Some Math Tips: CHEMICAL EQUILIBRIA   Chem 210-Jasperse   Ch. 16

1. $(a + b)^2 = a^2 + 2ab + b^2$

example: $(0.24- x)^2 = 0.0576 – 0.48x + x^2 = x^2 – 0.48x + 0.0576$

example: $(3.2e-5 - x)^2 = 1.02e-9 – 6.4e-5\ x + x^2 = x^2 – 6.4e-5\ x + 1.02e-9$

2. **Quadratic Equation: $ax^2 + bx + c = 0$** $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

example: $x^2 – 1.48x + 0.0576 = 0$ $x = 1.44$ or 0.04

example: $x^2 – .60\ x + 0.025 = 0$ $x = 0.43$ or 0.17

Note 1: Quadratics are a bother to solve. Avoid them if possible. Often the "simplifying assumption" (see #4) can enable you to avoid quadratic solutions.

Note 2: Quadratics can often give 2 answers, but one will frequently be nonsense.

3. **"SIMPLIFYING ASSUMPTION": If m>>x, then m – x = m (approximately)**

examples: $0.14 – 3.6e-5 = 0.14$ $1.23e-3 – 1.0e-6 = 1.23e-3$

Use: for many equations in which K is small, "x" will also be relatively small.   In these circumstances, the degree to which the starting materials react ("x") will be relatively insignificant from their concentrations perspective, and we can assume the equilibrium concentration of the reactants will not differ significantly from their initial concentration.
- THE SIMPLIFYING ASSUMPTION WILL OFTEN MAKE THE USE OF THE QUADRATIC EQUATION UNNEEDED
- Guide: If "x" is >5% of "m", then the simplifying assumption is not appropriate.

4. **The "Square Root" Simplification: If both numerator and denominator have "squares", it is convenient to take the square root of both sides to simplify**

examples: $0.10 = x^2/(0.050- x)^2$ Take square root of both sides: $0.316 = x/(0.050- x)$
                                        Rearrange: $0.0158 – 0.316x = x$
                                        Solve for "x": $x = 0.012$

5. **$m = x^n$**
To solve for x, when "m" and "n" are known:
    a. enter "m"
    b. hit $x^{1/y}$ or   button (depending on your calculator)
    c. enter "n"
example:
$25 = x^3$ $x = 2.92$
$1.48e-6 = x^3$ $x = 0.0114$
$2.14e-13 = x^4$ $x = 6.80e-4$