Exercise 7.2
Reaction Quotients vs. Equilibrium Constants

1. What is the fundamental difference between a reaction quotient (Q) and an equilibrium constant (K)? When is it appropriate to calculate each from activities of products and reactants?

2. Complete the following statements by filling in the appropriate symbol between Q and K.

(a) A reaction is favoured in the forward direction when Q ___ K.

(b) A reaction is favoured in the reverse direction when Q ___ K.

(c) A reaction proceeds in both directions at the same rate (having reached equilibrium) when Q ___ K.

3. A flask containing $NO_{2(g)}$ and $N_2O_{4(g)}$ has reached equilibrium:

$$2\ NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$$

The flask contains 0.261 bar $NO_{2(g)}$ and 0.459 bar $N_2O_{4(g)}$.

(a) Calculate the equilibrium constant for this reaction.

(b) If another flask contains 0.452 bar $NO_{2(g)}$ and 0.763 bar $N_2O_{4(g)}$, will the reaction proceed in the forward or reverse direction to reach equilibrium?

4. The equilibrium constant for the following reaction is 7.1×10^{-9}:

$$PbI_{2(s)} \rightleftharpoons Pb^{2+}_{(aq)} + 2\,I^{-}_{(aq)}$$

If you combined 0.500 L of $0.025\,M\ Pb(NO_3)_{2(aq)}$ and 0.500 L of $0.045\,M\ NaI_{(aq)}$, would you expect a precipitate to form?

There are hints at the bottom of the page.

1. *A precipitate will only form if this reaction is favoured in the reverse direction…*
2. *Calculate Q for this reaction and compare it to K.*
3. *The sodium cations and nitrate anions are spectator ions.*
4. *Don't forget that the two solution volumes combine to make a new total solution volume! The number of moles of each ion do not change.*