Temperature-composition diagrams

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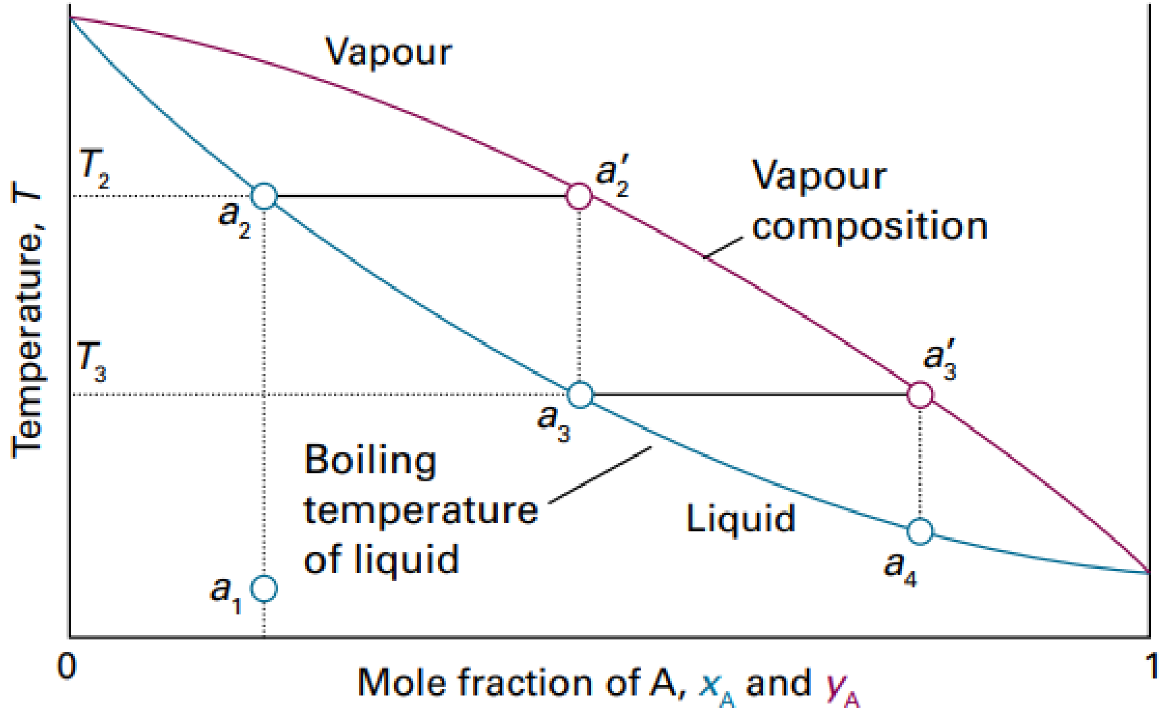
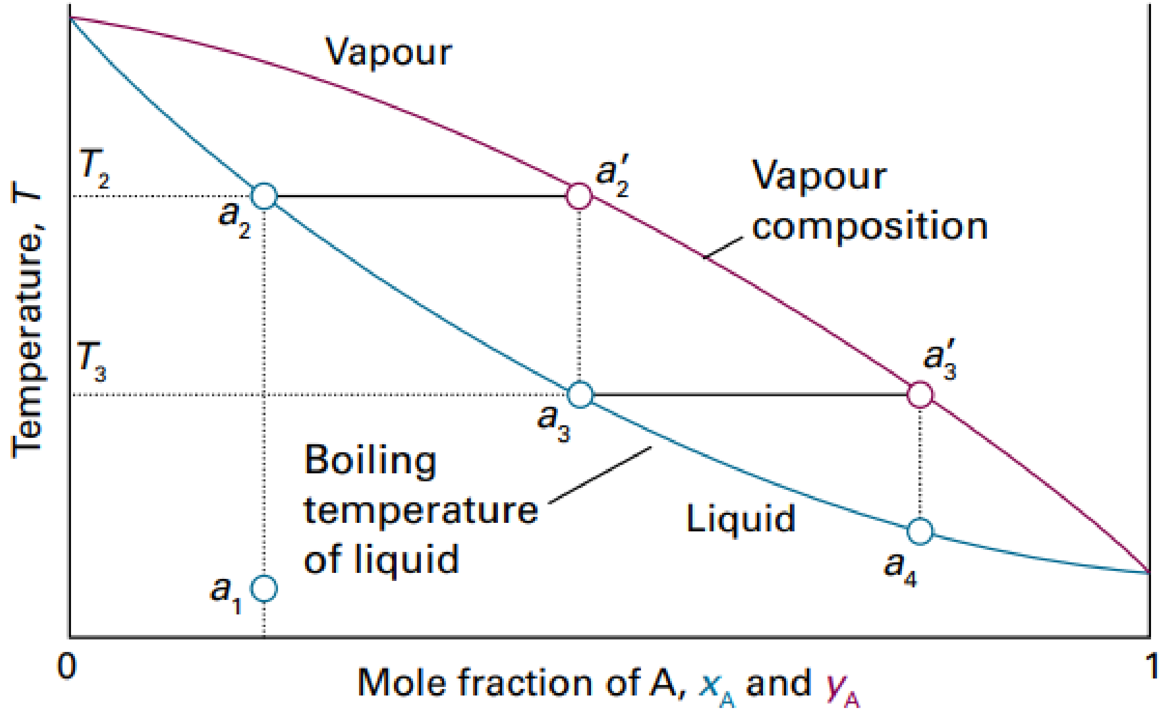


