CH 13

- 3 STEPS OF SOLVATION
- SOL. AS A FUNCTION OF T AND P
- CALC. MOLALITY
- COLLIGATIVE PROPERTIES
  - VP
  - FP
  - BP
  - OSMOSIS

m	
0,10	$MgCl_2$
0.20	GLUCOSE
0.20	ETHANOL
0,30	GLUCOSE
0,20	NaCl

Figure 13.4 Enthalpy Changes Accompanying the Solution Process

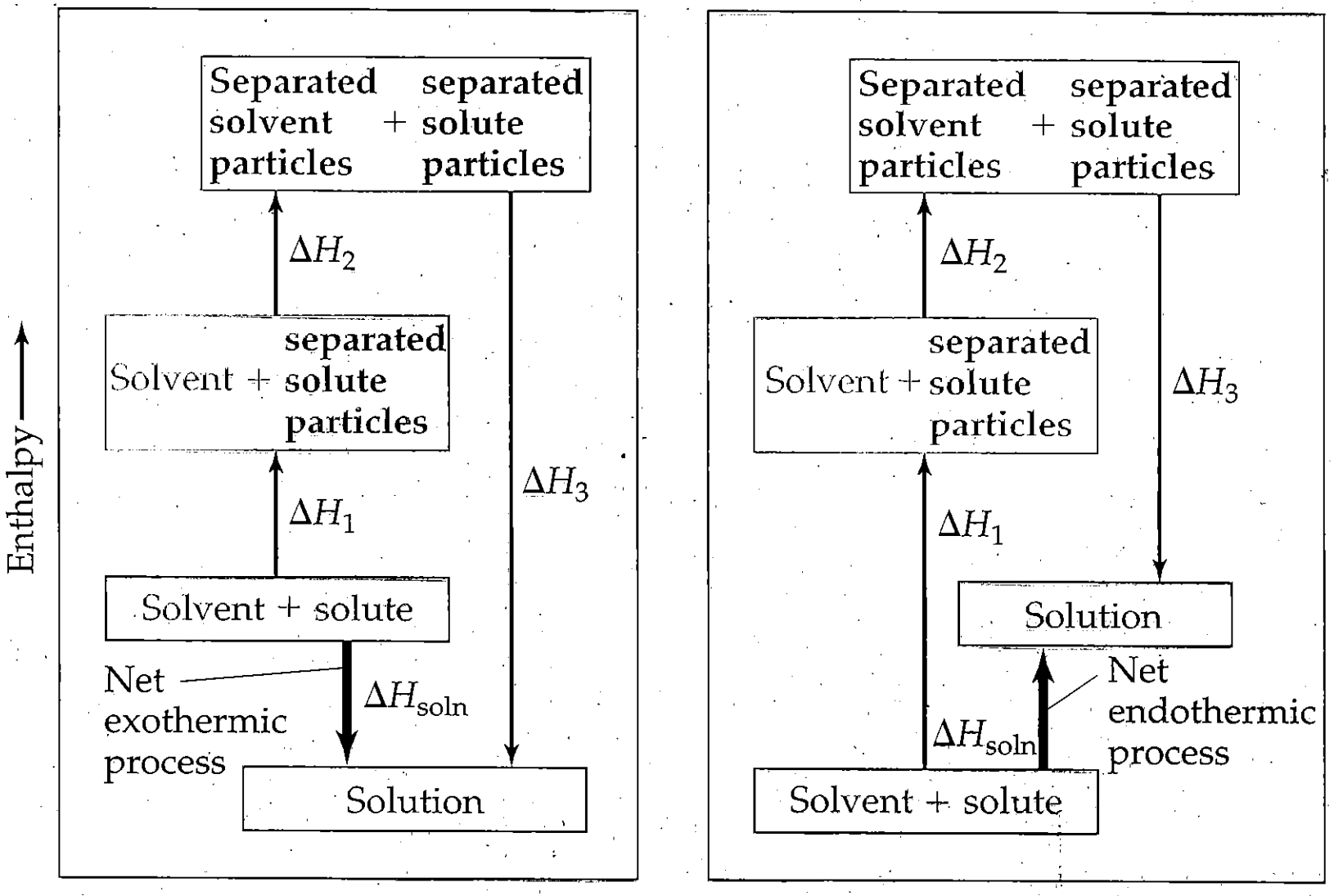
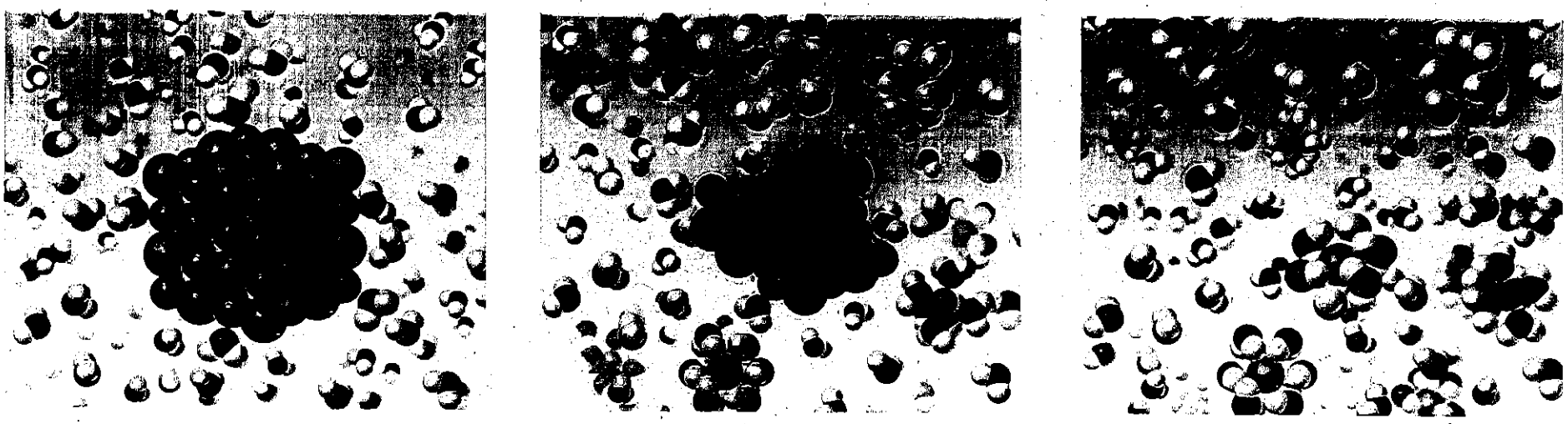


