If you need 0.657 moles of hydrochloric acid, how many liters of 0.0555 M HCl do you need to measure out?

$$0.0555 \text{ mol HCl} = 1 \text{ L}$$

$$0.657 \text{ mol HCl} \times \frac{\text{L}}{0.0555 \text{ mol HCl}} = \boxed{11.8 \text{ L}}$$

11800 mL

This amount of solution is too large for typical lab-scale work. We should use a more concentrated HCl solution to get 0.657 mol HCl.

What if we used 6.00 M HCl?

$$6.00 \text{ mol HCl} = 1 \text{ L}$$

$$0.657 \text{ mol HCl} \times \frac{\text{L}}{6.00 \text{ mol HCl}} = \boxed{0.110 \text{ L}}$$

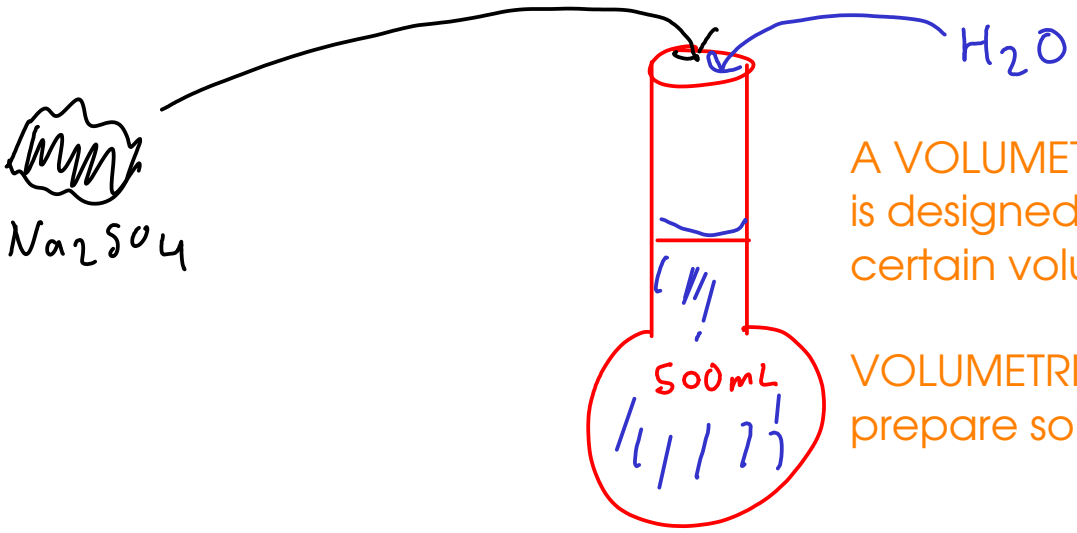
110. mL

110. mL is a more reasonable lab-scale volume ... we'd use this instead of the 0.0555 M ...

Example: How would we prepare 500. mL of 0.500 M sodium sulfate in water?

Na_2SO_4: 142.05 g/mol

Dissolve the appropriate amount of sodium sulfate into enough water to make 500. mL of solution.



volumetric flask

A VOLUMETRIC FLASK is a flask that is designed to precisely contain a certain volume of liquid.

VOLUMETRIC FLASKS are used to prepare solutions.

We know we need 500. mL of solution, and we also know that the concentration should be 0.500 M. From that, we can calculate the noles of sodium sulfate required and then convert that to a mass using formula weight.

$$0.500\ \text{mol}\ Na_2SO_4 = 1\ L \quad | \quad 1\ mL = 10^{-3}\ L \quad | \quad 142.05\ g\ Na_2SO_4 = 1\ \text{mol}\ Na_2SO_4$$

$$500.\ mL \times \frac{10^{-3}\ L}{mL} \times \frac{0.500\ \text{mol}\ Na_2SO_4}{L} \times \frac{142.05\ g\ Na_2SO_4}{\text{mol}\ Na_2SO_4} = \boxed{35.5\ g\ Na_2SO_4}$$

To prepare the solution, weigh our 35.5 grams sodium sulfate into a 500 mL volumetric flask, then dilute to the mark with distilled or deionized water.

