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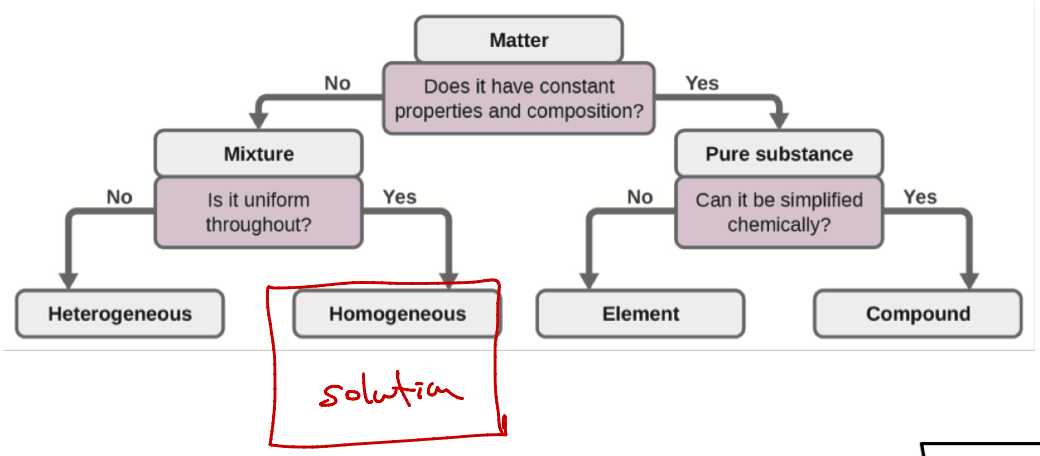
CHAPTER 15 - part
(MOLARITY)

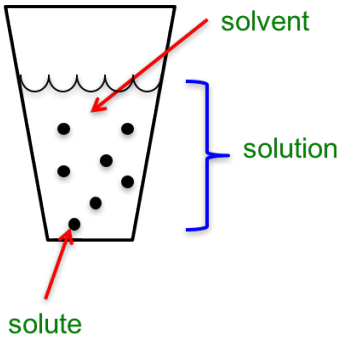
[redacted]

