- Solutions of lead(II) nitrate (0.080 M, 60 mL) and potassium iodide (0.080 M, 40 mL) are mixed. What amount (in mol) of $PbI_2(s)$ precipitates?

Marks 4

Lead(II) nitrate and potassium iodide react according to the equation:

$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2K(NO_3)(aq)$

The reaction requires *two* moles of KI for every *one* mole of $Pb(NO_3)_2$. As the same concentrations of the two solutions are used but the volume of KI is smaller, it is this that limits the amount of product. The number of moles of KI used is given by the concentration (in M) × volume (in L):

$$\text{moles of KI} = 0.080 \text{ mol L}^{-1} \times \frac{40}{1000} \text{ L} = 0.0032 \text{ mol}$$

As *one* mole of PbI_2 is made for every *two* moles of KI used, the maximum yield of PbI_2 is one half of the number of moles of KI:

moles of PbI_2 = ½ × 0.0032 mol = 0.0016 mol

Answer: **0.0016 mol**

What is the final concentration of $K^+(aq)$ ions remaining in solution after the reaction?

The number of moles of K^+ is 0.0032 mol. After mixing, the total volume = (60 + 40 mL) = 100 mL or 0.1 L. The concentration is:

concentration = number of moles / volume = (0.0032 mol) / (0.1 L) = 0.032 M

Answer: **0.032 M**

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