More on MOLARITY

To prepare a solution of a given molarity, you generally have two options:

1. Weigh out the appropriate amount of solute, then dilute to the desired volume with solvent (usually water)

2. Take a previously prepared solution ("stock solution") of known concentration and DILUTE it with solvent to form a new solution

   - Use DILUTION EQUATION

The dilution equation is easy to derive with simple algebra.

$M \times V$

$\frac{mol}{L} \times L = moles\ solute$

... but when you dilute a solution, the number of moles of solute REMAINS CONSTANT. (After all, you're adding only SOLVENT)

$$M_1 V_1 = M_2 V_2$$

Since the number of moles of solute stays the same, this equality must be true!

$M_1 V_1$: before diution

$M_2 V_2$: after dilution

$M_1V_1 = M_2V_2$ ... the "DILUTION EQUATION"

M_1 = molarity of concentrated solution

V_1 = volume of concentrated solution

M_2 = molarity of dilute solution

V_2 = volume of dilute solution (total volume, not volume of added solvent!)

The volumes don't HAVE to be in liters, as long as you use the same volume UNIT for both volumes!

Example: Take the 0.500 M sodium sulfate we discussed in the previous example and dilute it to make 150. mL of 0.333 M solution. How many mL of the original solution will we need to dilute?

$M_1V_1 = M_2V_2$ $M_1 = 0.500\ M$ $M_2 = 0.333\ M$

$V_1 = ?$ $V_2 = 150.\ mL$

$(0.500\ M)V_1 = (0.333\ M)(150.\ mL)$

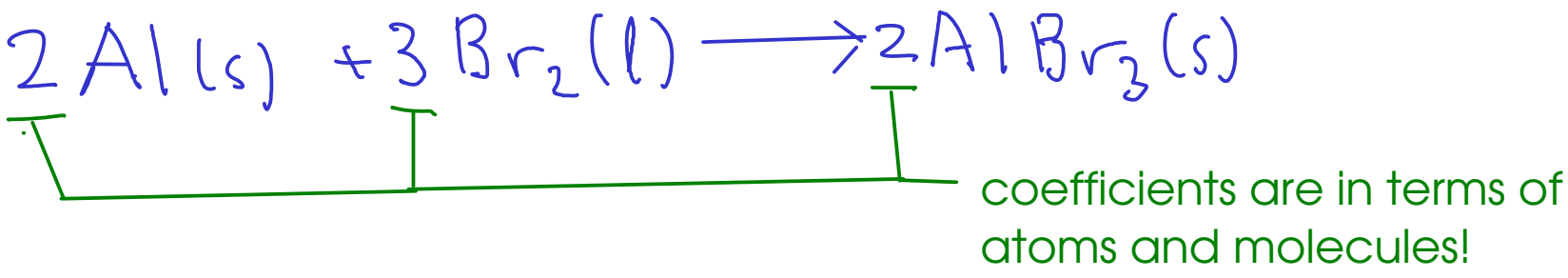
$V_1 =$ **99.9 mL of 0.500 M Na_2SO_4**

Take 99.9 mL of 0.500 M sodium sulfate, and dilute with distilled water to make 150 mL of solution. (Ideally, use 150 mL volumetric flask if available)

CHEMICAL CALCULATIONS CONTINUED: REACTIONS

- Chemical reactions proceed on an ATOMIC basis, NOT a mass basis!

- To calculate with chemical reactions (i.e. use chemical equations), we need everything in terms of ATOMS ... which means MOLES of atoms



2 atoms Al = 3 molecules Br_2 = 2 formula units $AlBr_3$

2 mol Al = 3 mol Br_2 = 2 mol $AlBr_3$

- To do chemical calculations, we need to:
  - Relate the amount of substance we know (mass or volume) to a number of moles
  - Relate the moles of one substance to the moles of another using the equation
  - Convert the moles of the new substance to mass or volume as desired