15

Concentrations, Dilutions, and Molarity

What is a solution — a second look

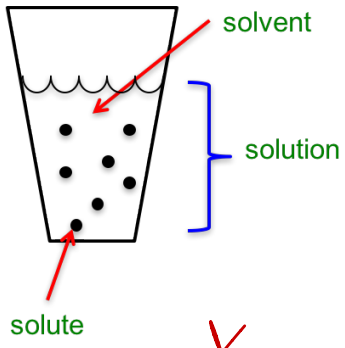




Solution = homogeneous mixture

solution = solvent + solute

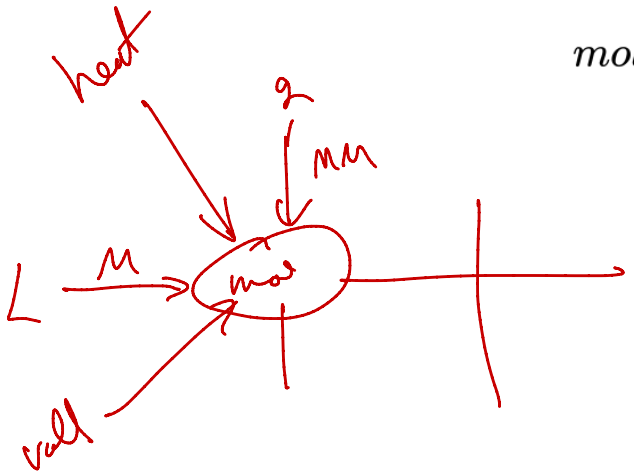
Molarity – a unit of concentration

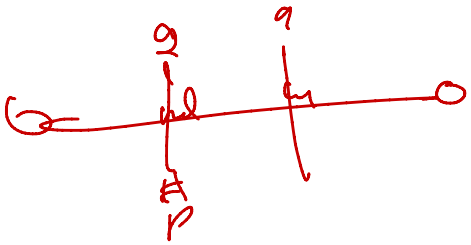


$D = \frac{m}{V}$

$$M = \frac{mol_{solute}}{L_{solution}}$$

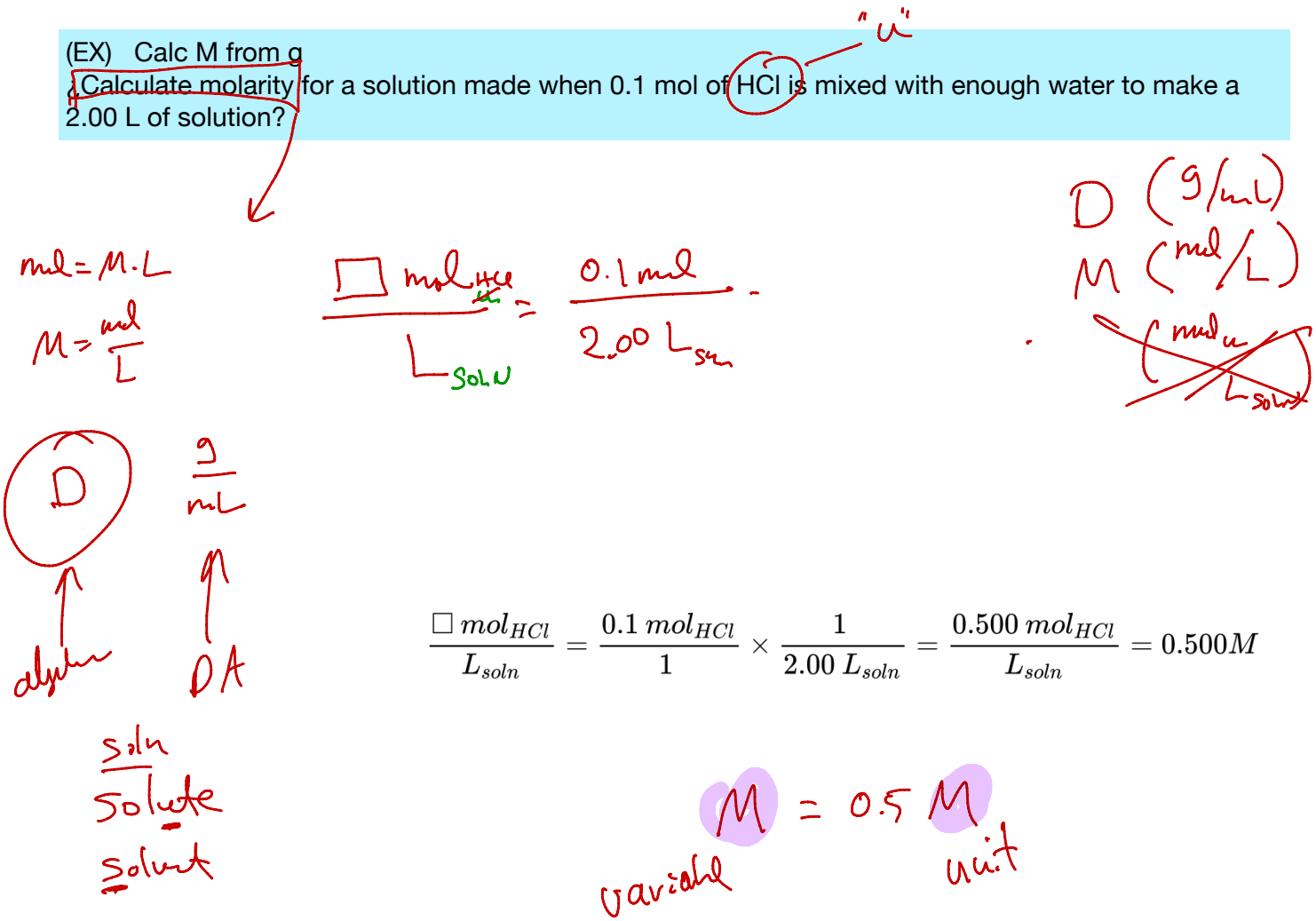
$$mol = M \cdot L$$





(EX) Calc M from g

¿Calculate molarity for a solution made when 0.1 mol of HCl is mixed with enough water to make a 2.00 L of solution?



