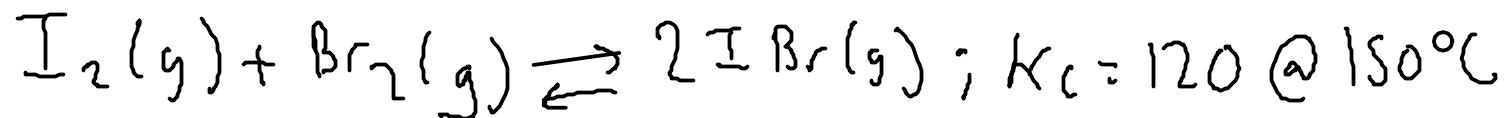
$$Q = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 [\text{O}_2]} = \frac{(0.40)^2}{(0.20)^2 (0.10)} = 40$$

$$Q > K_c$$

$$40 > 4.17 \times 10^{-2}$$

Since $Q > K_c$, the reaction is not at equilibrium and will proceed to the LEFT, forming more sulfur dioxide and oxygen.

A 5.0 L vessel initially contains 0.0015 mol of each reactant. Find the equilibrium concentrations of all species in the vessel at equilibrium at 150 C.



$$K_c = \frac{[\text{IBr}]^2}{[\text{I}_2][\text{Br}_2]} = 120$$

Set up a chart to relate all the equilibrium concentrations.

Species	[Initial]	Δ	[Equilibrium]
I_2	$\frac{0.0015\text{mol}}{5.0\text{L}} = 0.0003$	$-x$	$0.0003 - x$
Br_2	$\frac{0.0015\text{mol}}{5.0\text{L}} = 0.0003$	$-x$	$0.0003 - x$
IBr	0	$+2x$	$2x$

Assign "x" to equal the change in iodine concentration

$$\frac{(2x)^2}{(0.0003 - x)(0.0003 - x)} = 120$$

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Either solve with quadratic equation OR take root of both sides!

$$\sqrt{\frac{(2x)^2}{(0.0003-x)^2}} = \sqrt{120}$$

$$\frac{2x}{0.0003-x} = 10.95445115$$

$$2x = (0.0003-x)(10.95445115)$$

$$0.1825741858x = 0.0003 - x$$

$$1.182574186x = 0.0003$$

$$x = 0.000253683873$$

Plug the value of "x" we calculated back into (Equilibrium) expressions to get our answers.

$$[I_2] = 0.0003 - x = 0.000046 \text{ M } I_2$$

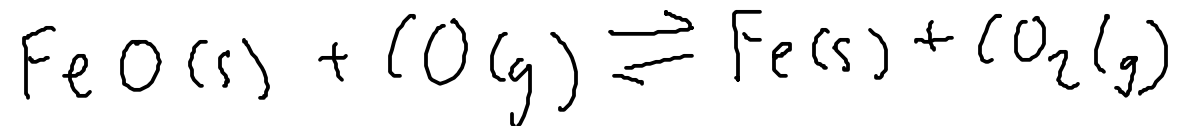
$$[Br_2] = 0.0003 - x = 0.000046 \text{ M } Br_2$$

$$[IBr] = 2x$$

$$= 0.00051 \text{ M } IBr$$

Species	[Equilibrium]
I_2	$0.0003 - x$
Br_2	$0.0003 - x$
IBr	$2x$

When carbon dioxide is removed from the equilibrium mixture by passing the gases through water (which preferentially absorbs carbon DIOXIDE), what is the direction of net reaction as a new equilibrium is achieved?

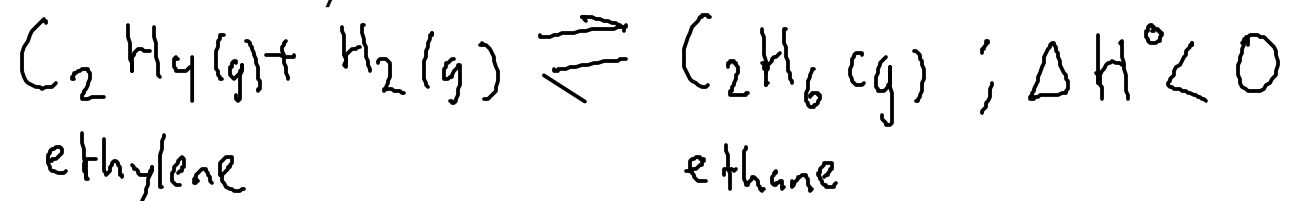


Since the water pulls in carbon dioxide, it REDUCES the concentration of carbon dioxide in the gas.

LE CHATELEIR'S PRINCIPLE says that if we remove one of the participants of the equilibrium, the equilibrium will shift to try to make more of the thing we removed.

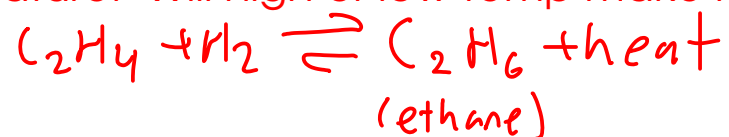
So the equilibrium will shift to the RIGHT to make more iron and carbon dioxide.

Predict the optimal conditions (temperature and pressure) for maximum conversion of ethylene to ethane.



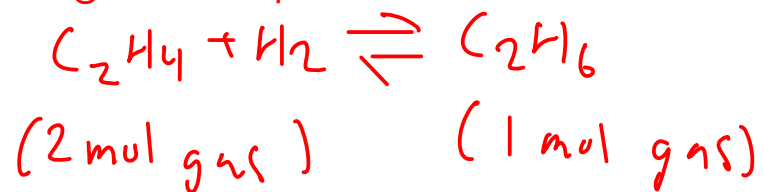
(The enthalpy change is less than zero, so it's an EXOTHERMIC reaction)

Temperature: Will high or low temp make more ethane?



LOWER TEMPERATURES will cause the equilibrium to shift to the right, meaning we'll get more ethane!

Pressure: Will high or low pressure make more ethane?



Since this equilibrium has different numbers of moles of gas on each side, it CAN respond to pressure. Compressing the reaction (INCREASING PRESSURE) will cause the reaction to shift to the side that has less gas - the ethane side!

Optimum conditions: LOW TEMPERATURE and HIGH PRESSURE.