

SI Chemistry - Full Discipline Demo

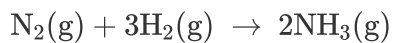
Digital Limiting Reactants

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Nitrogen and hydrogen react to form ammonia:



Identify the limiting reactant (hydrogen or nitrogen) in each of the following combinations of starting chemicals.

⚡ 0.75 moles of nitrogen and 2.5 moles of hydrogen ⚡ 1.0 mole of nitrogen and 1.0 mole of hydrogen ⚡ 1.0 mole of nitrogen and 4.0 moles of hydrogen ⚡ 10.0 grams of nitrogen and 10.0 grams of hydrogen	
Limiting Reactant: Hydrogen	Limiting Reactant: Nitrogen
1	2

Correct answers:

1 1.0 mole of nitrogen and 1.0 mole of hydrogen

2 0.75 moles of nitrogen and 2.5 moles of hydrogen

1.0 mole of nitrogen and 4.0 moles of hydrogen

10.0 grams of nitrogen and 10.0 grams of hydrogen

Label each type of reaction.

☐ Combination	$\text{Al}_2(\text{SO}_4)_3 (\text{aq}) + 6\text{NaOH} (\text{aq}) \rightarrow 2\text{Al}(\text{OH})_3 (\text{s}) + 3\text{Na}_2\text{SO}_4 (\text{aq})$
☐ Decomposition	1
☐ Double displacement	$2\text{KClO}_3 (\text{s}) \rightarrow 2\text{KCl} (\text{s}) + 3\text{O}_2 (\text{g})$
☐ Single displacement	2
	$4\text{Fe} (\text{s}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3 (\text{s})$
	3
	$\text{Cl}_2 (\text{g}) + 2\text{NaI} (\text{aq}) \rightarrow 2\text{NaCl} (\text{aq}) + \text{I}_2 (\text{aq})$
	4

Correct answers:

- 1 Double displacement 2 Decomposition 3 Combination
4 Single displacement

Move the terms to complete each statement.

⚙ Chemical equation

⚙ Limiting reactant

⚙ Reactant

⚙ Stoichiometry

A describes a reaction that occurs between two or more chemical substances.

A chemical substance that participates and undergoes change in a chemical reaction is called a .

can be used to determine how much of each reactant is needed to produce a specific amount of each product.

The reactant that is consumed first is referred to as the .

Correct answers:

- 1 Chemical equation 2 Reactant 3 Stoichiometry
4 Limiting reactant

Exploration

The substances that interact in a reaction are called reactants, while the substances produced from the reaction are called products.

☐ True



☐ False

The proportion of reactants to products can be calculated using a balanced chemical equation and stoichiometry.

☐ True



☐ False

A ____ reaction occurs when an uncombined element displaces an element in a compound.

- ☐ decomposition
- ☐ combination
- ☒ single displacement
- ☐ double displacement

✓

In a chemical reaction, the reactant that is consumed first is referred to as the ____.

- ☐ stoichiometry
- ☐ smaller reactant
- ☒ limiting reactant
- ☐ balanced equation
- ☐ limiting product

✓

In the chemical equation $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$, if calcium is the limiting reactant, then ____ will be in excess.

- ☐ Ca
- ☒ O_2
- ☐ CaO
- ☐ no substances

✓

If you know the starting mass of the limiting reactant in a balanced equation, you can only determine the mass of the product, and not the mass of leftovers.

- ☐ True
- ☒ False

✓

Exercise 1

What are the limiting "reagents" in Trials 1, 2, and 3 in Data Table 2?

Bread, bread, and cheese

What was more conceptually challenging to solve in the Game simulation: problems where the molecules were hidden, or problems where the numbers were hidden? What insight does this give about how you think about these problems?

Most students will likely say it was more challenging when the molecules were hidden, which likely shows that they are counting up the images to figure out the solution.

How did you solve the Game simulation in Level 2? What information did you need to come to the right answer?

Most students may discuss looking at the equation for this part of the simulation--this is often easier as looking at the more visually complicated space-filling molecules get more challenging.

How did you solve the Game simulation in Level 3? How was this different than the other levels?

With multiple reactants and products, students are likely to rely more heavily on the equation instead of just the images. Other levels may have been able to count the space-filling molecules.

Throughout this exercise, you likely ended up with scenarios where there was more than one "Leftover" unreacted species. How would you expect this to be different if you were working with moles of reactants rather than individual molecules?

Working with moles instead of molecules, one of the reagents is going to get used up fully, instead of having a situation where more than one molecule is unused (which might indicate in students' minds that there is more than one limiting reactant, or no limiting reactant).

