



# General Chemistry I

## The Mole Map

Dr. Koni Stone  
Chapter 3, clicker 3



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How many moles of sodium carbonate are  
in 50.5 grams of sodium carbonate?

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- A. 106 moles
- B.  $4.76 \times 10^{-1}$  moles
- C. 2.10 moles
- D.  $5.35 \times 10^3$
- E. None of these

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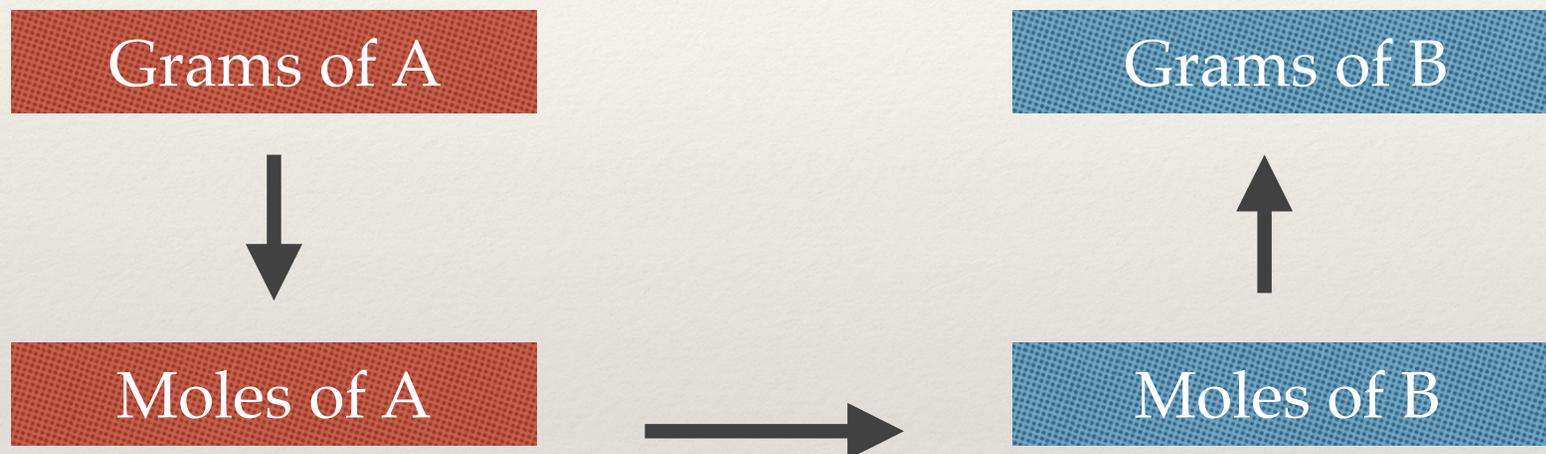
E. None of these

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# The Mole Map

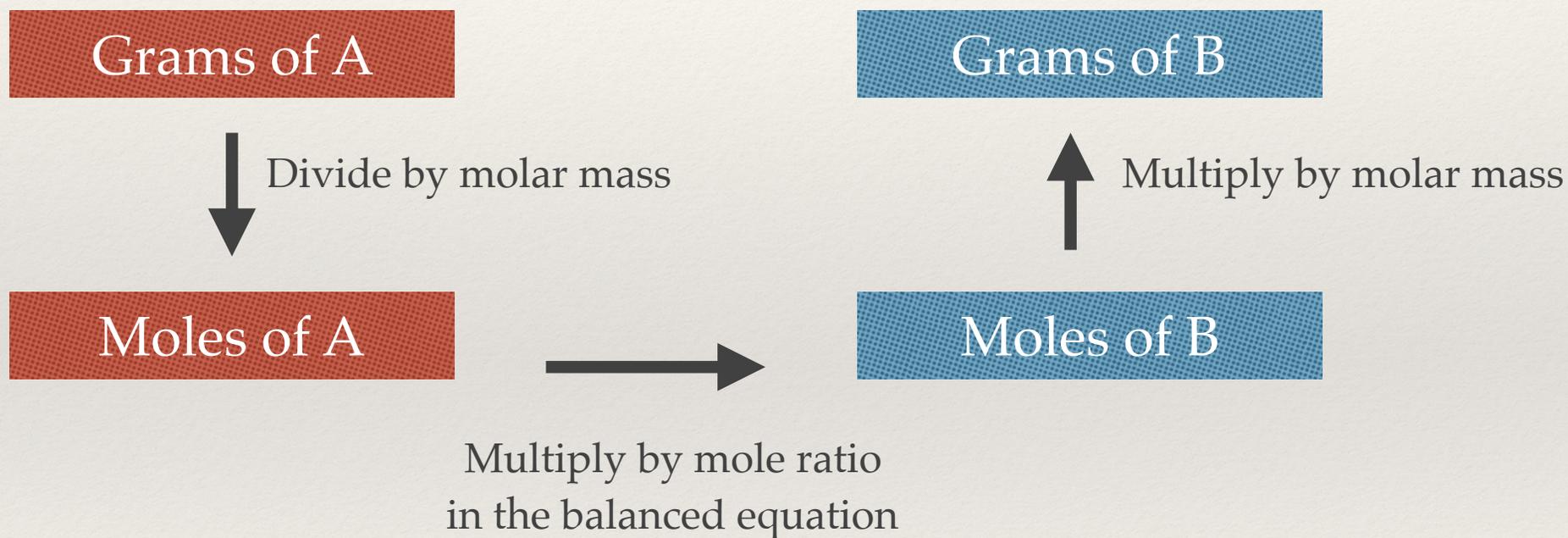
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How to get from grams of one thing to grams of another.