Figure 13.1 Dissolution of an Ionic Solid in Water



(a) (b) (c)

Figure 13.2 Hydration of Na^+ and Cl^- ions

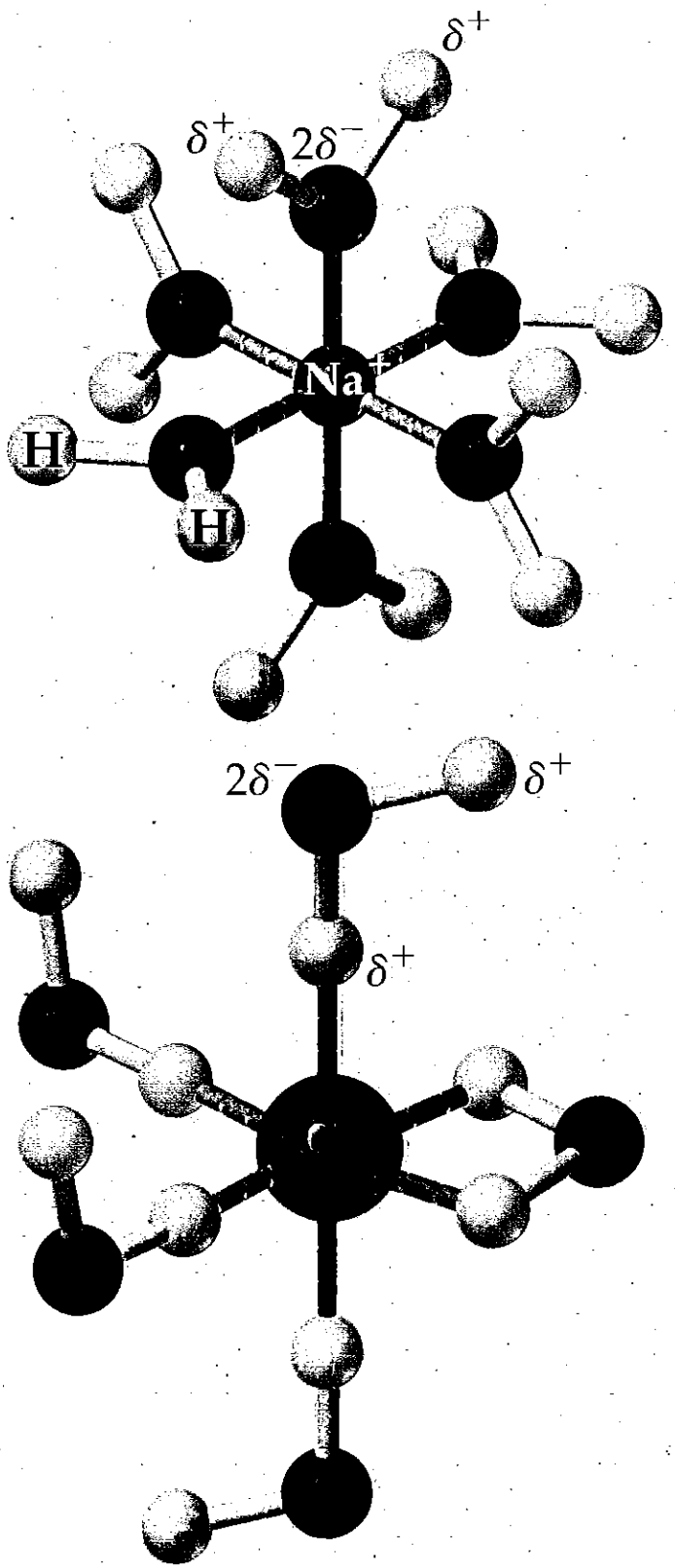


Figure 13.12 Influence of Hydrogen Bonding on Aqueous Solubility

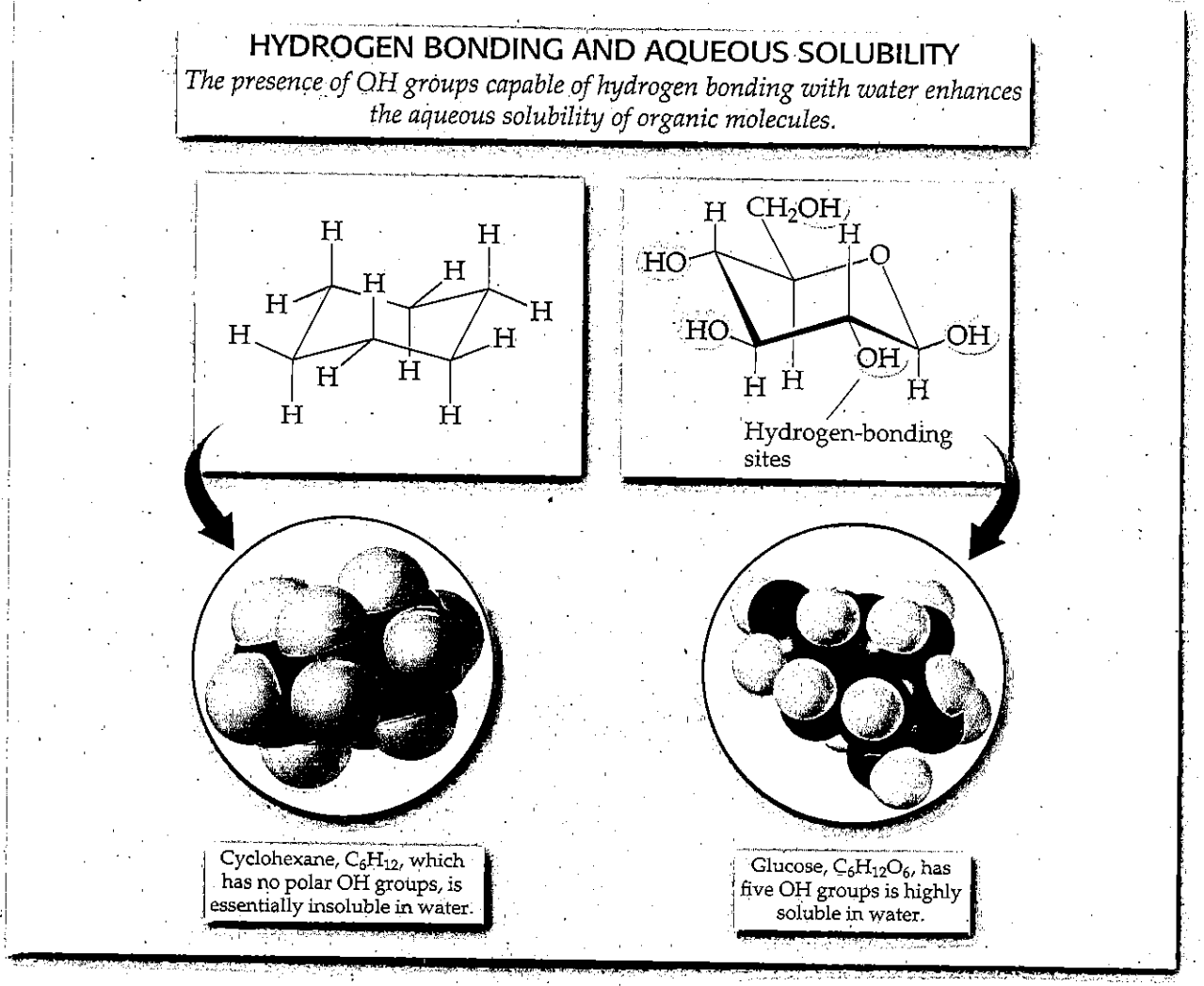
