

Question 7.71:

What is the maximum concentration of equimolar solutions of ferrous sulphate and sodium sulphide so that when mixed in equal volumes, there is no precipitation of iron sulphide?
(For iron sulphide, $K_{sp} = 6.3 \times 10^{-18}$).

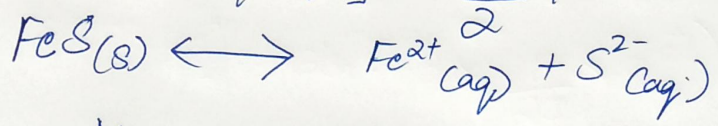
Answer

Let the maximum concentration of each solution be x mol/L. After mixing, the volume of the concentrations of each solution will be reduced to half, i.e. $\frac{x}{2}$.

$$\therefore [FeSO_4] = [Na_2S] = \frac{xM}{2}$$

$$\text{Then } [Fe^{2+}] = [FeSO_4] = \frac{xM}{2}$$

$$\text{Also, } [S^{2-}] = [Na_2S] = \frac{xM}{2}$$



$$K_{sp} = [Fe^{2+}][S^{2-}]$$

$$6.3 \times 10^{-18} = \left(\frac{x}{2}\right)\left(\frac{x}{2}\right)$$

$$\frac{x^2}{4} = 6.3 \times 10^{-18}$$

$$\Rightarrow x = 5.02 \times 10^{-9}$$

If the concentrations of both solutions are equal to or less than $5.02 \times 10^{-9}M$, then there will be no precipitation of iron sulphide.