2.4 (extension) Equilibrium Systems: Solids and Liquids: Concentration Changes

- Solids and Liquids have constant concentrations, so increasing / decreasing concentrations of (s) and (l) will **NOT cause a shift**

- Only concentration changes in (g) and (aq) reactants and products will cause a shift

2.4 (extension) Equilibrium Systems in Solution

a) What's Different with Solutions?

i) solutions at equilibrium will follow all we learned about Le Chatelier's principle and gases from previous, but there is a bit more info required for dealing with **concentration changes** with solutions!

ii) $Fe(NO_3)_{3\ (aq)}\ +\ KSCN_{(aq)}\ \rightleftharpoons\ FeSCN^{2+}_{\ (aq)}\ +\ KNO_{3\ (aq)}$
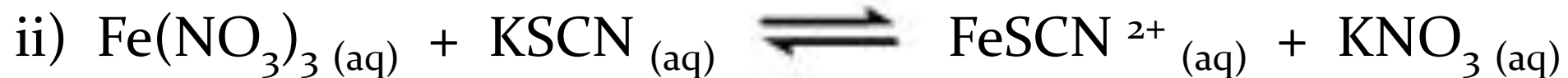
New Fact 1: changing the concentration of some of the substances in a solution equilibrium will NOT affect the equilibrium.

New Fact 2: we can change the concentration of just an ion (i.e.: Fe^{3+}) and not necessarily the whole substance (i.e.: $Fe(NO_3)_3$) to affect the equilibrium.

Lets now see how this works!

iii) In complete ionic form, the above reaction is:

$$Fe^{3+}_{(aq)} + 3NO_3^-{}_{(aq)} + K^+_{(aq)} + SCN^-_{(aq)} \rightleftharpoons FeSCN^{2+}_{(aq)} + K^+_{(aq)} + 3NO_3^-{}_{(aq)}$$

iv) Since $3NO_3^-{}_{(aq)}$ and $K^+_{(aq)}$ appear on both sides of the equation, they can cancel out!

$3NO_3^-{}_{(aq)}$ and $K^+_{(aq)}$ are spectator ions and play no part in the equilibrium.

v) The NET ionic equation is then :

$$Fe^{3+}_{(aq)} + SCN^-_{(aq)} \rightleftharpoons FeSCN^{2+}_{(aq)}$$

vi) To explain Fact 1, changing the concentration of KNO_3 will not affect the equilibrium.

vii) To explain Fact 2, we can affect the equilibrium by just adding Fe^{3+} or SCN^-

b) Example Questions

i) Increasing the $[Fe^{3+}]$ will shift the reaction to the _____

right, left, no change

ii) Decreasing the $[FeSCN^{2+}]$ will shift the reaction to the _____

right, left, no change

iii) Decreasing the $[KNO_3]$ will shift the reaction to the _____

right, left, no change

iv) Adding some NaSCN will shift the reaction to the _____

SCN -   right, left, no change