Stoichiometry

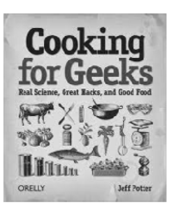
Stoichiometry

Calculate quantities of substances in chemical reactions

For a Balanced chemical equation, the coefficients show:

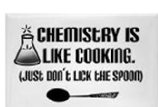
- **# formula units that react**
- **mole ratio of reactants & products**
- **(with molar mass)   # grams of reactants & products**

Uses mole concept to calculate chemical quantities



Stoichiometry

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



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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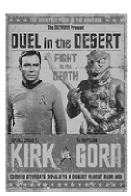
Kirk Used Stoichiometry to Defeat the Gorn



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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

$$Na_2CO_3 + 2\,HCl \rightarrow 2\,NaCl + CO2 + H_2O$$

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 Na_2CO_3
Record the exact mass of Na_2CO_3 in the dish
Remove the evaporating dish and Na_2CO_3 from the balance
Slowly add HCl to the Na_2CO_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 Na_2CO_3

xs HCl will be evaporated into the air you might breathe

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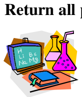
Stoichiometry Lab

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_2 are formed from 2.00 grams Na_2CO_3?

$Na_2CO_{3\,(aq)} + 2\,HCl_{(aq)} \rightarrow 2\,NaCl_{(aq)} + H_2CO_{3\,(aq)}$

$H_2CO_{3\,(aq)} \rightarrow H_2O_{(l)} + CO_{2\,(g)}$

$$2.00\ g\ Na_2CO_3 \times \frac{1\ mole\ Na_2CO_3}{105.99\ g} \times \frac{1\ mole\ CO_2}{1\ mole\ Na_2CO_3} \times \frac{44.01\ g}{1\ mole\ CO_2} = 0.83\ g$$

How much CO_2 (mL) is formed from 2.00 grams Na_2CO_3?

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

$$0.83\ g\ CO_2 \times \frac{1\ mole\ CO_2}{44.01\ g} \times \frac{22.4\ L}{1\ mole} = 0.422\ L \rightarrow 422\ mL$$

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More "Numbers"

How much 6 M HCL is needed to completely react with 2.00 g Na_2CO_3?

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

$$2.00\ g \times \frac{1\ mole\ Na_2CO_3}{105.99\ g} \times \frac{2\ mole\ HCl}{1\ mole\ Na_2CO_3} \times \frac{1\ L}{6\ moles\ HCl} \times \frac{1000\ mL}{1\ L} = 6.28\ mL$$

How many grams NaCl are formed from 2.00 grams Na_2CO_3?

$$2.00\ g \times \frac{1\ mole\ Na_2CO_3}{105.99\ g} \times \frac{2\ mole\ NaCl}{1\ mole\ Na_2CO_3} \times \frac{58.43\ g}{1\ mole\ NaCl} = 2.21\ g$$

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More "Numbers"

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

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

% Error should be small and negative

For isolation of 2.16 grams:

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

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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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