Temperature-composition diagrams

The blue line is the boiling temperature for a range of compositions



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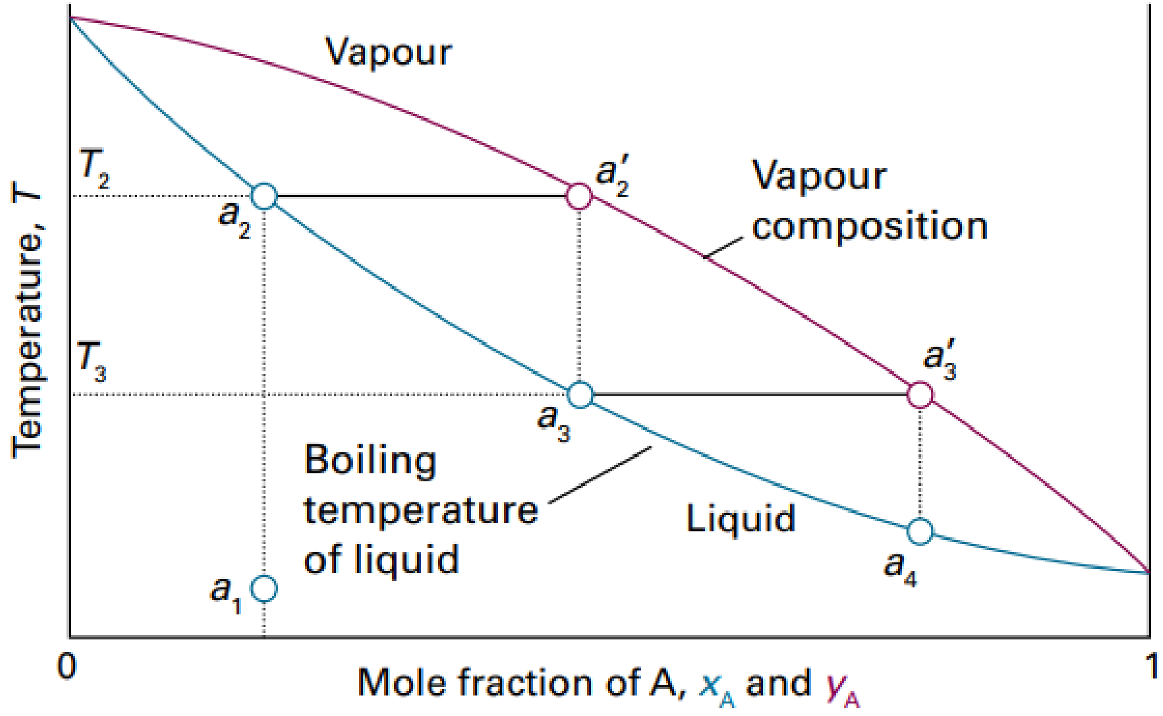

The red line is the composition of the vapor in equilibrium with the liquid at each temperature

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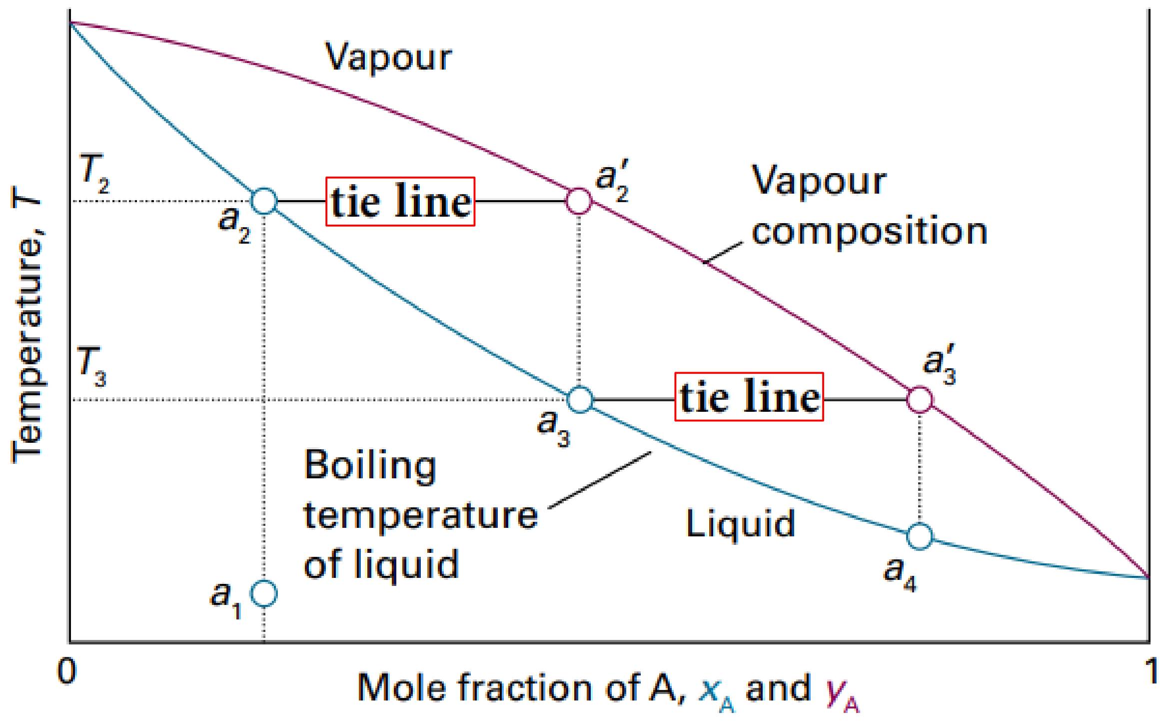

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Temperature-composition diagrams

