How to approach equilibrium problems

Which way will the reaction go to reach equilibrium?

Calculate the value of Q and compare it to K.
If Q is larger than K, Q must decrease and the reaction will go in the reverse direction.
If Q is smaller than K, Q must increase and the reaction will go in the forward direction.
If Q is equal to K, it is at equilibrium and it will stay that way.

Chapter 15-type problems (not acid-base)

Given initial M's or P's and the value of K_c or K_p, calculate equilibrium M's or P's:

Medium-sized K value
Is the equilibrium constant medium-sized? (K value is between 1000 and 0.001)
If so, you cannot make any approximations. (In other words, you will not be able to neglect x.)
Set up a chart in the normal way. Write the K expression. Solve for x. You will probably need to use the quadratic equation.

Very large or very small K value
Is the equilibrium constant very small or very large? (K smaller than 10^{-5} or K larger than 10^{5})

For reactions with very large or very small K values, there are four possible situations:

- K is very small and reaction is going forward - reaction will proceed very little in the forward direction, so set up a chart and neglect x's since x's will be very small.

- K is very large and reaction is going forward: this means that it will go forward to completion until the limiting reactant is used up, and then backward a little to reach equilibrium. Set up two charts. For the first one, assume LR goes to zero. For the second one, assume the x's are very small so you can neglect them to simplify the equation.

- K is very large and reaction is going backward: it won't proceed very much in the reverse direction. Set up a chart and neglect x's since x's will be very small.

- K is very small and reaction is going backward: this means that it will go backward to completion until the limiting reactant is used up, and then forward a little to reach equilibrium. Set up two charts. For the first one, assume LR goes to zero. You can then calculate all concentrations after the reaction goes to completion. Use these concentrations as your initial conditions for the second chart. For the second chart, assume the x's are very small so you can neglect them to simplify the equation.

Acid-Base problems

For weak acids, K_a values are always small.
If $[HA]/K_a$ is greater than 1000, it is definitely safe to neglect x.
If the $[HA]/K_a$ ratio is less than 1000, then use the method of successive approximations instead.

For weak bases, K_b values are always small.
If $[B]/K_b$ is greater than 1000, it is definitely safe to neglect x.
If the $[B]/K_b$ ratio is less than 1000, then use the method of successive approximations instead.