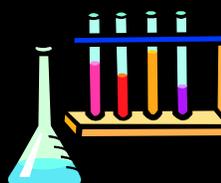




## Stoichiometry



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## Stoichiometry



**Calculate quantities of substances in chemical reactions**

**For a Balanced chemical equation, the coefficients show:**

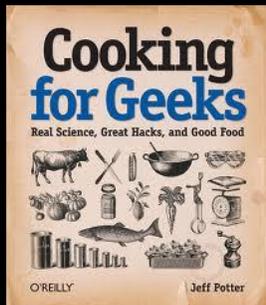
- # formula units that react
- mole ratio of reactants & products
- (with molar mass) # grams of reactants & products



**Uses mole concept to calculate chemical quantities**

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## Stoichiometry



Process for getting the right ingredients  
'cause chemical procedure = a recipe



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## Thinking Moles



## Solves Problems



And  
yields a better product!

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## Generalized Pathway



“Per” Expression” (Molar Ratio)



Grams → Moles → Moles → Grams  
Given                  Wanted

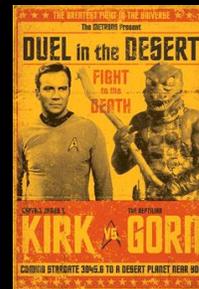


Entry & Exit Points Depend On  
Given                  Wanted

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## Kirk Used Stoichiometry to Defeat the Gorn



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# Stoichiometry Lab



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## Today's Lab (Work as a Table Unit in the Hood)

**Purpose:** To investigate reaction of sodium carbonate and hydrochloric acid



### Procedure:

Measure the mass of an evaporating dish and a watch glass.

Remove the watch glass, tare the balance, and add 1.5 – 2 g of  $\text{Na}_2\text{CO}_3$

Record the exact mass of  $\text{Na}_2\text{CO}_3$  in the dish

Remove the evaporating dish and  $\text{Na}_2\text{CO}_3$  from the balance

Slowly add HCl to the  $\text{Na}_2\text{CO}_3$  until no more gas is evolved

**Safety note:** HCl is caustic to the skin and eyes! Use caution.



Stoichiometry says you will not need more than 7 mL for 2 g of  $\text{Na}_2\text{CO}_3$

xs HCl will be evaporated into the air you might breathe

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## Stoichiometry Lab



When the reaction is complete, use Bunsen Burner to evaporate to dryness

Use the watch glass as a cover to help prevent spattering.

Heat the contents very carefully

Allow the evaporating dish and watch glass to cool completely

Weigh the evaporating dish, NaCl and watch glass.



The NaCl product is drain disposable

Wash out the product with water

Clean the evaporating dish and watch glass with soap and water

Rinse evaporating dish with tap water & RO water

Dry the watch glass & evaporating dish and return to their drawers.

Clean up all other glassware

Return all pieces of equipment to proper storage drawer or cabinet



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## Some "Numbers"

How many grams CO<sub>2</sub> are formed from 2.00 grams Na<sub>2</sub>CO<sub>3</sub>?



$$2.00 \text{ g Na}_2\text{CO}_3 \times \frac{1 \text{ mole Na}_2\text{CO}_3}{105.99 \text{ g}} \times \frac{1 \text{ mole CO}_2}{1 \text{ mole Na}_2\text{CO}_3} \times \frac{44.01 \text{ g}}{1 \text{ mole CO}_2} = 0.83 \text{ g}$$

How much CO<sub>2</sub> (mL) is formed from 2.00 grams Na<sub>2</sub>CO<sub>3</sub>?

(One mole of a substance occupies 22.4 L at STP)

$$0.83 \text{ g CO}_2 \times \frac{1 \text{ mole CO}_2}{44.01 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mole}} = 0.422 \text{ L} \rightarrow 422 \text{ mL}$$



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## More "Numbers"



How much 6 M HCL is needed to completely react with 2.00 g Na<sub>2</sub>CO<sub>3</sub>?

(6 M HCL means 6 moles HCl per liter of solution)

$$2.00 \text{ g} \times \frac{1 \text{ mole Na}_2\text{CO}_3}{105.99 \text{ g}} \times \frac{2 \text{ mole HCl}}{1 \text{ mole Na}_2\text{CO}_3} \times \frac{1 \text{ L}}{6 \text{ moles HCl}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 6.28 \text{ mL}$$

How many grams NaCl are formed from 2.00 grams Na<sub>2</sub>CO<sub>3</sub>?

$$2.00 \text{ g} \times \frac{1 \text{ mole Na}_2\text{CO}_3}{105.99 \text{ g}} \times \frac{2 \text{ mole NaCl}}{1 \text{ mole Na}_2\text{CO}_3} \times \frac{58.43 \text{ g}}{1 \text{ mole NaCl}} = 2.21 \text{ g}$$



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## More "Numbers"

$$\% \text{ Yield} = \frac{\text{Actual (Obtained in Experiment)}}{\text{Theoretical (Calculated Yield based on Stoichiometry)}} \times 100$$

$$\% \text{ Error} = \frac{\text{Actual Yield (g)} - \text{Theoretical Yield (g)}}{\text{Theoretical Yield (g)}} \times 100$$

% Error should be small and negative



For isolation of 2.16 grams:

$$\% \text{ Yield} = \frac{2.16 \text{ g}}{2.21 \text{ g}} \times 100 = 97.7 \quad \% \text{ Error} = \frac{(2.16 \text{ g} - 2.21 \text{ g})}{2.21 \text{ g}} \times 100 = - 2.26$$



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## Stoichiometry Lab



### Results

Table that displays the answers to your calculations.  
Be sure to report all results with correct units and proper significant figures

### Conclusion

Brief paragraph describing how you met the purpose of today's lab  
You should summarize your results - include the balanced chemical equation



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## Let's Boldly Go Explore Today's Lab



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