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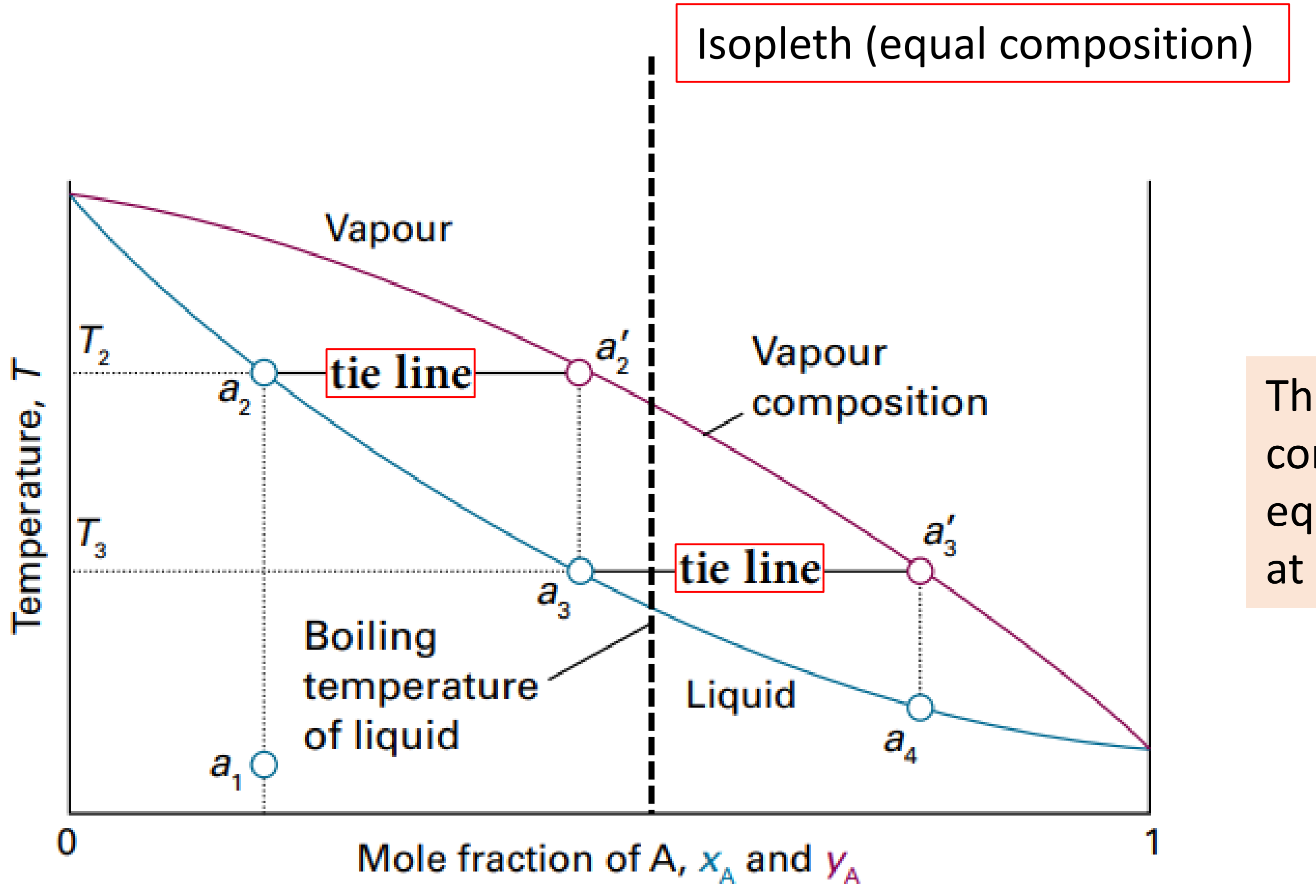

The red line is the composition of the vapor in equilibrium with the liquid at each temperature

Lever rule

To determine the relative proportions of two phases in a system at equilibrium

Lever rule

Number of A molecules in the liquid	$\mathbf{n_{A,L}}$
Number of A molecules in the vapor	$\mathbf{n_{A,V}}$

Lever rule

Number of A molecules in the liquid	$\mathbf{n_{A,L}}$
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Total A	

Lever rule

Number of A molecules in the liquid	$n_{A,L}$
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Lever rule

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Overall (liquid+vapor) mole fraction A	

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Total A + B in liquid	
Total A + B in vapor	

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mole fractions

↓

amount of A in the liquid phase is $n_L x_A$

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mole fractions

amount of A in the liquid phase is $n_L x_A$

amount of A in the vapour phase is $n_V y_A$

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Number of A molecules in the liquid	$n_{A,L}$
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total amount of A

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mole fractions

amount of A in the liquid phase is $n_L x_A$

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$$n_A = n_L x_A + n_V y_A$$

total amount of A

$$n_A = n z_A = n_L z_A + n_V z_A$$

By equating these two expressions:

$$n_L x_A + n_V y_A = n_L z_A + n_V z_A$$

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mole fractions

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$$n_A = n_L x_A + n_V y_A$$

total amount of A

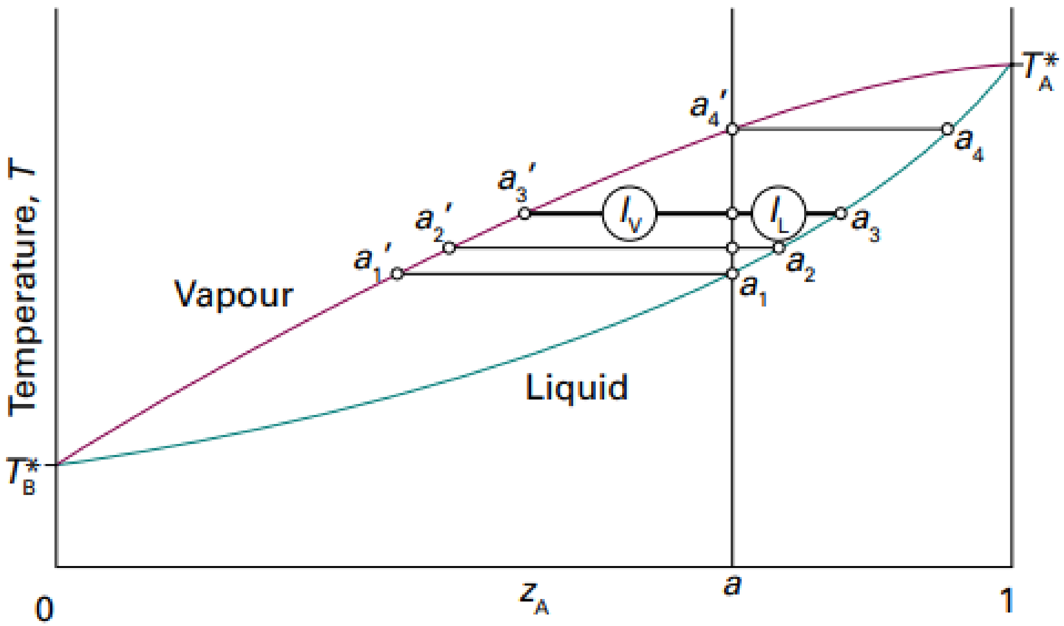
$$n_A = n z_A = n_L z_A + n_V z_A$$

By equating these two expressions:

