

N-28

Limiting Reagent
Stoichiometry

Limiting Reagent Stoichiometry:

A type of stoich problem where you run out of one chemical too soon, and have extra of the other chemical left over



*How do I know if it is a
“regular” stoichiometry problem,
or a “limiting” reagent problem?*

Hint!

How many starting values?

- ◆ One starting value – “regular” stoich
- ◆ Two starting values – “limiting” stoich



Regular or Limiting?

Regular

If you react 25 g of hydrogen gas with oxygen gas, how many grams of water can you make?

One

How many starting values?

Two

Limiting

If you react 25 g of hydrogen gas with 30 g of oxygen gas, how many grams of water can you make?

Key terms:

Limiting Reagent

(LR)

**The chemical
you run out of
too soon**

Excess Reagent

(XS)

**The chemical you
have extra left
over of**

Usually 3 types of problems:

1

Find
Limiting
Reagent

2

Find
Amounts
Made

3

Find how
much XS
left over

ALL ABOUT MOLE RATIOS!

“The KEY to Stoichiometry!”

Dimensional Analysis, units, labeling, etc required!



Use mole ratios and
dimensional analysis to compare...

What you *NEED* *versus* What you *HAVE*



Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. Stoich with limiting (*if asked*)
5. Find xs left (*if asked*)

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



1

Find
Limiting
Reagent

2

Find
Amounts
Made

3

Find how
much XS
left over

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



1

Find
Limiting
Reagent

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



150.0 g K		1 mol K	=	3.836 mol K
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		39.10 g K		
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225 g Br ₂		1 mol Br ₂	=	1.408 mol Br ₂
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		159.8 g Br ₂		
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Steps

1. **Grams to moles**
2. Have vs. need
3. Identify limiting
4. Stoich with limiting
5. Find xs left

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



HAVE:	3.836 mol	1.408 mol
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NEED:		1.918 mol
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3.836 mol K	1 mol Br₂
	2 mol K

= 1.918 mol Br₂ NEEDED to use up all the K you have!

Steps

1. Grams to moles
2. **Have vs. need**
3. Identify limiting
4. Stoich with limiting
5. Find xs left

Nice thing – it doesn't matter which starting value you try first! Cuts down the length of the problems/work a lot!
You could have started with 1.408 moles of Br₂ instead!

If you reacted 150.0 g of K with 225 g of Br₂, how much KBr can be made? How much excess reagent is left?



HAVE:	3.836 mol	1.408 mol
--------------	------------------	------------------

NEED:		1.918 mol
--------------	--	------------------

Steps

1. Grams to moles
2. Have vs. need
3. **Identify limiting**
4. Stoich with limiting
5. Find xs left

You don't have enough Br₂ – that makes it the “limiting reagent” – you will run out of it first!

So K is your “excess reagent” – you will have some extra left over when done.

If you reacted 150.0 g of K with 225 g of Br₂, how much KBr can be made? How much excess reagent is left?



HAVE:	3.836 mol	1.408 mol
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Div by	2 mol	1 mol
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Coeff:	= 1.918	= 1.408
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Br₂ is **Limiting**,
K is in **excess**

The Short Cut is:

- 1. Still convert to moles**
- 2. Divide each mole # by its own coefficient**
- 3. Smallest one wins! Is limiting**

Steps

1. Grams to moles
2. Have vs. need
3. **Identify limiting**
4. Stoich with limiting
5. Find xs left

SHORTCUT METHOD

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



1

Find
Limiting
Reagent

2

Find
Amounts
Made

3

Find how
much XS
left over

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



2

Find
Amounts
Made

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



225 g Br ₂	1 mol Br ₂	2 mol KBr	119 g KBr
	159.8 g Br ₂	1 mol Br ₂	1 mol KBr

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. **Stoich with limiting**
5. Find xs left

**= 335.1 g KBr
can be made**

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



Or...realize you already did part of it right?!

