Marks 7

- A 0.060 M solution of aluminium nitrate and a 0.080 M solution of potassium phosphate are prepared by dissolving $Al(NO_3)_3$ and K_3PO_4 in water. Write the ionic equations for these two dissolutions reactions.

Dissolution of $Al(NO_3)_3$	**$Al(NO_3)_3(s) \rightarrow Al^{3+}(aq) + 3NO_3^-(aq)$**
Dissolution of K_3PO_4	**$K_3PO_4(s) \rightarrow 3K^+(aq) + PO_4^{3-}(aq)$**

If these solutions are combined, aluminium phosphate precipitates. Write the ionic equation for the precipitation reaction.

$Al^{3+}(aq) + PO_4^{3-}(aq) \rightarrow AlPO_4(s)$

100.0 mL of the aluminium nitrate solution is added to 50.0 mL of the potassium phosphate solution. What amount (in mol) of aluminium phosphate precipitates?

100.0 mL of a 0.060 M solution of $Al(NO_3)_3$ contains:

number of moles of Al^{3+} = concentration × volume = $c \times V$
= 0.060 mol L^{-1} × 0.1000 L = 0.0060 mol

50.0 mL of a 0.080 M solution of K_3PO_4 contains:

number of moles of PO_4^{3-} = concentration × volume = $c \times V$
= 0.080 mol L^{-1} × 0.0500 L = 0.0040 mol

As the ionic equation has a 1 : 1 ratio of Al^{3+} : PO_4^{3-} reacting, PO_4^{3-} is the limiting reagent. The ionic equation shows that 1 mol of $AlPO_4$ is made from 1 mol of PO_4^{3-} so 0.0040 mol will produce 0.0040 mol.

Answer: **0.0040 mol**

What is the final concentration of aluminium ions remaining in solution after the precipitation?

Formation of 0.0040 mol of $AlPO_4$ requires 0.0040 mol of Al^{3+}. Therefore, the amount remaining is:

number of moles of Al^{3+} remaining = (0.0060 – 0.0040) mol = 0.0020 mol

After mixing the total solution volume is (100.0 + 50.0) mL = 150.0 mL. Hence, the concentration of $Al^{3+}(aq)$ is:

concentration = number of moles / volume = n / V
= 0.0020 mol / 0.1500 L = 0.013 mol L^{-1}

Answer: **0.013 M**