Marks 4

- Lead ions react with bromide ions according to the following equation.

$$Pb^{2+}(aq) + 2Br^{-}(aq) \rightarrow PbBr_2(s)$$

If 0.040 M lead(II) nitrate solution (100.0 mL) is added to 0.020 M potassium bromide solution (300.0 mL), what amount (in mol) of lead(II) bromide precipitates?

The number of moles of Pb^{2+} ions in 100.0 mL of a 0.040 M solution of $Pb(NO_3)_2$ is:

number of moles = concentration × volume
= (0.040 mol L^{-1}) × (0.1000 L) = 0.0040 mol

The number of moles of Br^- ions in 300.0 mL of a 0.020 M solution of KBr is:

number of moles = (0.020 mol L^{-1}) × (0.3000 L) = 0.0060 mol

The precipitation reaction requires 2 Br^- ions for every Pb^{2+} ion. As there is *less* than twice as much Br^- than Pb^{2+}, it is the Br^- that is the limiting reagent.

From the chemical equation, 2 mol of Br^- leads to 1 mol of $PbBr_2$(s) and so:

number of moles of $PbBr_2$(s) formed = ½ × 0.0060 mol = 0.0030 mol

Answer: **0.0030 mol**

What is the final concentration of NO_3^-(aq) ions remaining in solution after the reaction?

NO_3^- is not involved in the reaction: it is a spectator ion. The amount present are the reaction is the same as at the beginning. When 1 mol of $Pb(NO_3)_2$ dissolves, it forms 1 mol of Pb^{2+}(aq) and 2 mol of NO_3^-(aq). Hence, the number of moles of NO_3^-(aq) present is:

number of moles = 2 × (0.040 mol L^{-1}) × (0.1000 L) = 0.0080 mol

After the solutions are mixed, the total volume is (100.0 + 300.0) mL = 400.0 mL.

This amount is now present in this volume and so has a concentration:

concentration = number of moles / volume = 0.0080 mol / 0.4000 L = 0.020 M

Answer: **0.020 M**