# Diluting Solutions

↳ reduce concentration by adding more solvent

$$M = \frac{n}{V}$$

$$n_{before} = n_{after}$$


$$n = M \cdot V$$

$$M_{before} \cdot V_{before} = M_{after} \cdot V_{after}$$

$$M_1 V_1 = M_2 V_2$$

(Ex) You have .013L of 12.0 Molar HCl solution. You need .50 M HCl, to what volume would you dilute this w/ water?

$M_1 = 12.0$ mol/L
$V_1 = .013$ L
$M_2 = .50$ mol/L
$V_2 = ?$

$(12.0 \frac{mol}{L})(.013L) = (.50 \frac{mol}{L}) V_2$

$\frac{.156 \text{ mol}}{.50 \frac{mol}{L}} = \frac{(.50 \frac{mol}{L}) V_2}{.50 \frac{mol}{L}}$

$.31 \text{ L} = V_2$

66000

Ex) You have 33.0 mL of 2.00 M NaCl solution and you need a 1.60 M solution. What volume should you dilute your solution to?

$M_1 V_1 = M_2 V_2$

$M_1 = 2.00$ M
$V_1 = 33.0$ mL $= .0330$ L
$M_2 = 1.60$ M
$V_2 = ?$

$(2.00\text{M})(.0330\text{L}) = (1.60\text{M}) V_2$

$.0413 \text{ L} = V_2$

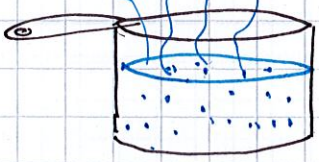
# Colligative Properties

- properties that depend only on the # of particles in solution NOT on their identity

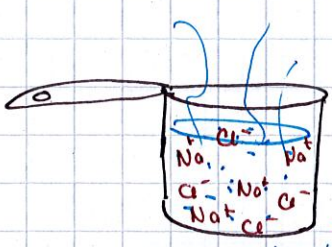
## (1) Boiling Point Elevation

adding a solute to a pure solvent raises the boiling point of resulting solution.

why?



pure $H_2O$




pure $H_2O$ + NaCl

In order for the $H_2O$ to boil, it has to gain more kinetic energy than normal to have enough to break through, past the solute particles & become a gas

How high the new boiling gets depends on the

### van Hoff factor (i)

for a covalent solute (2 or more nonmetals) Ex $C_{12}H_{22}O_{11}$, $CO_2$ — $i = 1$

for an ionic solute (metal + nonmetals) Ex NaCl $Fe_2(SO_4)_3$ — $i$ = # ions in the compound

$\overset{1+}{Na}\overset{1-}{Cl}$ $i = 2$

$\overset{1+}{Al}\overset{3-}{Br_3}$ $i = 4$

$\overset{3+}{Cr_3}(\overset{2-}{PO_4})_4$ $i = 7$

## (2) Freezing Point Depression

- adding a solute to a pure solvent lowers its freezing point of the resulting solution.

Why?