$$n_L x_A + n_V y_A = n_L z_A + n_V z_A$$

$$n_L (z_A - x_A) = n_V (y_A - z_A)$$

Lever rule



mole fractions

amount of A in the liquid phase is $n_L x_A$

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$$n_A = n_L x_A + n_V y_A$$

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Lever rule

mole fractions

amount of A in the liquid phase is $n_L x_A$

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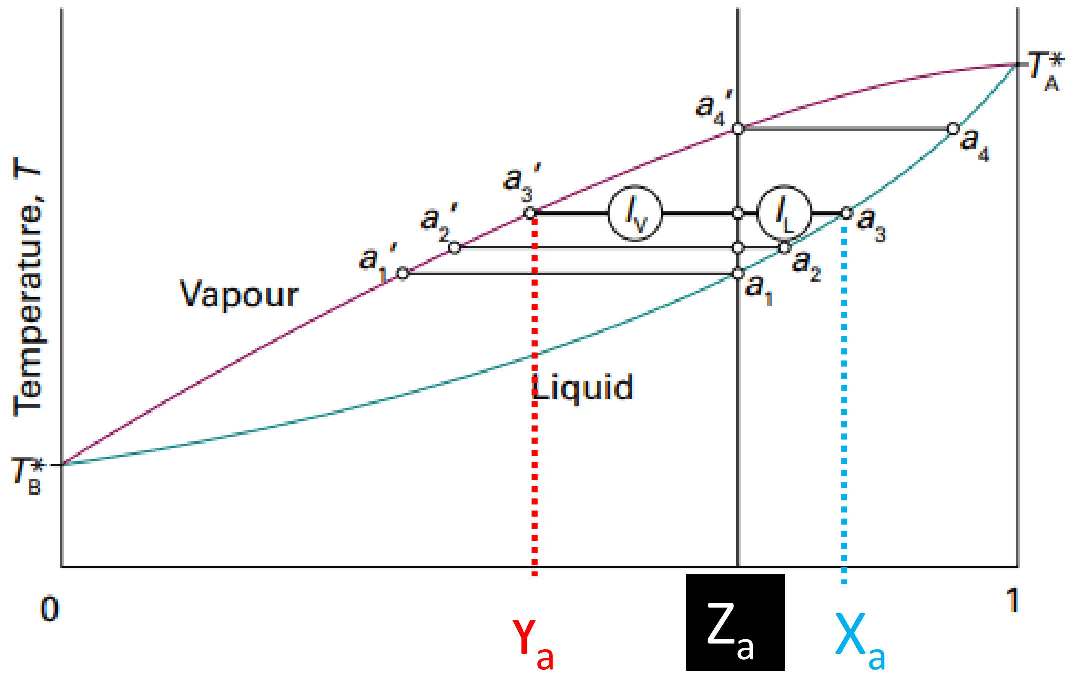

$$n_A = n_L x_A + n_V y_A$$

total amount of A

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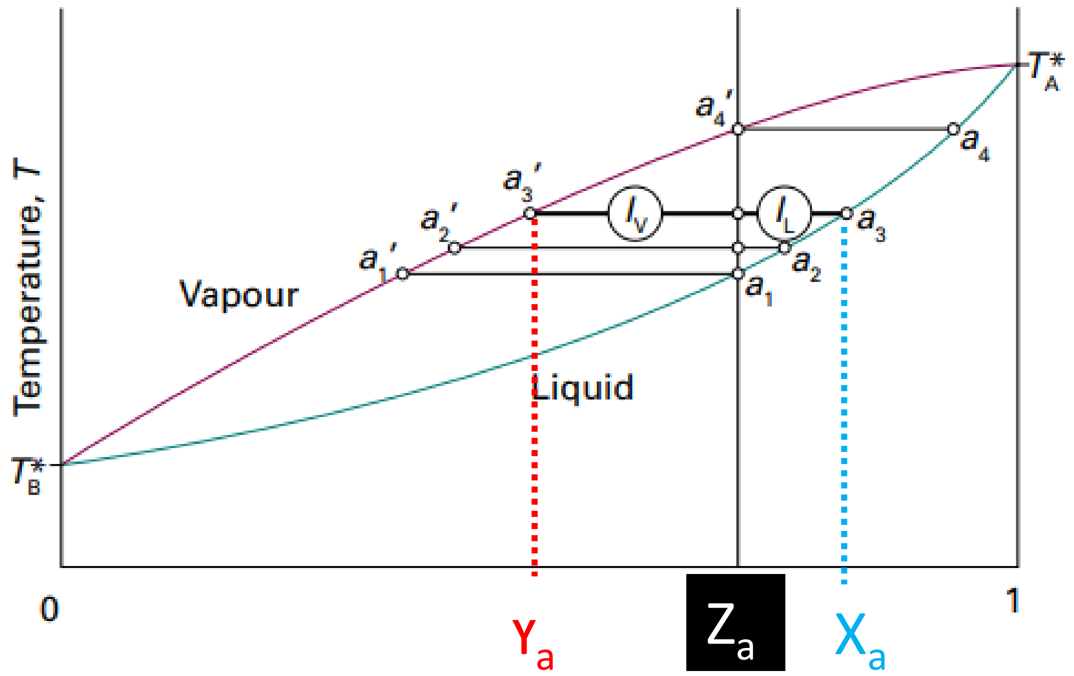
$$n_L (z_A - x_A) = n_V (y_A - z_A)$$

Lever rule



mole fractions

amount of A in the liquid phase is $n_L x_A$

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$$n_A = n_L x_A + n_V y_A$$

total amount of A

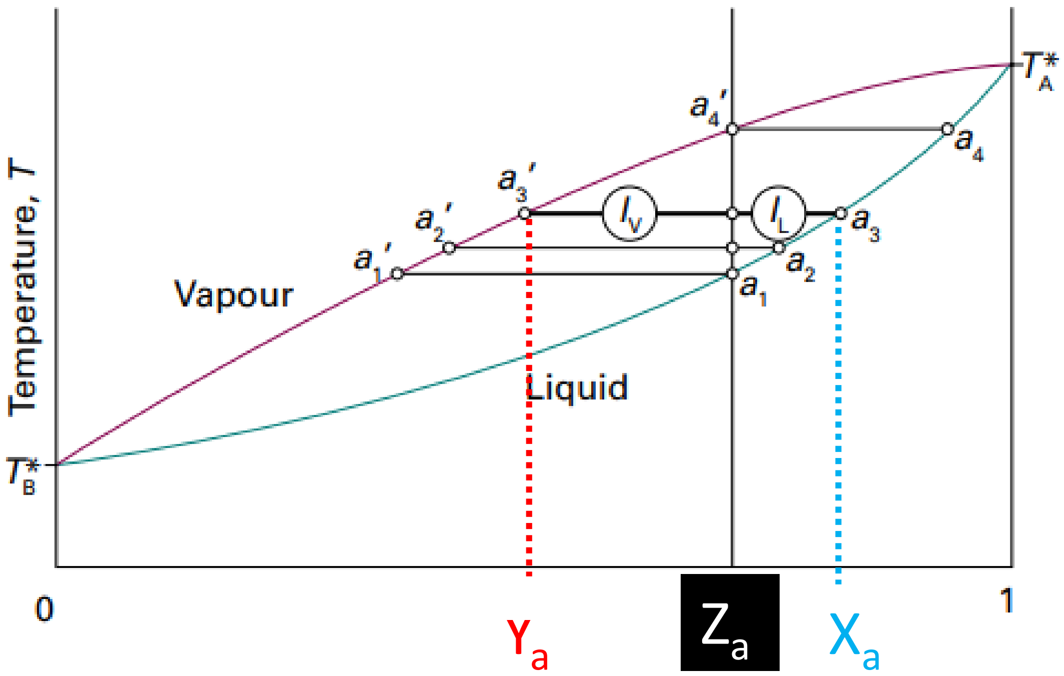
$$n_A = n z_A = n_L z_A + n_V z_A$$

By equating these two expressions :

