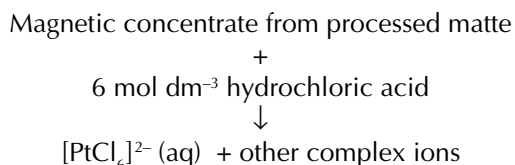


The solvent extraction of platinum

The last stage of extraction of platinum involves dissolving the magnetic concentrate produced from the matte. This concentrate is the solid obtained after smelting and magnetic separation. After removal of the base metals, the concentrate is dissolved in hydrochloric acid to give a solution of the platinum as a complex ion, $[\text{PtCl}_6]^{2-}(\text{aq})$, the hexachloroplatinate(IV) ion, along with other complex ions.



Once the platinum is in solution it can be removed selectively by exchange of ions using amines dissolved in organic solvents. In this process, the metals are extracted using the technique of partition.

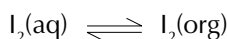
The partition coefficient, K , is :

$$K = \frac{[\text{Concentration of solute in organic layer}]}{[\text{Concentration of solute in aqueous layer}]}$$

so if K is greater than 1, there is a greater proportion of solute in the organic layer.

1. Demonstration

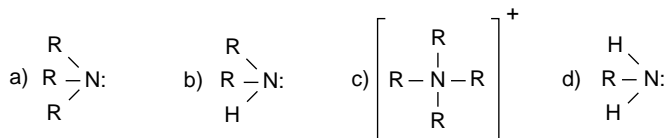
Iodine dissolves in both the aqueous solvents and the organic solvents:



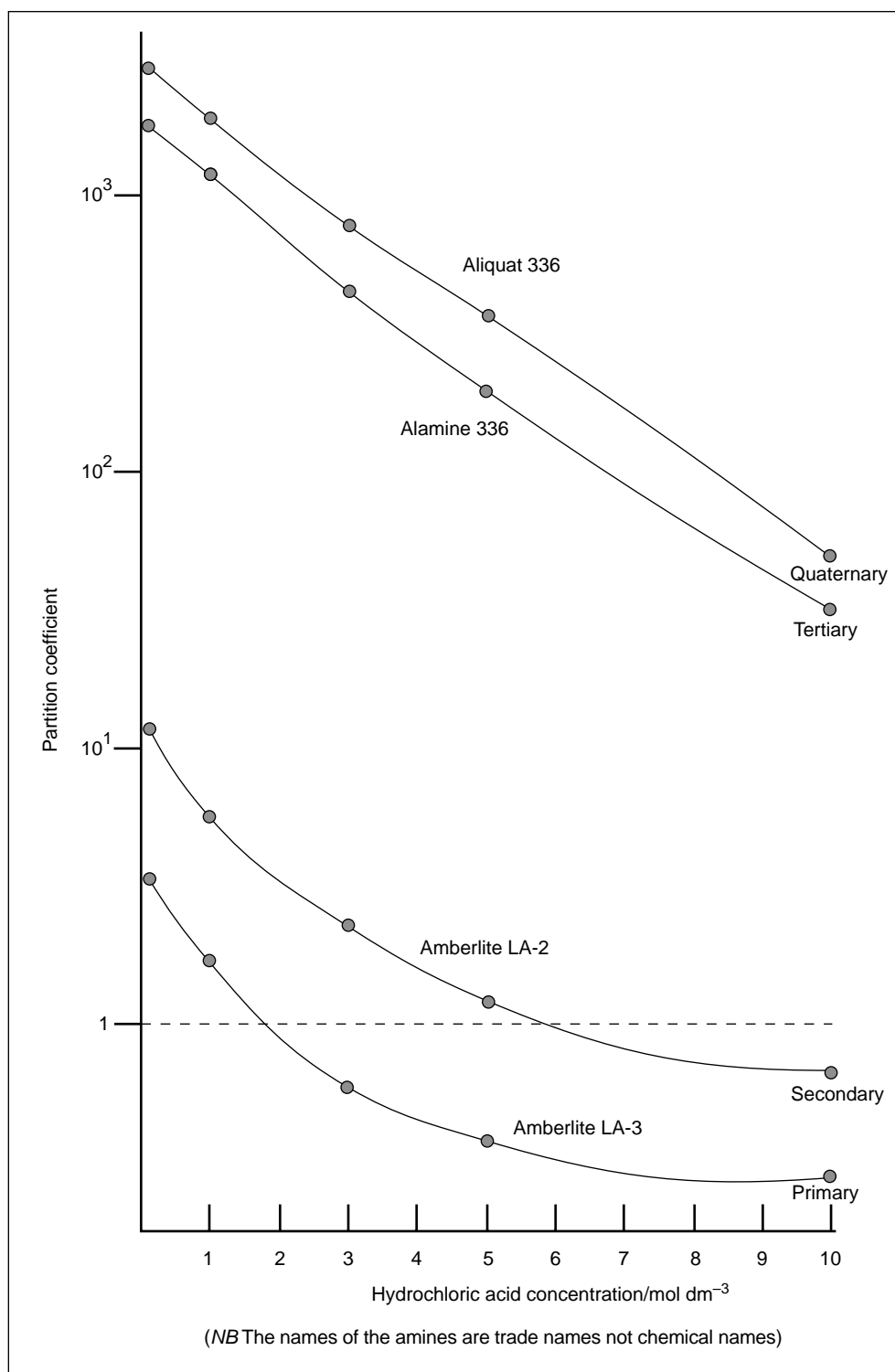
- Which layer is the organic layer?
- In which layer is the iodine most soluble?
 - Explain why you might expect this.
 - Would K for this example be greater than, less than or equal to 1?

2. The organic layer used in the solvent extraction of platinum could be a solution of primary, secondary, tertiary amines or quaternary ammonium salts.

Label the following amines as primary, secondary, tertiary and quaternary cations.



- Predict the equation for the reaction between a primary amine and hydrochloric acid.
- The figure shows the distribution data for the extraction of $[\text{PtCl}_6]^{2-}$ from an aqueous solution by an organic solvent containing different amines.



- a) Which amine is the most efficient for extracting $[\text{PtCl}_6]^{2-}$?
- b) What is the significance of the dotted line at partition coefficient value 10^0 ?
- c) At 7 mol dm^{-3} hydrochloric acid, for which amine(s) does the $[\text{PtCl}_6]^{2-}$ dissolve more in the aqueous acid than in the organic amine-containing layer?