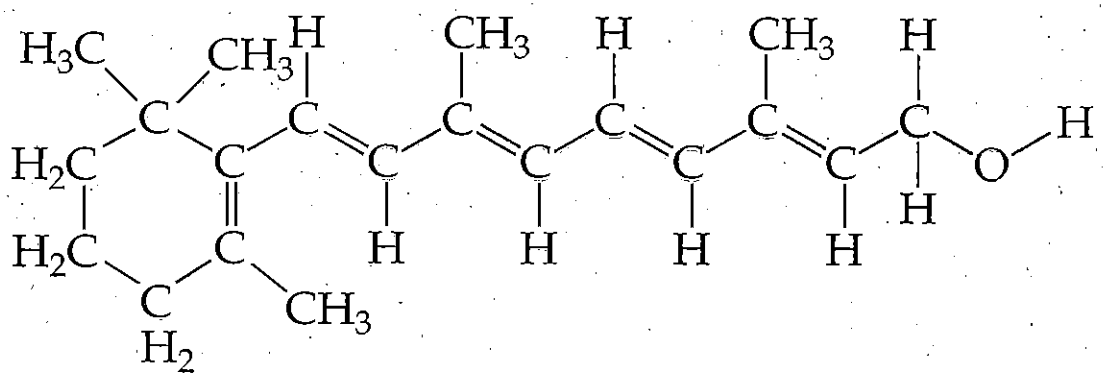
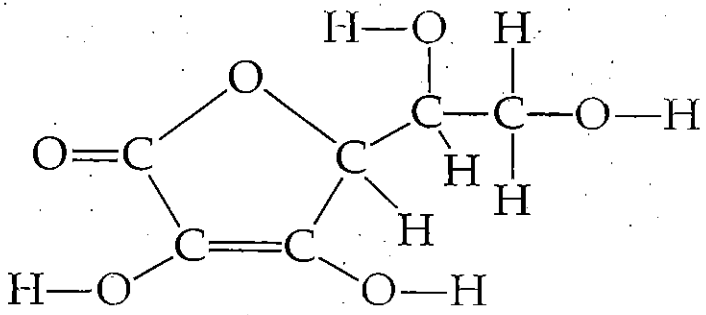
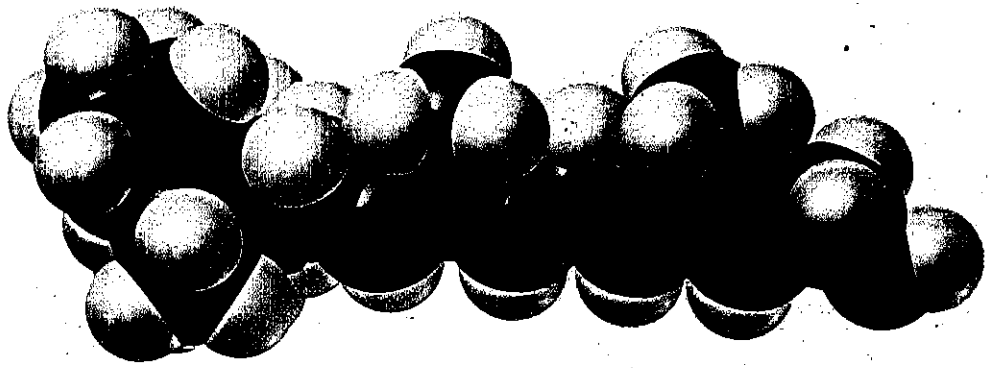