# The Mole Map

How to get from grams of one thing to grams of another.



Grams of A

Grams of B



Divide by  
molar mass



Multiply by  
molar mass

Moles of A



Moles of B

Multiply by mole ratio  
in the balanced equation

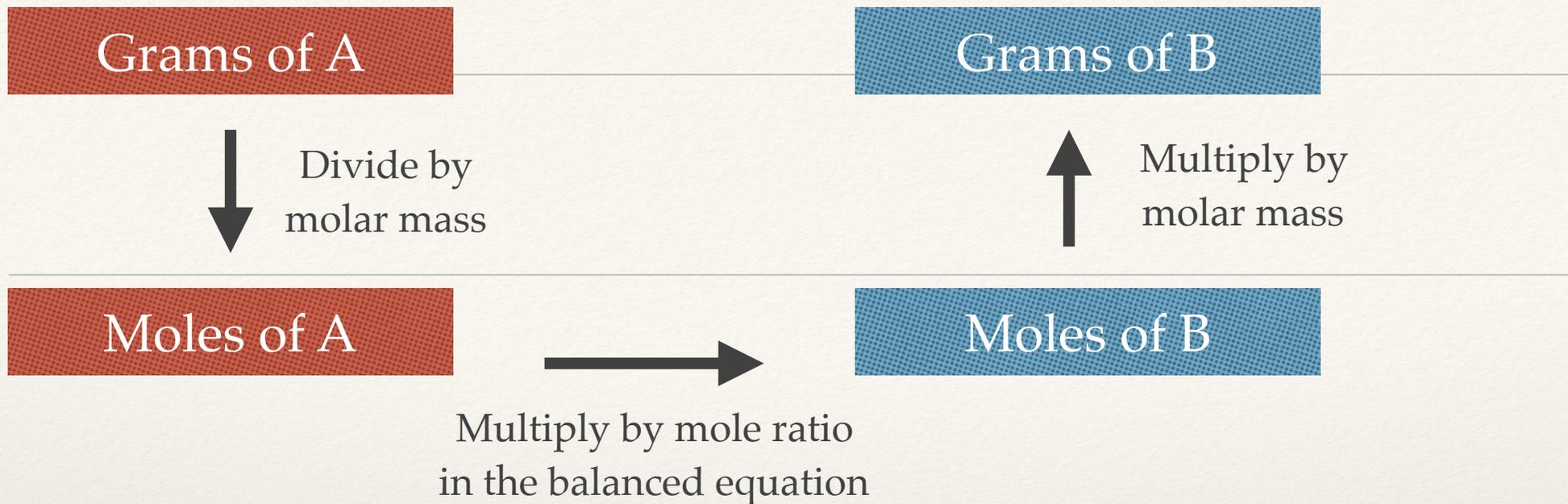
How many grams of carbon dioxide are produced when 55 grams of pentane ( $C_5H_{12}$ ) are combusted?

