Ch 12

12.1 - all
12.2 - skip energy calculations
12.3 - skip
12.4 - 12.5 - read
12.6 - 12.7 - all
12.8 - skip
12.9 - lecture material

Molarity: \[
\text{M} = \frac{\text{mol solute}}{L \text{ solution}}
\]

How many mols of NaOH are in 15.0 L of 3.5 M NaOH solution?

15.0 L solution \times \frac{3.5 \text{ mol}}{1 \text{ L}} = 52.5 \text{ mol NaOH}

What volume of 6.0 M NaCl soln contains 50.0 mol NaCl?

50.0 \text{ mol NaCl} \times \frac{1 \text{ L}}{6.0 \text{ mol}} = 8.3 \text{ L solution}
Creating solutions

1. Dissolve a solid
   - Calc mols solid
   - add $H_2O$ to make desired vol of soln

2. Dilute a stock solution
   - add water to decrease concentration

Want: $500mL$ of $1.5M$ solution
Have: $6M$ stock solution

$M_1V_1 = M_2V_2$

Molarity $\to$ Volume

\[
(6M) \frac{V_1}{(1.5M) (500mL)}
\]

\[
V_1 = \frac{(1.5M) (500mL)}{(6M)}
\]

\[
V_1 = 125mL \text{ stock soln required}
\]

If you dilute $1.8L$ of $4.0M$ solution to $6.0L$,
what is the diluted concentration?

\[
M_1V_1 = M_2V_2
\]

\[
(4.0M) (1.8L) = M_2 (6.0L)
\]

\[
M_2 = 1.2M
\]
\[ \% \text{ by mass} = \frac{g \text{ solute}}{g \text{ solution}} \times 100\% \]

\[ \% \text{ by volume} = \frac{\text{Vol. solute}}{\text{Vol. solution}} \times 100\% \]

% ethanol in water is nearly always vol %

40 vol% ethanol 750 mL = solution volume

how many mL ethanol are in this solution?

\[ \frac{40 \text{ vol}%}{100\%} = \frac{x \text{ mL ethanol}}{750 \text{ mL solution}} \times 100\% \]

0.40 = \frac{x \text{ mL ethanol}}{750 \text{ mL solution}}

\[ x = 0.40 (750 \text{ mL}) = 300 \text{ mL ethanol} \]

40 wt% = 80 proof
Temperature behavior of pure substances

- Ice: -20°C

Heating curve of water

- Boiling point
- Melting point
- Solid ice
- Liquid water
- Boiling (liquid to gas)
- Steam

Heat added

When pure substances are heated, the heat energy can be used for either:

1. Increasing temperature (faster molecular motion)
2. Breaking intermolecular forces to change phase

* Only one at a time though.

Freezing-point depression (when solutes dissolved)

Boiling-point elevation

Pure H₂O + ice

<0°C

+-5°C, maybe

Ice-water + solute

Stir

Stir

0°C

Pure H₂O

Boiling

100°C

Pure H₂O

Boiling

>100°C

Water + solute