Figure 13.13 Comparison of the Molecular Structures of Vitamins A and C

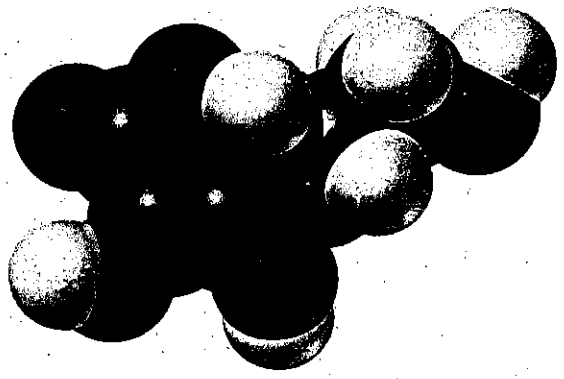






Vitamin A

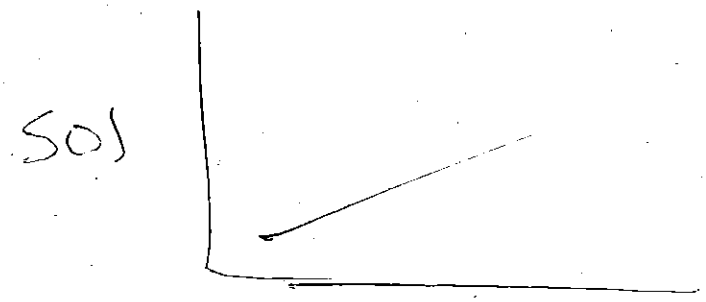
(a)



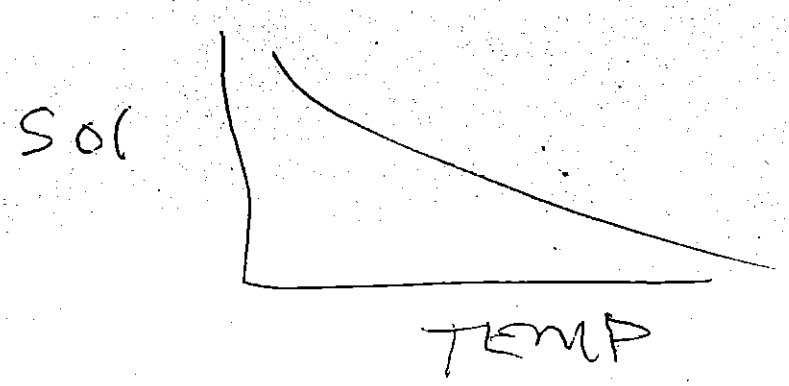
Vitamin C

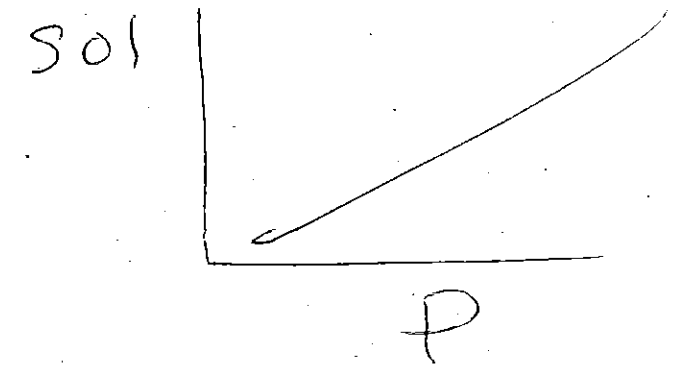
(b)

SOLUB OF SOLID IN LIQ



SOLUB OF GAS IN LIQ





COLLIGATIVE PROPERTIES

WHAT HAPPENS TO THE PROPERTIES OF A PURE SOLVENT WHEN YOU ADD A N.V.S.

VP

FP

BP

WHAT IS OSMOSIS?

