

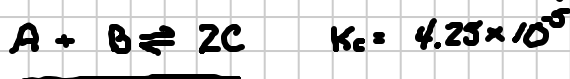
Lecture 9.2 Solving Equilibrium Problems using the Quadratic Equation!

Note Title

10/3/2011

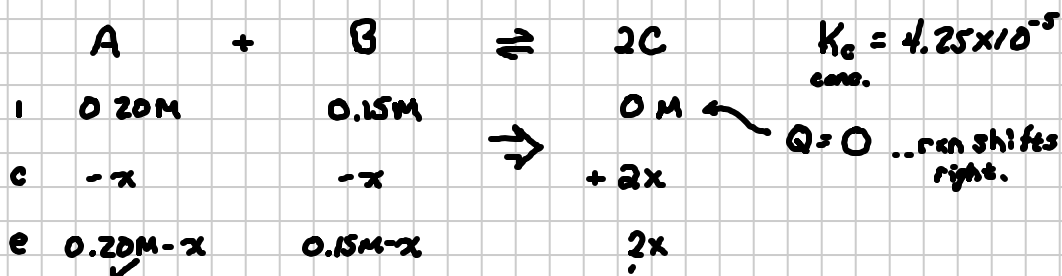
Example. 0.20 mole A and 0.15 mole of B are placed in a 1.00L reaction flask.

If they react to produce C via the following reaction:



... what are the molar concentrations of A, B & C at equilibrium?

$$[A]_i = \frac{\text{mole A}}{\text{Vol}} = \frac{0.20 \text{ mol}}{1.00 \text{ L}} = 0.20 \text{ M}_A \quad \left\{ \quad [B]_i = \frac{0.15 \text{ mol}}{1.00 \text{ L}} = 0.15 \text{ M}$$



L.M.A. $K_c = \frac{[C]_e^2}{[A]_e [B]_e} \left\{ \quad 4.25 \times 10^{-5} = \frac{(2x)^2}{(0.20M-x)(0.15M-x)} \right.$ ← perfect square

... algebra

... $(4.25 \times 10^{-5})(0.20-x)(0.15M-x) = \underbrace{(2x)^2}_{4x^2}$... solve for x

... $\underbrace{3.999975 \times 10^{-6}}_a x^2 + \underbrace{1.4857 \times 10^{-3}}_b x - \underbrace{1.275 \times 10^{-6}}_c = 0$

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

$x = \underbrace{5.627 \times 10^{-4}}_{\text{☺}} \quad \text{or} \quad \underbrace{-5.66 \times 10^{-4}}_{\text{neg. impossible ?}}$

$[A]_e = 0.20 - x = 0.20 - 5.627 \times 10^{-4} = 0.1994373 \text{ M} = 0.20 \text{ M}$ ☹

$[B]_e = 0.15 - x = 0.15 - 5.627 \times 10^{-4} = 0.1494373 \text{ M} = 0.15 \text{ M}$ ☹

$[C]_e = 2x = 2(5.627 \times 10^{-4}) = 1.1254 \times 10^{-3} \text{ M} = 1.13 \times 10^{-3} \text{ M}$

Checking Work: $Q = \frac{[C]^2}{[A][B]} = \frac{(1.1254 \times 10^{-3})^2}{(0.20 \text{ M})(0.15)} = 4.25 \times 10^{-5} = K_c$ ☺