1. Translate the words into symbols



2. Balance the equation





How many grams of carbon dioxide are produced when 55 grams of pentane ( $C_5H_{12}$ ) are combusted?

1. Translate the words into symbols



2. Balance the equation



3. Use the mole map

$$55 \text{ grams } C_5H_{12} \times \frac{1 \text{ mole } C_5H_{12}}{72 \text{ grams}} \times \frac{5 \text{ moles } CO_2}{1 \text{ mole } C_5H_{12}} \times \frac{44 \text{ grams}}{1 \text{ mole } CO_2} = 1.7 \times 10^2 \text{ grams of } CO_2$$

Grams of A

Grams of B



Divide by  
molar mass



Multiply by  
molar mass

Moles of A



Moles of B

Multiply by mole ratio  
in the balanced equation

How much oxygen is needed to burn 42 grams of butane ( $C_4H_{10}$ )?

1. Translate the words into symbols



2. Balance the equation



Multiply everything by 2 to get rid of the fraction.

Grams of A

Grams of B



Divide by  
molar mass



Multiply by  
molar mass

Moles of A



Moles of B

Multiply by mole ratio  
in the balanced equation

How much oxygen is needed to burn 42 grams of butane (C<sub>4</sub>H<sub>10</sub>)?

1. Translate the words into symbols

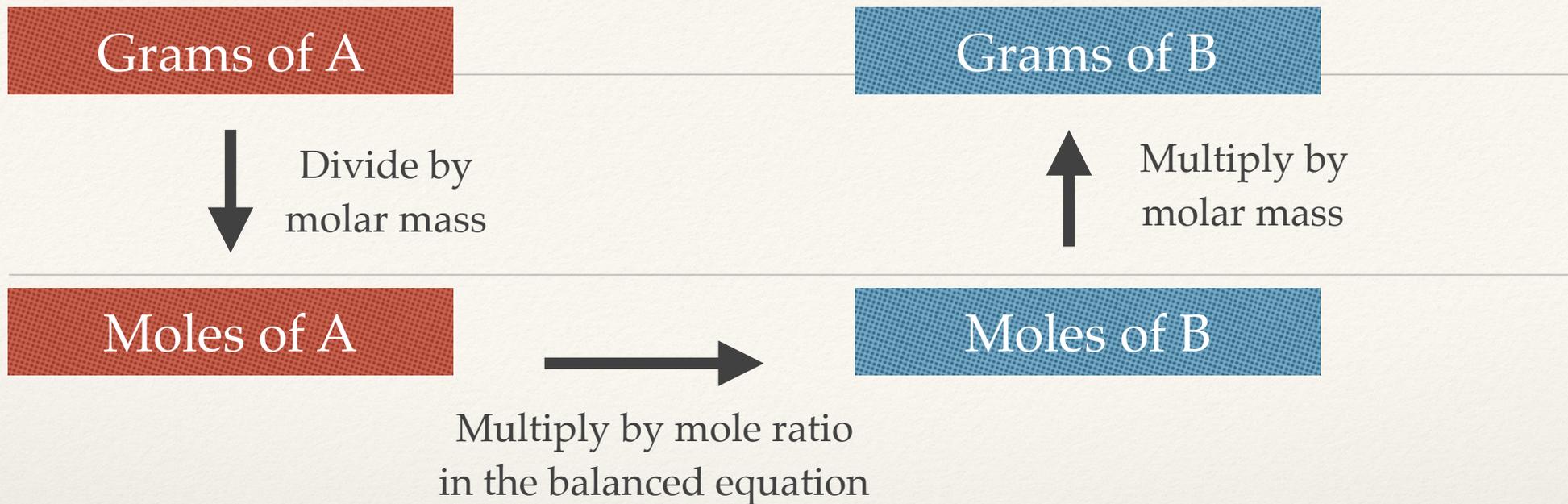


2. Balance the equation



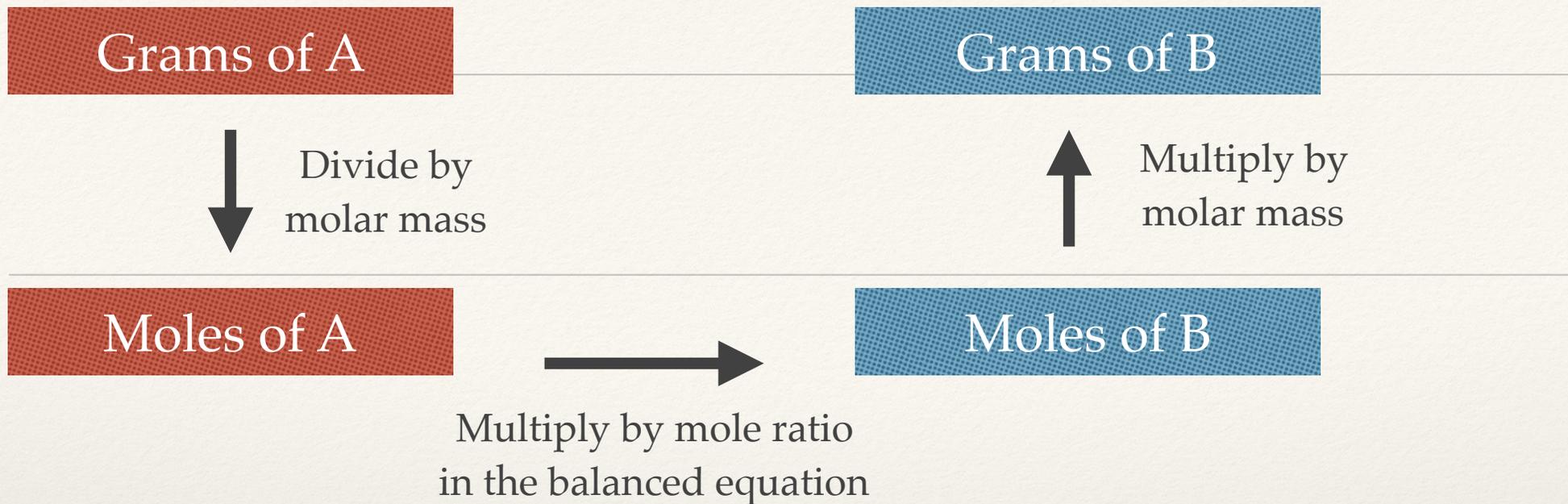
3. Use the mole map

$$42 \text{ grams C}_4\text{H}_{10} \times \frac{\text{Mole C}_4\text{H}_{10}}{58 \text{ grams}} \times \frac{13 \text{ moles O}_2}{2 \text{ mole C}_4\text{H}_{10}} \times \frac{32 \text{ grams}}{\text{Mole O}_2} = 1.5 \times 10^2 \text{ grams of O}_2$$



How much water is produced when 122 grams of propane ( $\text{C}_3\text{H}_8$ ) is burned?

- A.  $2.00 \times 10^2$
- B. 199.636
- C.  $2.12 \times 10^4$
- D. 1.44
- E. None of these



How much water is produced when 122 grams of propane ( $C_3H_8$ ) is burned?