Data Table 1: Cheese Sandwich Simulation
(SAMPLE ANSWER BELOW)

Trial #	# of Bread Slice "Reactants"	# of Cheese Slice "Reactants"	# of Sandwich "Products"	Leftovers
1	8	7	4	3 cheese
2				
3				

Data Table 2: Meat and Cheese Sandwich Predictions
(SAMPLE ANSWER BELOW)

Trial	# of Bread Slices (before reaction)	# of Meat Slices (before reaction)	# of Cheese Slices (before reaction)	# of Sandwiches (after reaction)	Leftovers
1	3	3	3	1	1 bread, 2 meat, 2 cheese
2	4	4	4	2	2 meat, 2 cheese
3	8	6	2	2	4 bread, 4 meat

Data Table 3: Molecules Simulation Products
(SAMPLE ANSWER BELOW)

Trial	# of First Reactant Molecules	# of Second Reactant Molecules	# of Each Product	# of Leftovers	Limiting Reactant
Making Water	8	7	8 H ₂ O	3 O ₂	H ₂
Making Ammonia	8	8	4 NH ₃	6 N ₂ , 2 H ₂	H ₂
Combusting Methane	3	4	2 CO ₂ , 4 H ₂ O	1 CH ₄	O ₂

Data Table 4: Limiting Reagents Game Simulation Record
(SAMPLE ANSWER BELOW)

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Level	Hidden Molecules or Numbers?	Score	Time
1	Neither	No sample answer	No sample answer
1	Molecules	No sample answer	No sample answer
1	Numbers	No sample answer	No sample answer
2	Neither	No sample answer	No sample answer
2	Molecules	No sample answer	No sample answer
2	Numbers	No sample answer	No sample answer
3	Neither	No sample answer	No sample answer
3	Molecules	No sample answer	No sample answer
3	Numbers	No sample answer	No sample answer

Competency Review

In the chemical equation $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$, 4Fe is considered a ____.

- ☒ reactant ✓
- ☐ product
- ☐ compound

Stoichiometry can be applied to a chemical equation to calculate ____.

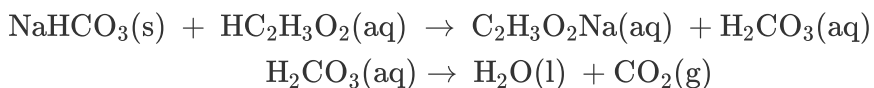
- ☐ the half-life of an element
- ☐ significant digits based on SI units
- ☐ activation energy in relation to chemical reactivity
- ☒ the proportions of reactants and products ✓

When chlorine reacts with sodium iodide to form sodium chloride and iodine, a ____ reaction takes place.

- ☐ combination
- ☐ decomposition
- ☒ single displacement ✓
- ☐ double displacement

Consider a closed system in which aluminum sulfate and sodium hydroxide react to form aluminum hydroxide and sodium sulfate. If aluminum sulfate is the limiting reactant in this specific scenario, what other information can be concluded about the substances?

- ☐ the reaction rate will decrease
- ☒ the sodium hydroxide will be found in excess
- ☐ the reverse reaction will be favored
- ☐ a single displacement reaction will proceed



If 0.00416 mols of $\text{HC}_2\text{H}_3\text{O}_2$ are reacted with 0.00595 mols of NaHCO_3 , _____ is/are considered a limiting reactant.

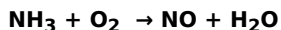
- ☐ $\text{HC}_2\text{H}_3\text{O}_2$ and NaHCO_3
- ☐ NaHCO_3
- ☒ $\text{HC}_2\text{H}_3\text{O}_2$
- ☐ the products
- ☐ no chemicals

In the double replacement reaction $2 \text{KI} + \text{Pb}(\text{NO}_3)_2 \rightarrow 2 \text{KNO}_3 + ______$, what would be found in the final spot of the balanced reaction?

- ☐ $2 \text{Pb}(\text{NO}_3)$
- ☒ PbI_2
- ☐ 2PbI
- ☐ $\text{K}(\text{NO}_3)_2$

Extension Questions

Consider the following reaction:



In an experiment, 3.25 g of NH_3 are allowed to react with 3.50 g of O_2 .

- a. Which reactant is the limiting reagent?
- b. How many grams of NO are formed?

c. How much of the excess reactant remains after the reaction?

(SAMPLE ANSWER BELOW)

- a. O₂
- b. 2.63 g NO
- c. 1.76 g NH₃ left