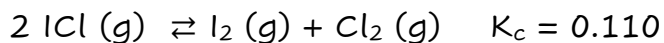


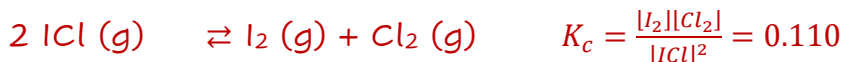
Equilibrium Problems Part 1

1. A sample containing 0.500 moles of ICl was placed into a 5.00 L flask and decomposed at 500 °C.



Calculate the equilibrium concentrations of all species, ICl, I₂, and Cl₂.

$$M = 0.500 \text{ mol}/5.00 \text{ L} = 0.100 \text{ M}$$



I	0.100 M	0	0
C	-2x	+x	+x
E	0.100 - 2x	x	x

$$K_c = \frac{[x][x]}{[0.100-2x]^2} = \frac{x^2}{[0.100-2x]^2} = 0.110 \quad \text{Take sq. root of both sides}$$

$$\frac{x}{0.100-2x} = \sqrt{0.110} \quad \text{Solve for } x$$

$$x = 0.0194 \text{ M}$$

$$[\text{I}_2] = [\text{Cl}_2] = \mathbf{0.0194 \text{ M}}$$

$$[\text{ICl}] = 0.100 \text{ M} - 2(0.0194 \text{ M}) = \mathbf{0.0612 \text{ M}}$$

2. The reaction $\text{H}_2(\text{g}) + \text{CO}_2(\text{g}) \rightleftharpoons \text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g})$ has $K_c = 0.106$ at 705 K. Initially, 0.632 M CO₂ and 0.570 M H₂ were allowed to react. Calculate the concentrations of all species at equilibrium.



I	0.570 M	0.632 M	0	0
C	-x	-x	+x	+x
E	0.570 - x	0.632 - x	x	x

$$K_c = \frac{[\text{H}_2\text{O}][\text{CO}]}{[\text{H}_2][\text{CO}_2]} = \frac{(x)(x)}{(0.570-x)(0.632-x)} = \frac{x^2}{(0.570-x)(0.632-x)} = 0.106$$

$$\frac{x^2}{x^2 - 1.20x + 0.360} = 0.106 \quad x^2 = 0.106(x^2 - 0.120x + 0.360) \quad \text{Collect terms to one side of the equation. } 0.894x^2 + 0.127x - 0.03816$$

$$\text{Use the quadratic formula } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-0.127 \pm \sqrt{(0.127)^2 - 4(0.894)(-0.03816)}}{2 \times 0.894} = \frac{-0.127 \pm 0.391}{1.79} \quad x = 0.147 \quad x = -0.289$$

$$x \text{ cannot be negative so our } x = 0.147 \text{ M}$$

$$[\text{H}_2\text{O}] = [\text{CO}] = \mathbf{0.147 \text{ M}}$$

$$[\text{H}_2] = 0.570 \text{ M} - 0.147 \text{ M} = \mathbf{0.423 \text{ M}}$$

$$[\text{CO}_2] = 0.632 \text{ M} - 0.147 \text{ M} = \mathbf{0.145 \text{ M}}$$