Dilution Calculations

- When two solutions are mixed, the resulting mixture has a total volume and total number of moles equal to the sum of the individual volumes and individual moles of the chemicals found in the separate solutions.

- $Molarity\ of\ the\ mixture\ = \frac{total\ moles\ of\ chemical\ we\ are\ interested\ in}{total\ volume\ of\ solution}$

Dilution of a Chemical in Solution

- When you add water to a chemical in solution you dilute the concentration. How do we find out what the concentration is now? ***Remember -> $concentration\ = \frac{moles}{volume}$ ➔ $c = \frac{n}{v}\ \ or\ \ n = c \times v$

- Here's what you do . . .

  Initial concentration of solution (concentrated form) = C_{conc}

  Initial volume of solution (concentrated form) = V_{conc}

  Diluted concentration (after water added) = C_{dil}

  Diluted volume (after water added) = V_{dil}

- So . . . moles in concentrated solution → $n_{conc} = C_{conc} \times V_{conc}$

  moles in diluted solution → $n_{dil} = C_{dil} \times V_{dil}$

- The amount of chemical (moles) is **NOT** changed when the solution is diluted, only concentration changes! moles of concentrated = moles of diluted

  $n_{conc} = n_{dil}$

  $C_{conc} \times V_{conc} = C_{dil} \times V_{dil} \quad or \quad C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$

Ex. – If $200.0\ mL$ of $0.500\ M$ NaCl is added to $300.0\ mL$ of water, what is the resulting [NaCl]?

Answer - $C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$ $C_{dil} = \frac{(0.500)(0.200)}{(0.300 + 0.200)}$ $C_{dil} = 0.200\ M$

Mixing Two Solutions of Different Concentrations of the Same Chemical

- Treat the two solutions as two separate "single" dilutions, then add to get the final concentration.

Ex. – If $300\ mL$ of $0.250\ M$ NaCl are added to $500.0\ mL$ of $0.100\ M$ NaCl, what is the resulting [NaCl]?

Answer - $C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$ $C_{dil} = \frac{(0.250)(0.300)}{(0.300 + 0.500)}$ $C_{dil} = 0.09375\ M$

$C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$ $C_{dil} = \frac{(0.100)(0.500)}{(0.300 + 0.500)}$ $C_{dil} = 0.0625\ M$

$[NaCl]_{total} = 0.09375 + 0.0625$ $[NaCl] = 0.156\ M$

Making a Dilute Solution

Ex. 1 – What volume of $6.00\ M$ HCl is used in making up $2.00\ L$ of $0.125\ M$ HCl?

Answer - $C_{conc} \times V_{conc} = C_{dil} \times V_{dil}$ $6.00 \times V_{conc} = 0.125 \times 2.00$ $V_{conc} = 4.17 \times 10^{-2}\ L$

Ex. 2 – A student mixes $100.0\ mL$ of water with $25.0\ mL$ of a sodium chloride solution having an unknown concentration. The student finds the molarity of the diluted solution is $0.0876\ M$. What is the molarity of the original sodium chloride solution?

Answer - $C_{conc} \times V_{conc} = C_{dil} \times V_{dil}$ $C_{conc} \times 0.025 = 0.0876 \times 0.125$ $C_{conc} = 0.438\ M$

Practice – Worksheet – Dilution Calculations Dilutions Calculations - Answers