1. Translate the words into symbols

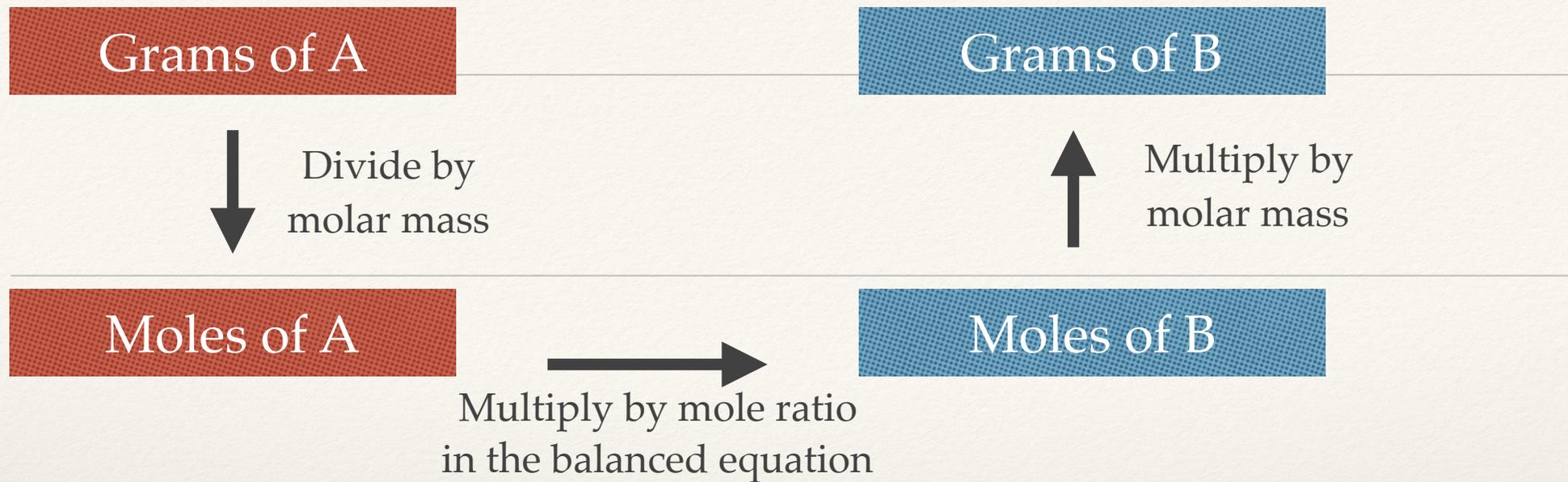


2. Balance the equation



3. Use the mole map

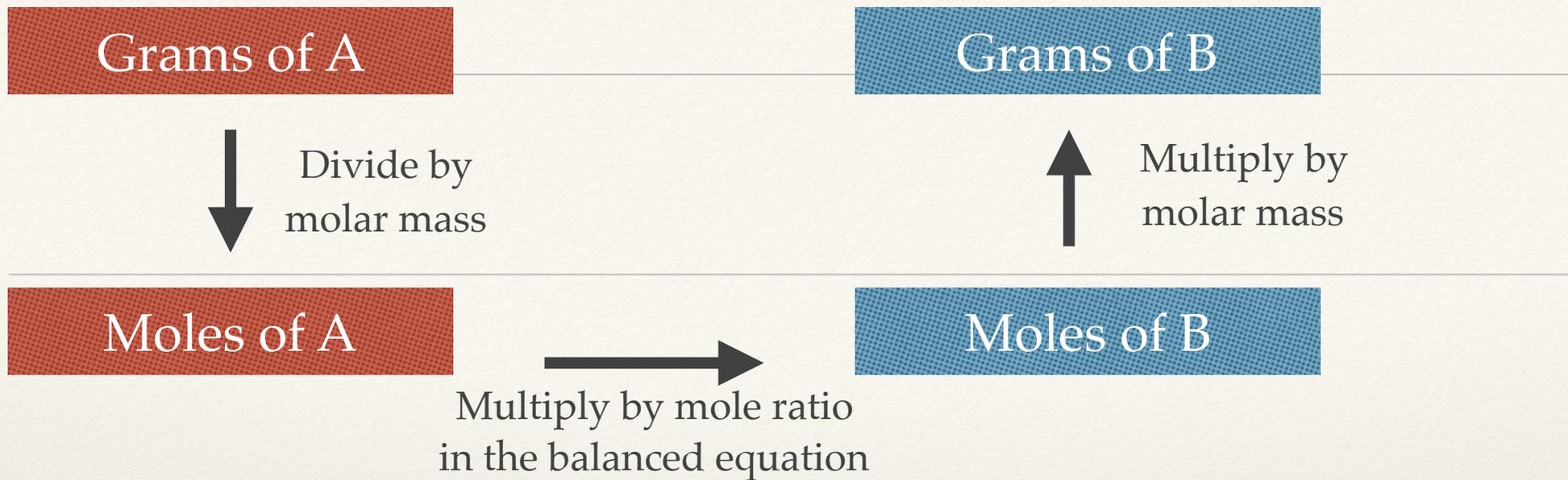
$$122 \text{ grams } C_3H_8 \times \frac{\text{Mole } C_3H_8}{44 \text{ grams}} \times \frac{4 \text{ moles } H_2O}{\text{mole } C_3H_8} \times \frac{18 \text{ grams}}{\text{Mole } H_2O} = 2.00 \times 10^2 \text{ grams of } H_2O$$



How much copper metal is produced when 5.4 grams of copper(I) sulfide reacts with oxygen to form copper metal and sulfur dioxide gas.