$$n_L x_A + n_V y_A = n_L z_A + n_V z_A$$

$$n_L \overbrace{(z_A - x_A)}^{l_L} = n_V \overbrace{(y_A - z_A)}^{l_V}$$

Lever rule



$$n_L l_L = n_V l_V$$

mole fractions

amount of A in the liquid phase is $n_L x_A$

amount of A in the vapour phase is $n_V y_A$

$$n_A = n_L x_A + n_V y_A$$

total amount of A

$$n_A = n z_A = n_L z_A + n_V z_A$$

By equating these two expressions :

$$n_L x_A + n_V y_A = n_L z_A + n_V z_A$$

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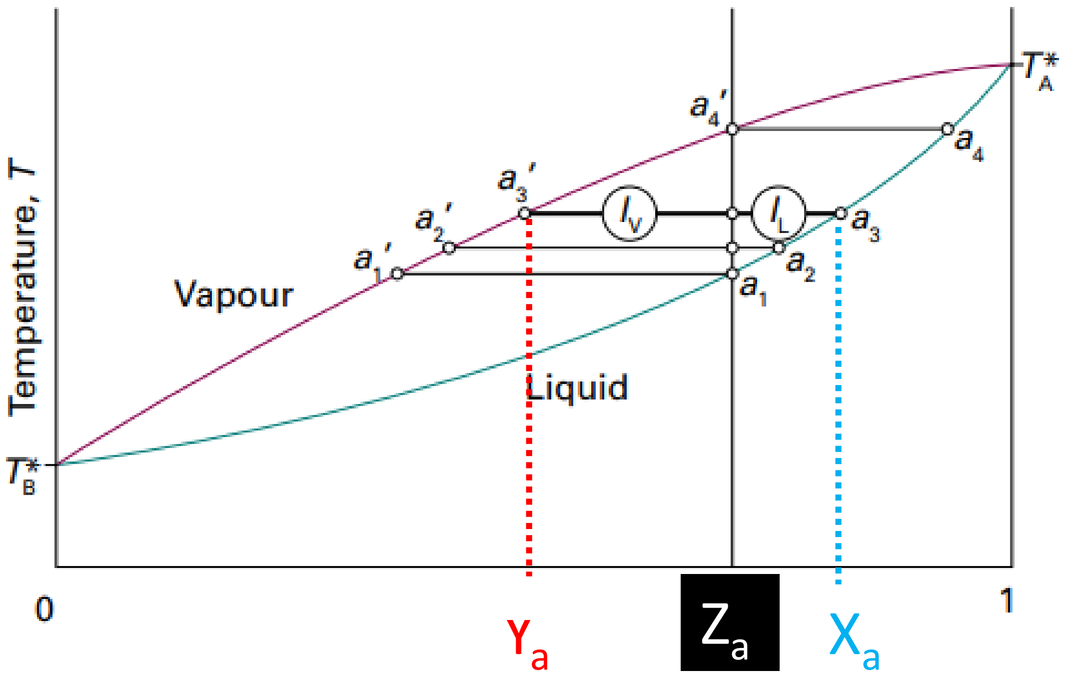
Lever rule



$$n_L l_L = n_V l_V$$

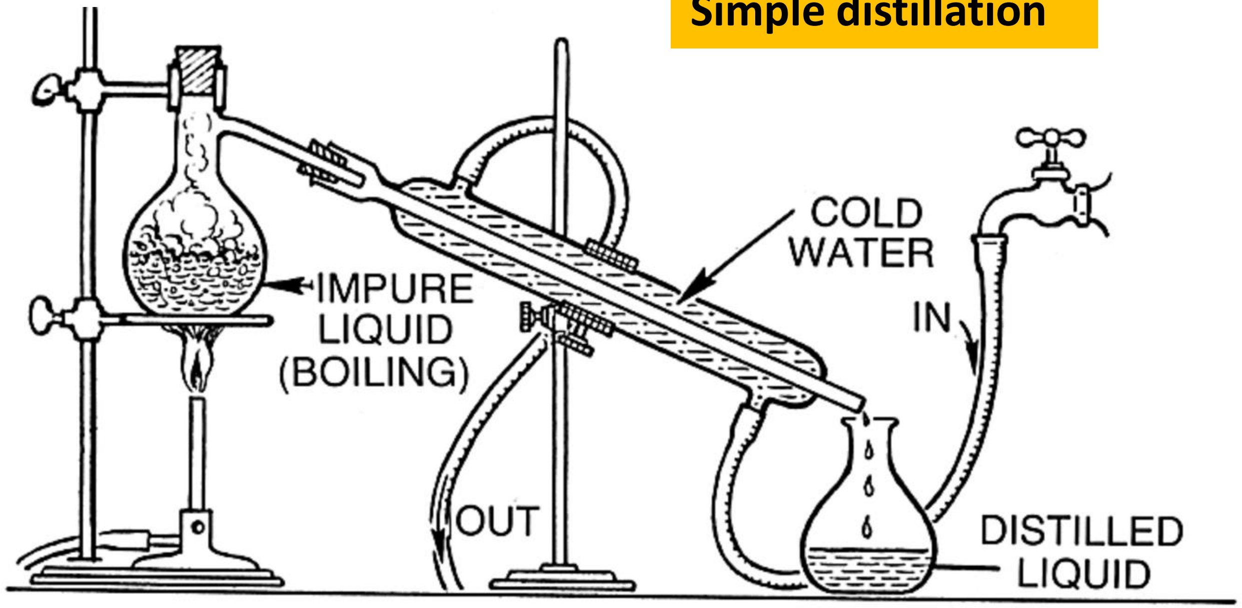
These isopleths show the change in liquid and vapor content at different temperatures for a given Z_a

