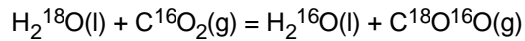


(2.8) In an investigation the isotope ratio $^{18}\text{O}/^{16}\text{O}$ was found to be 2.045×10^{-3} for fresh water and 2.127×10^{-3} for carbon dioxide in the atmosphere. Calculate the equilibrium constant (mole fractions!) for the reaction:



$$k = x_{\text{H}_2^{16}\text{O}(\text{l})} \cdot x_{\text{C}^{18}\text{O}^{16}\text{O}(\text{g})} / x_{\text{H}_2^{18}\text{O}} \cdot x_{\text{C}^{16}\text{O}_2(\text{g})} \quad (\text{from the given reaction})$$

The isotope ratio in fresh water is given by:

$$x_{18w} = x_{\text{H}_2^{18}\text{O}(\text{l})} / x_{\text{H}_2^{16}\text{O}(\text{l})} = 2.045 \times 10^{-3}$$

and in the atmosphere:

$$x_{18a} = x_{\text{C}^{18}\text{O}^{16}\text{O}(\text{g})} / (2x_{\text{C}^{16}\text{O}_2(\text{g})} + x_{\text{C}^{18}\text{O}^{16}\text{O}(\text{g})}) = 2.127 \times 10^{-3}$$

We can now rewrite the equilibrium constant as:

$$k = (1/x_{18w})^2 \cdot x_{18a}; \quad \text{neglect fraction } x_{\text{C}^{18}\text{O}^{16}\text{O}(\text{g})} \text{ in comparison with } x_{\text{C}^{16}\text{O}_2(\text{g})}.$$

$$x_{18w} := 2.045 \cdot 10^{-3} \quad x_{18a} := 2.127 \cdot 10^{-3} \quad k := \frac{2 \cdot x_{18a}}{x_{18w}^2} \quad k = 2.080$$