$$\frac{\square\ mol_{HCl}}{L_{soln}} = \frac{0.1\ mol_{HCl}}{1} \times \frac{1}{2.00\ L_{soln}} = \frac{0.500\ mol_{HCl}}{L_{soln}} = 0.500M$$

M = 0.5 M

variable unit

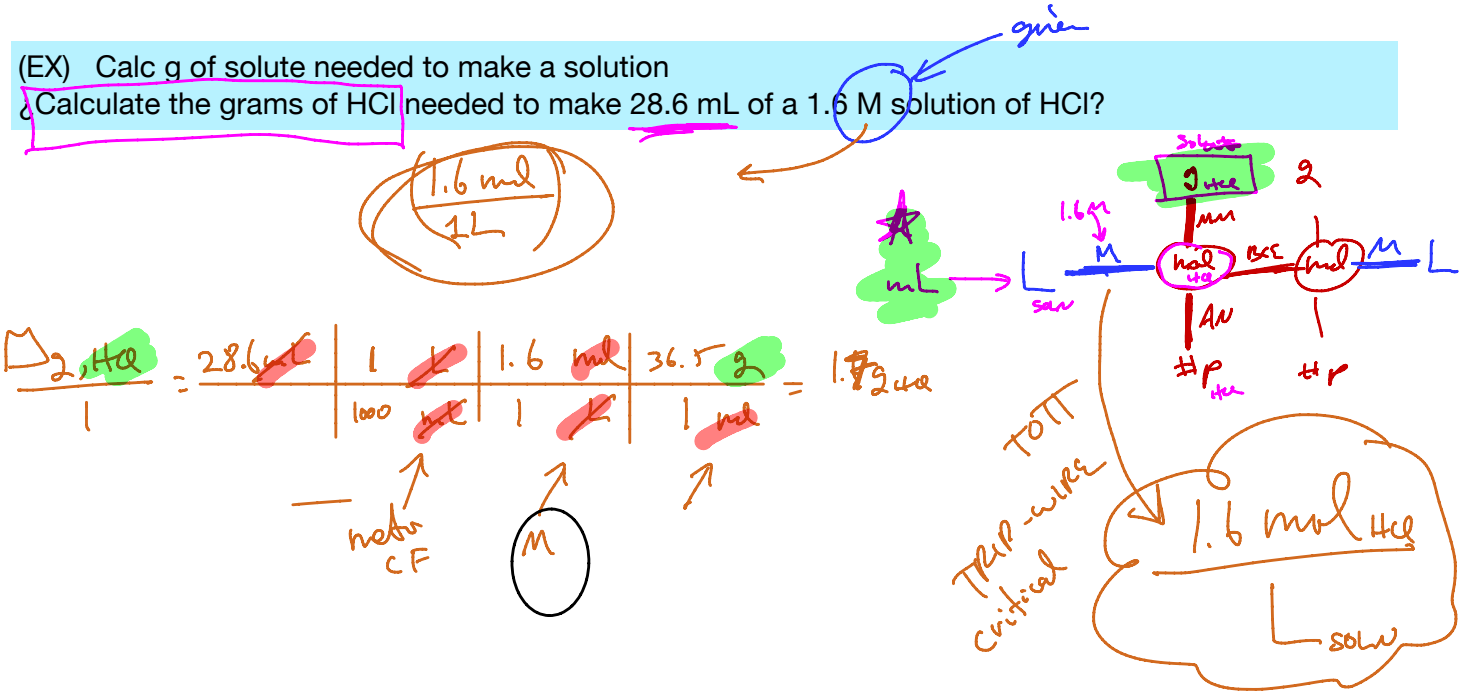
(EX) Calc M from g

¿Calculate molarity for a solution of 3.65 g HCl in 2.00 L of solution?