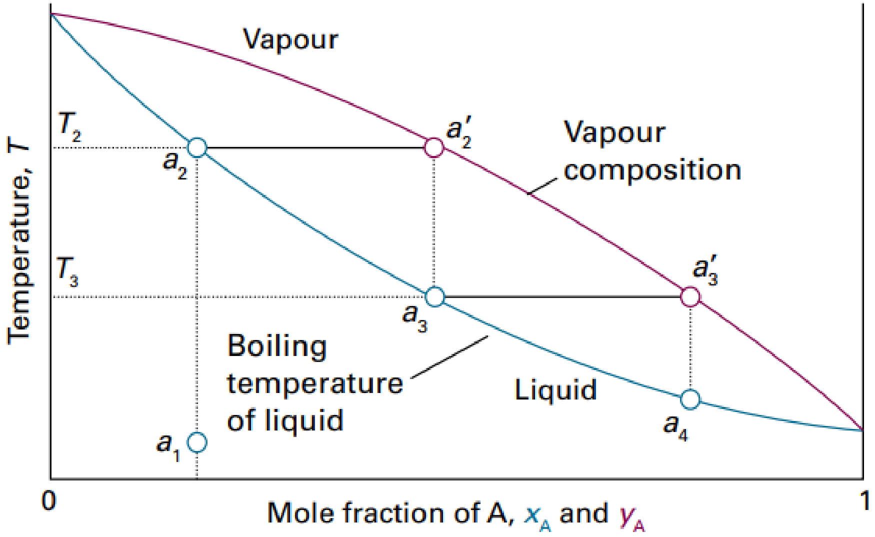
Distillation

Separating components of a mixture based on differences in their volatilities

Distillation

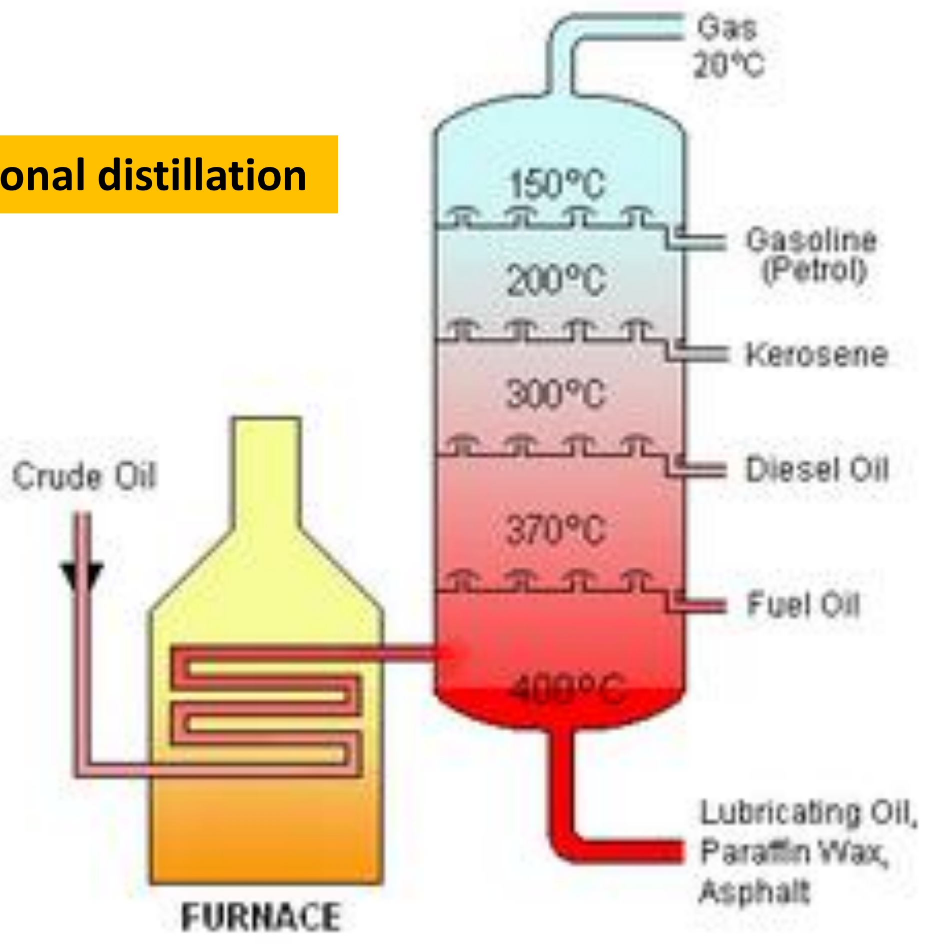
Simple distillation





Distillation

Fractional distillation



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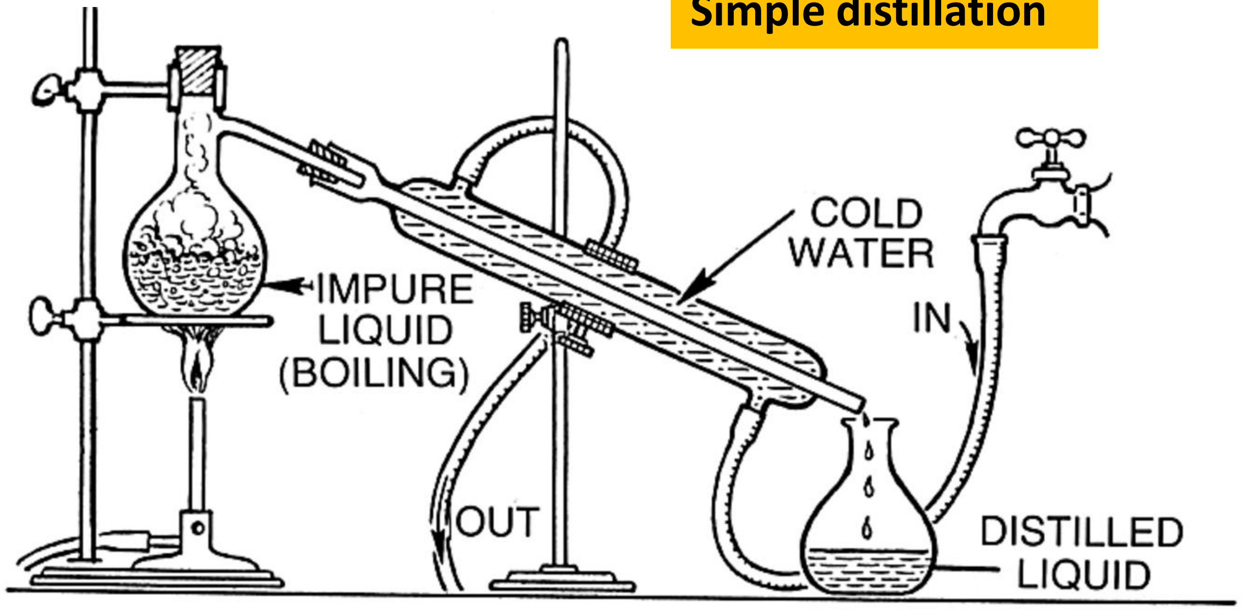
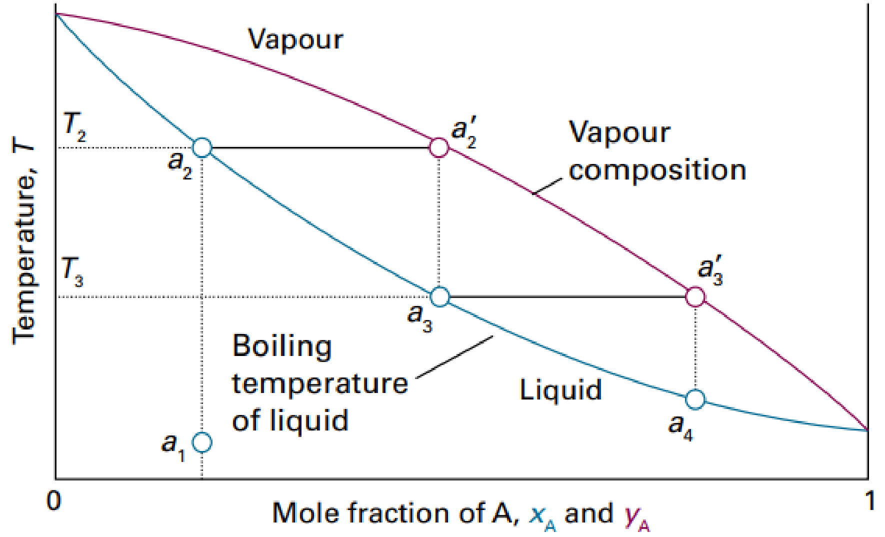