1.408 mol Br ₂	2 mol KBr	119 g KBr
	1 mol Br ₂	1 mol KBr

**= 335.1 g KBr
can be made**

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. **Stoich with limiting**
5. Find xs left

***Just be careful not to round too much early on if you want to use your earlier answer to continue doing your stoichiometry – you have to use your judgement**

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



1

Find
Limiting
Reagent

2

Find
Amounts
Made

3

Find how
much XS
left over

If you reacted 150 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



3

Find how
much XS
left over

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



HAVE:	3.836 mol	1.408 mol
NEED:	2.816 mol	1.918 mol

Br₂ is Limiting, so use it to find amount of XS used

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. Stoich with limiting
5. Find xs left

1.408 mol Br ₂	2 mol K
	1 mol Br ₂

= 2.816 mol K used during the reaction

If you reacted 150.0 g of K with 225 g of Br₂, how many g of KBr can be made? How much excess reagent is left?



HAVE:	3.836 mol	1.408 mol
NEED:	2.816 mol	1.918 mol

LEFT: **1.02** mol

**Now subtract to
see what is left!**

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. Stoich with limiting
5. **Find xs left**

*** If it doesn't specify a unit (common) – then just leave in moles!
Otherwise, just do more dimensional analysis to convert**

The “danger” of looking up videos & examples of limiting stoich online...

There are so many weird little tricks, other methods, etc. But they don't all ADEQUATELY show units, concepts, etc.

If you want to demonstrate mastery of the CONCEPTS to get full points, use this method.

Not all teachers use this method, but you're stuck with me...

#sorrynotsorry 😊 Ha!



**Let's
try one
more!**

If you reacted 13.2 g of Fe with 6.34 g of O₂, how many g of Fe₂O₃ can be made? How many grams of excess are left?



$$\frac{23.2 \text{ g Fe}}{55.85 \text{ g Fe}} \times \frac{1 \text{ mol Fe}}{1 \text{ mol Fe}} = 0.236 \text{ mol Fe}$$

$$\frac{6.34 \text{ g O}_2}{32 \text{ g O}_2} \times \frac{1 \text{ mol O}_2}{1 \text{ mol O}_2} = 0.198 \text{ mol O}_2$$

Steps

1. **Grams to moles**
2. Have vs. need
3. Identify limiting
4. Stoich with limiting
5. Find xs left

If you reacted 13.2 g of Fe with 6.34 g of O₂, how many g of Fe₂O₃ can be made? How many grams of excess are left?



HAVE:	0.236 mol	0.198 mol
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NEED:		0.177 mol
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0.236 mol Fe	3 mol O₂
	4 mol Fe

= 0.177 mol O₂ NEEDED to use up all the Fe you have!

Steps

1. Grams to moles
2. **Have vs. need**
3. Identify limiting
4. Stoich with limiting
5. Find xs left

If you reacted 13.2 g of Fe with 6.34 g of O₂, how many g of Fe₂O₃ can be made? How many grams of excess are left?



HAVE: 0.236 mol 0.198 mol

NEED: 0.177 mol

0.236 mol Fe	3 mol O ₂
0.177 mol O ₂	4 mol Fe

= 0.177 mol O₂ NEEDED to use up all the Fe you have!

You have more than enough O₂, so it is the excess reagent, so Fe is your limiting reagent!

Steps

1. Grams to moles
2. Have vs. need
3. **Identify limiting**
4. Stoich with limiting
5. Find xs left

If you reacted 13.2 g of Fe with 6.34 g of O₂, how many g of Fe₂O₃ can be made? How many grams of excess are left?



HAVE: 0.236 mol 0.198 mol

NEED: 0.177 mol

0.236 mol Fe	2 mol Fe ₂ O ₃	159.69 g Fe ₂ O ₃
	4 mol Fe	1 mol Fe ₂ O ₃

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. **Stoich w/ limiting**
5. Find xs left

= 18.84 g
Fe₂O₃ can
be made

If you reacted 13.2 g of Fe with 6.34 g of O₂, how many g of Fe₂O₃ can be made? How many grams of excess are left?



HAVE:	0.236 mol	0.198 mol
NEED:		0.177 mol
LEFT:		0.021 mol

**Now
subtract to
see what is
left!**

Steps

1. Grams to moles
2. Have vs. need
3. Identify limiting
4. Stoich w/ limiting
5. **Find xs left**

0.021 mol O₂	32 g O₂	= 0.672 g O₂ left over
	1 mol O₂	

Pros and Cons to all methods

- ◆ You have to be careful with rounding when using this method.
- ◆ But it is faster, less likely to make mistakes, and safer when it comes to getting partial credit.
- ◆ If you need help – come see me! Don't start looking things up online, it confuses more people than I've seen it help. Please let me help you! 😊