CALCULATING CONCENTRATIONS

MOLARITY M $\quad \frac{\text{moles solute}}{\text{L solution}}$

MOLALITY m $\quad \frac{\text{moles solute}}{\text{kg solvent}}$

EXAMPLE

50 g NaCl DISSOLVED IN 500 ml H_2O

WHAT IS M?

$$50\text{ g NaCl} \times \frac{1\text{ mole}}{58.4\text{ g}} = \frac{0.86\text{ moles}}{0.5\text{ L}} = 1.71\ M$$

$$\rho_{H_2O} = \frac{g}{ml} = \frac{kg}{L}$$

$$m = \frac{.86\text{ moles}}{.5\text{ kg}} = 1.71\ m$$

$$\text{DENSITY} = \frac{\text{MASS}}{\text{VOL}} = \frac{g}{ml} = \frac{kg}{L}$$

FREEZING POINT

$$\Delta BP = k_{BP} \cdot m \cdot i$$

$$\Delta FP = k_{FP_{H_2O}} \times m \cdot i$$

FOR 1.71 m NaCl

$$\Delta FP = 1.86\ ^\circ C/m \cdot 1.71\ m \cdot 2 \text{ PARTICLES}$$

$$\Delta FP = 6.4\ ^\circ C$$

FOR 11.3 m ETHANOL (80 PROOF VODKA)

$$\Delta FP = 1.86\ ^\circ C/m \cdot 11.3\ m \cdot 1$$

$$\Delta FP = 21\ ^\circ C$$

$$FP = -21\ ^\circ C$$

$$K_{B_{H_2O}} = 0.52\ ^\circ C / \text{molal}$$

ADD 50 g NaCl TO
500 ml WATER WHAT IS FP?

$$\Delta T_f = k_f \cdot m \cdot i$$

$$= \left(1.86 \frac{^\circ C}{m}\right)(1.70\, m)(2)$$

$$\Delta T = 6.32\ ^\circ C$$

$$T = -6.32\ ^\circ C$$

$$m_{NaCl} = \frac{\text{Moles NaCl}}{\text{Kg Solvent}} = \frac{50\,g \times \frac{1\,mole}{58.5\,g}}{0.500\,kg}$$

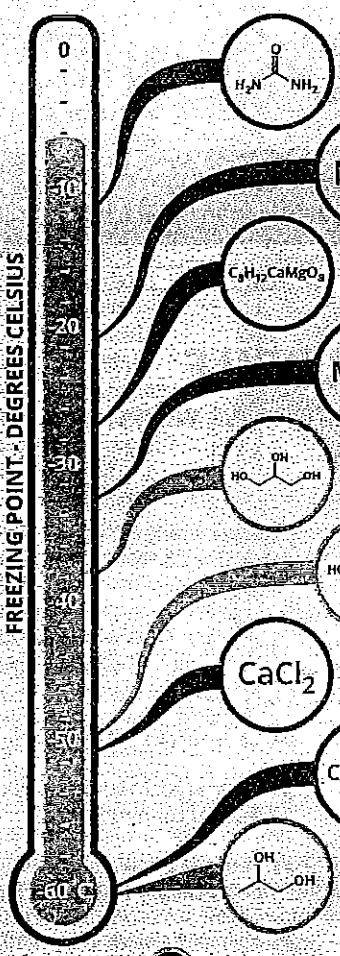
ELECTROLYTES	i
NaCl	
$CaCl_2$	
$Ca(NO_3)_2$	
$MgCl_2$	

NON-ELECTROLYTES	i
SUGARS	$i = 1$
ALCOHOLS	"
GLYCOLS (ANTIFREEZE)	"

PeriodicGraphics
With Compound Interest

DEICERS & ANTIFREEZE

Deicers "interfere" with water molecules, making it more difficult for H_2O to aggregate and freeze. In this way, they lower the freezing point of water. Each of these chemicals has what is known as a "eutectic point": the lowest temperature to which they can depress the freezing point of water. This occurs at a particular deicer concentration.



KEY

Formula — Chemical Name
Percent weight in solution & eutectic point

● Primary use: deicing chemical
● Primary use: antifreeze chemical

ROAD DEICERS

Crews traditionally deice roads with sodium chloride because it is inexpensive. But its tendency to cause corrosion has led to other compounds, such as calcium chloride and magnesium chloride, being used.

AIRPLANE DEICERS

Because chloride salts can be corrosive, their use is prohibited on aircraft. Instead, a range of glycols, as well as other nonchloride salts, commonly protect planes. They are also applied to runways.

ANTIFREEZE CHEMICALS

As salts can cause corrosion of metal parts on machinery and in vehicles, glycols are instead used in antifreeze. Ethylene glycol has been in use for longer, but it's toxic to humans and animals; propylene glycol is effectively nontoxic.

Periodic Graphics is a collaboration between C&EN and Andy Brunning, chemistry educator and author of the popular graphics blog Compound Interest. To see more of Brunning's work, go to compoundchem.com.

Figure13.23 Osmosis