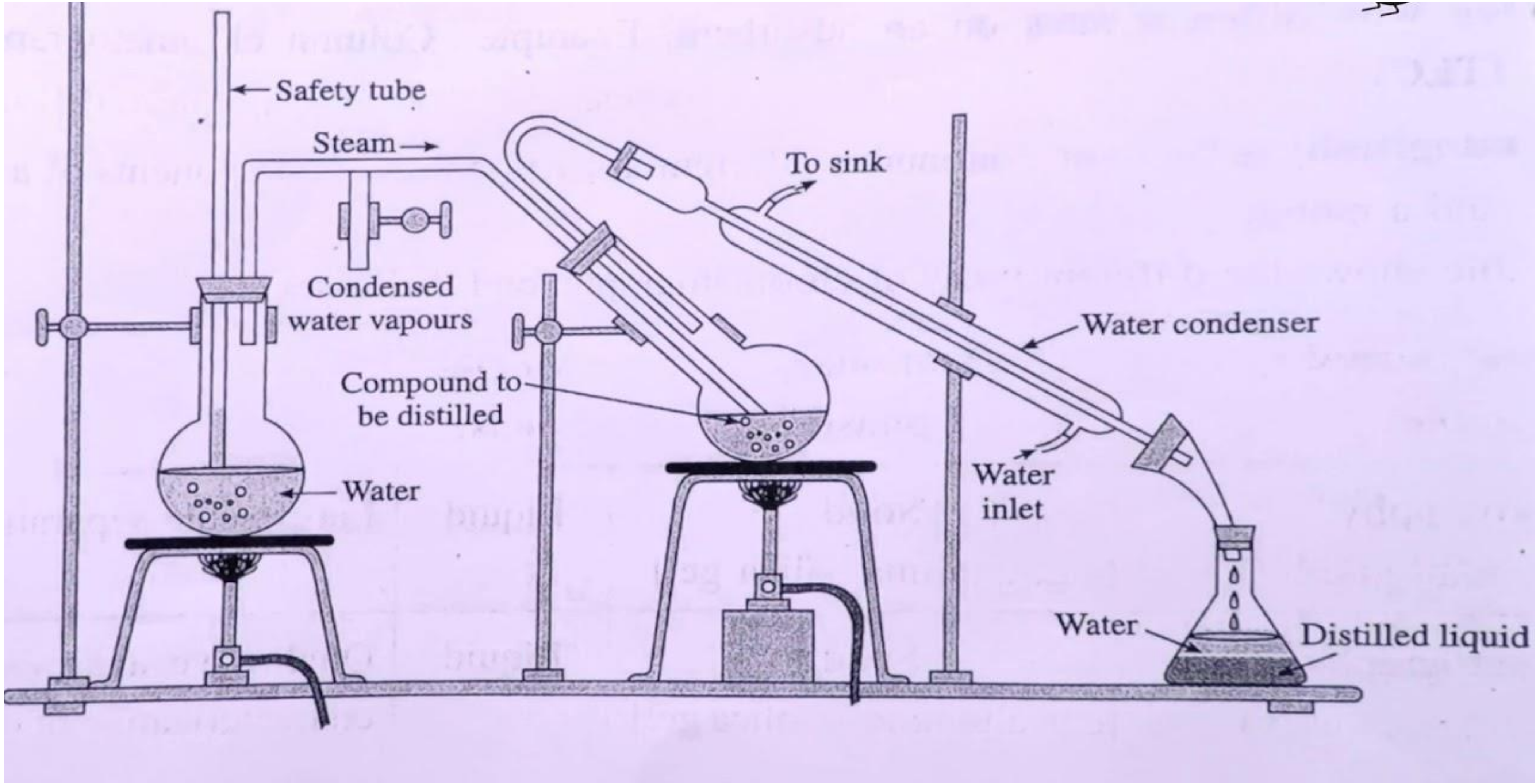


To separate a mixture of liquids with closer boiling points or those containing several components

