

[TP] A non-volatile solute lowers the vapor pressure of the solvent. This in turn means the boiling point of the solvent must increase. Why? Because ...

20% 1. higher temperature is necessary to evaporate the solute
20% 2. the solute particles stick to the solvent particles, analogous to van der Waals *a*
20% 3. at the normal boiling point the vapor pressure of the solvent will be too low
20% 4. the solute vapor pressure is so low
20% 5. Some other reason

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Lecture 11 CH102 A1 (MWF 9:05 am)

Friday, February 15, 2019

- Effect of temperature on solubility
- Review: Colligative properties

Next: Begin ch13: Dynamic chemical equilibrium

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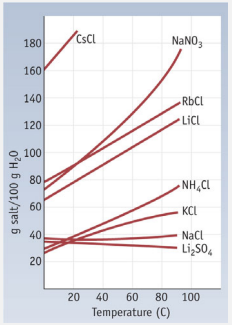
Effect of temperature on solubility

Sign of $\Delta_{sol}H$ does not predict relative solubility (cold packs and hot packs!)

Usually solubility increases with temperature



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Effect of temperature on solubility

But not always!

	SOLUBILITY (g per 100 mL)	
Compound	10 °C	40 °C
Li_2SO_4	35.5	33.7
LiCl	74.5	89.8

What could be going on?

Solubility depends on something in additional to enthalpy change! We'll learn more soon.

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Summary

$\Delta_{\text{latt}}H$ and $\Delta_{\text{aq}}H$ reflect ion size and ion charge

$\Delta_{\text{sol}}H$ reflects competition between $\Delta_{\text{latt}}H$ and $\Delta_{\text{aq}}H$

In general, we cannot predict sign of $\Delta_{\text{sol}}H$

Sign of $\Delta_{\text{sol}}H$ does not predict relative solubility (cold packs and hot packs!)

Effect of temperature means there is more to learn

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Colligative properties summary

Non-volatile solute (negligible vapor pressure) …

- lowers vapor pressure of solvent: $\Delta P = -i\, x_{\text{solute}}\, P_0$
- raises boiling point of solvent: $\Delta T = +i\, m_{\text{solute}}\, K_{\text{b}}$
- lowers freezing point of solvent: $\Delta T = -i\, m_{\text{solute}}\, K_{\text{f}}$

If solute cannot pass through a membrane …

- the solvent will create an osmotic pressure: $\Pi = i\, c_{\text{solute}} RT$

Details and practice in textbook, lab, and discussion

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[TP] A non-volatile solute lowers the vapor pressure of the solvent. This in turn means the boiling point of the solvent must increase. Why? Because …

0% 1. higher temperature is necessary to evaporate the solute
0% 2. the solute particles stick to the solvent particles, analogous to van der Waals a
0% 3. at the normal boiling point the vapor pressure of the solvent will be too low
0% 4. the solute vapor pressure is so low
0% 5. Some other reason

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[TP] The vapor pressure of water at 32 °C is 4.76 kPa. A glass of water is sealed in a 1.00 L container filled with air at 32 °C. After the water comes to equilibrium with the air in the container, the total pressure is 1 bar and there is 500. g of liquid water in the glass, and the partial pressure of water vapor in the container is …

0% 1. less that 4.76 kPa
0% 2. 4.76 kPa
0% 3. more than 4.76 kPa
0% 4. Further information required

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[Group Quiz] Then, 35.0 g of ethylene glycol if dissolved in the liquid water. After the water returns to equilibrium, the mass of the liquid water ...

0% 1. will have decreased
0% 2. will be unchanged
0% 3. will have increased
0% 4. Further information required

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Colligative properties summary

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If solute cannot pass through a membrane ...

- the solvent will create an osmotic pressure: $\Pi = i\, c_{\text{solute}} RT$

Details and practice in textbook, lab, and discussion

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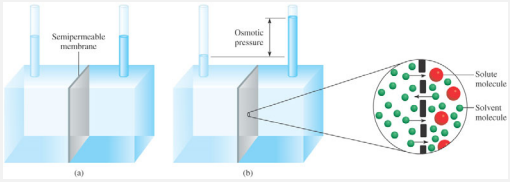
Osmotic pressure $\Pi = i\, c\, R\, T$



$i\, c$ = moles of solute/L of solution
T = temperature in K

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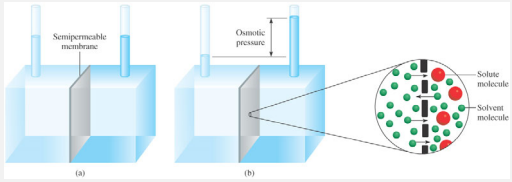
Osmotic pressure $\Pi = i\, c\, R\, T$



From height difference, get $\Pi = F/A$ = density $\times\, \Delta h \times g$

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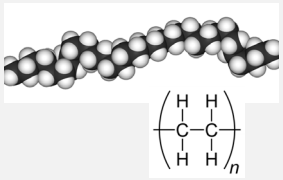
Osmotic pressure $\Pi = i\ c\ R\ T$

1.40 g of polyethylene ($i = 1$) dissolved in 100. mL of benzene generates an osmotic pressure of 0.248 kPa at 25 °C. Calculate the molar mass of the polyethylene.

Calculate the concentration…



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