$$? \frac{mol_{HCl}}{L_{soln}} = \frac{3.65\ g_{HCl}}{1} \left| \frac{1\ mol_{HCl}}{36.5\ g_{HCl}} \right| \frac{1}{2.00\ L_{soln}} = \frac{0.0500}{0.500}\ \frac{mol_{HCl}}{L_{soln}} = \frac{0.0500}{0.500}\ M$$

(EX) Calc g of solute needed to make a solution

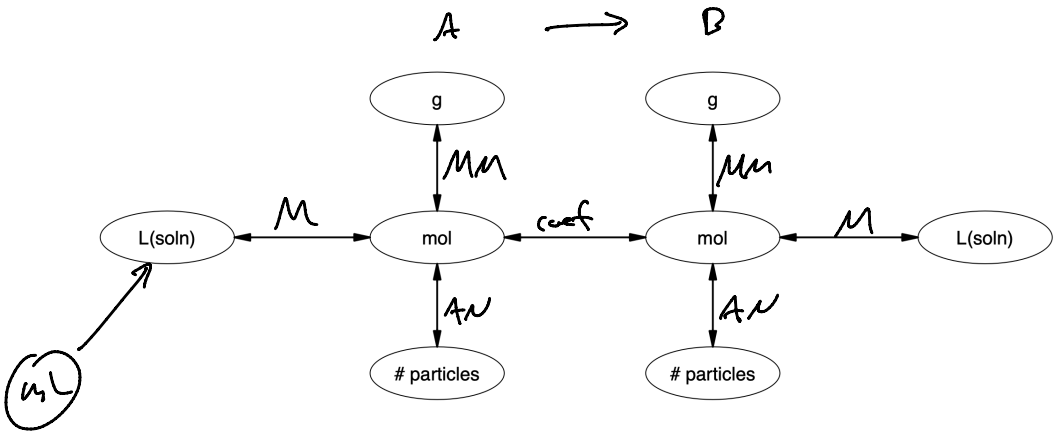
¿Calculate the grams of HCl needed to make 28.6 mL of a 1.6 M solution of HCl?



$$\frac{\square\, g_{HCl}}{1} = \frac{1.6\ mol_{HCl}}{1\ L_{soln}} \times \frac{36.5\ g_{HCl}}{1\ mol_{HCl}} \times \frac{28.6\ mL}{1} \times \frac{1\ L}{1000\ mL} = \frac{1.6\ g_{HCl}}{1} = 1.7$$

alternate solution: use mapping, where molarity, M, is written as a conversion factor . . .

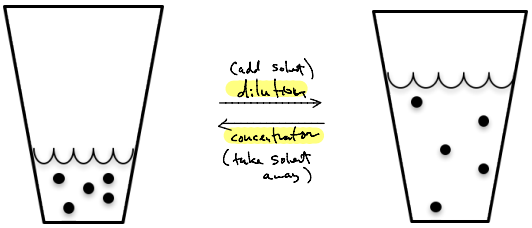
(uses the same CF's and given data as above, but in the order provided in the map)



MARK BOX AND STAR, THEN FOLLOW THE FLOW OF THE MAP

$$\frac{\square\ g_{HCl}}{1} = \frac{28.6\ mL}{1} \times \frac{1\ L}{1000\ mL} \times \frac{1.6\ mol_{HCl}}{1\ L_{soln}} \times \frac{36.5\ g_{HCl}}{1\ mol_{HCl}} = \frac{1.6\ g_{HCl}}{1}$$

Molarity – Concentration/Dilution



$$C(\text{before}) \cdot V(\text{before}) = C(\text{after}) \cdot V(\text{after})$$

$$\boxed{C \cdot V = C' \cdot V'}$$

NOTE: Can use any unit of volume, or concentration, but must be consistent on both sides

$$M(\text{before}) \cdot V(\text{before}) = M(\text{after}) \cdot V(\text{after})$$