Steam distillation

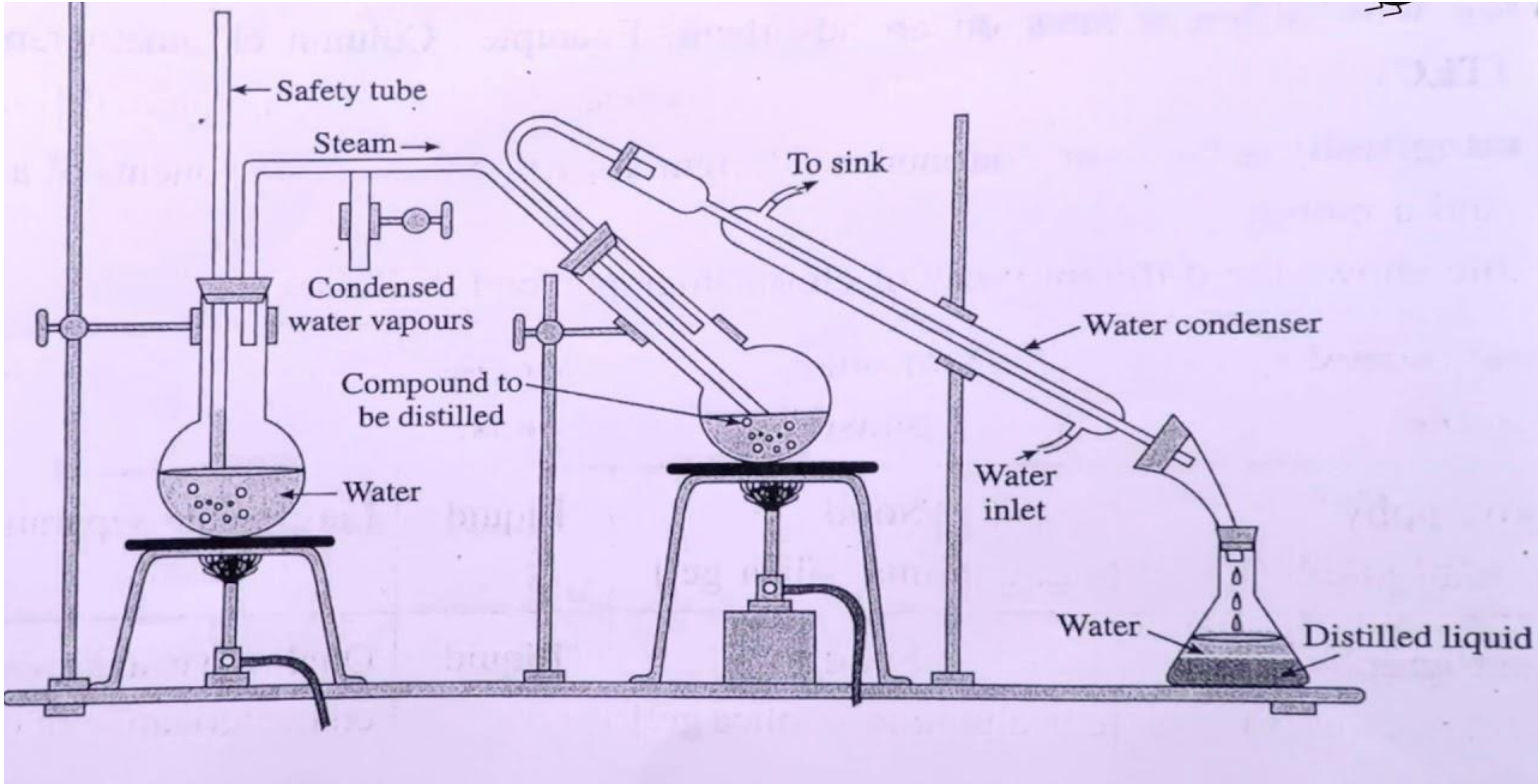
To separate temperature-sensitive compounds

Steam distillation



Steam distillation

In steam distillation, water and the organic compound co-distill, forming a vapor mixture. This lowers the boiling point of the organic compound, so it distills at a temperature below its normal boiling point.



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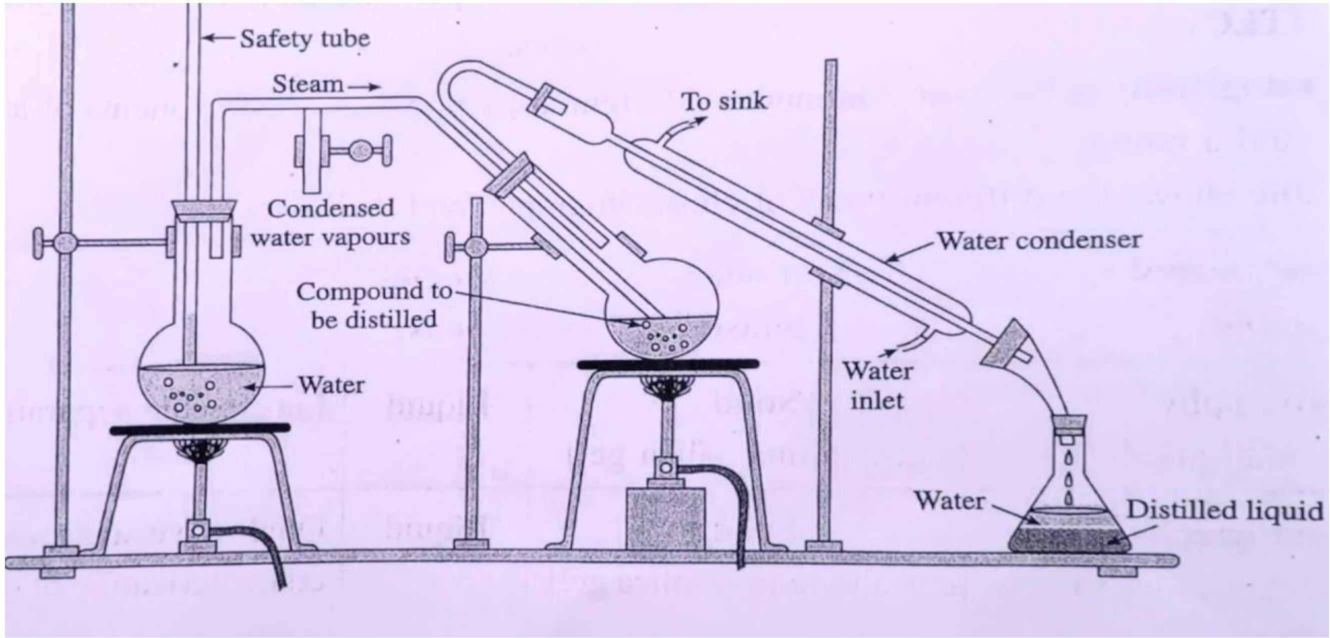

Steam distillation is used to distill temperature-sensitive, water-insoluble compounds.
Ex:

- Organic compounds with high boiling points
- Aromatic oils, terpenes, alkaloids, etc.