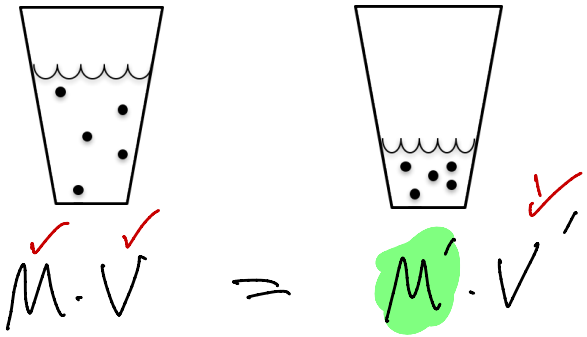
$$M(b) \cdot V(b) = M(a) \cdot V(a)$$

$$\boxed{M \cdot V = M' \cdot V'}$$

Caveat!!! "V" is the TOTAL volume, not the volume of solvent added or taken away

(EX) CONCENTRATION

¿You have 176 mL of a 0.500 M solution of $CaCl_2$, but leave the top off of the container. Days later, you find that 55 mL of the water has evaporated. This is all the $CaCl_2$ you have, so you must use this sample, but you can only do so if you know its 'new' concentration. What is the 'new' concentration?



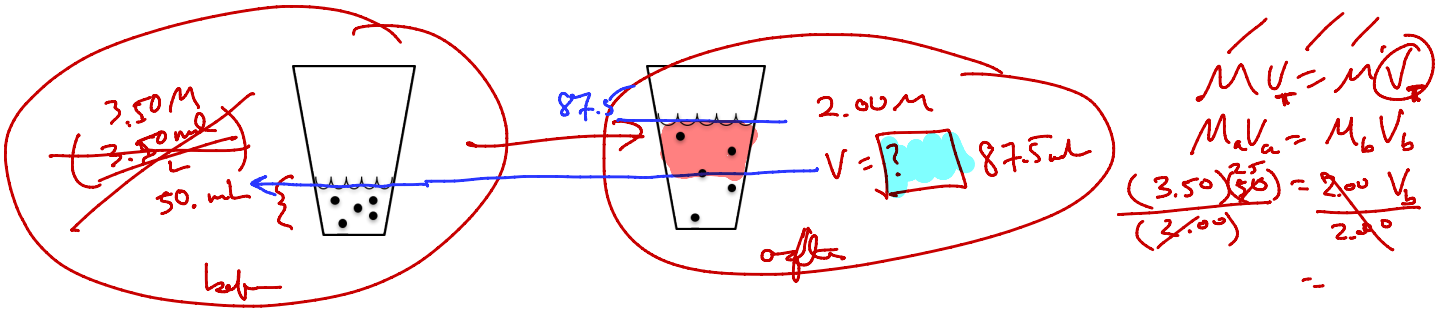
(answer: 0.727 M)

Wed, Oct 30

(EX) Dilution

¿A lab-tech wants to dilute 50. mL of 3.50 M sulfuric acid solution to 2.00 M. (a) To what volume must the original solution be diluted? (b) What volume of water (solvent) must be added to the original solution?

↳ Analysis: 2-M's and 1-Vol given, and looking for a 2nd Vol; therefore, it's a CV=C'V' problem



(a) Calculate TOTAL volume to final solution

$$C_b \bullet V_b = C_a \bullet V_a$$

$$(3.50\ M)(50.0\ mL) = (2.00.mL)V_a$$

$$\frac{(3.50\ M)(50.0\ mL)}{(2.00.mL)} = V_a = 87.5\ mL$$

TOTAL VOLUME

["b" denotes before dilution, and "a" denotes after dilution]

(b) Calculate volume of solvent ADDED

$$V_{total} = V_{initial} + V_{added}$$

$$V_{added} = V_{total} - V_{initial}$$

$$V_{added} = 87.5\ mL - 50.mL$$

$$V_{added} = 37.5\ mL$$

—> answer diagram next page <—

—> answer diagram for previous page <—