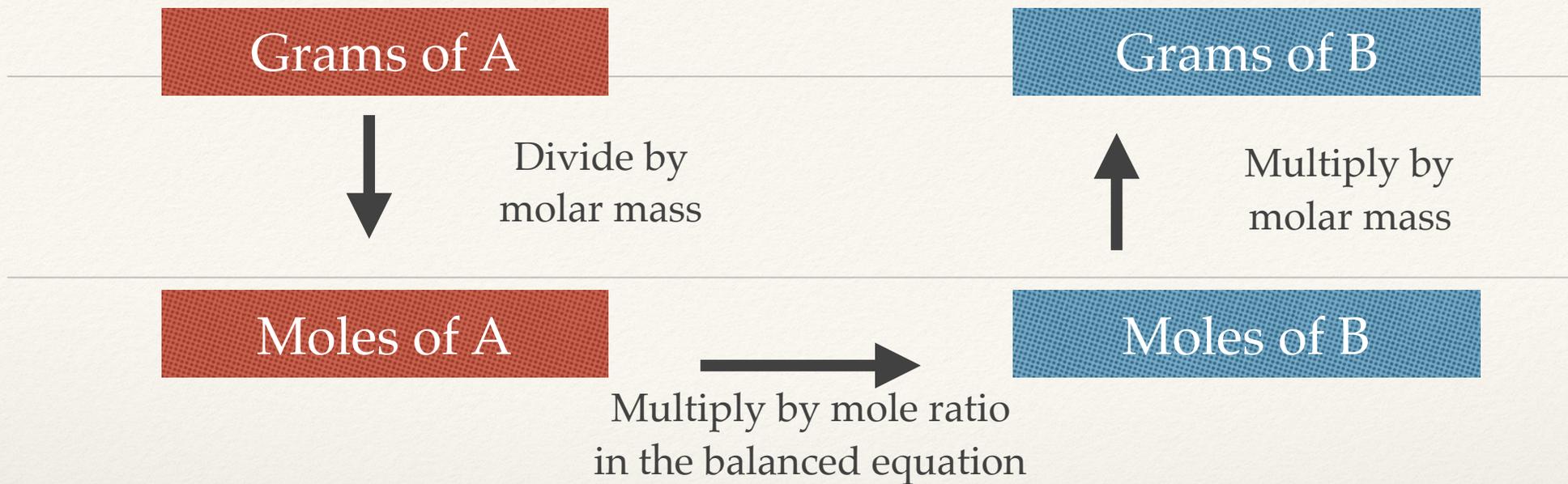
1. Translate the words into symbols
2. Balance the equation
3. Use the mole map

- A.  $2.31 \times 10^{-1}$  grams Cu(s)
- B.  $2.7 \times 10^1$  grams Cu(s)
- C. 4.3 grams Cu(s)
- D. 1.1 grams Cu(s)
- E. None of these



How much copper metal is produced when 5.4 grams of copper(I) sulfide reacts with oxygen to form copper metal and sulfur dioxide gas.

1. Translate the words into symbols
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1. Translate the words into symbols



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3. Use the mole map

5.4 grams $\text{Cu}_2\text{S}$ x	mole $\text{Cu}_2\text{S}$ x	<b>2</b> moles $\text{Cu(s)}$ x	63.5 grams	= 4.3 grams
	159 grams	mole $\text{Cu}_2\text{S}$	mole $\text{Cu(s)}$	of $\text{Cu(s)}$

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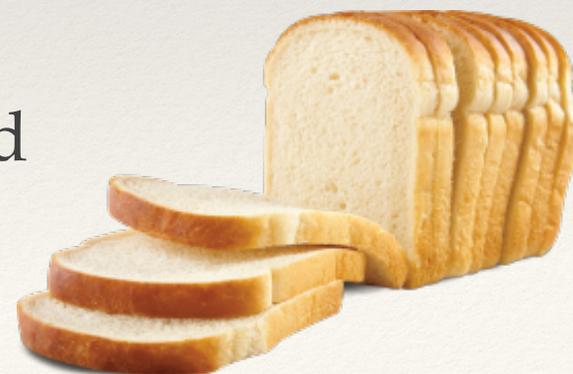
# What is Limiting?

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When masses of both reactants are given you don't know which one will get used up and which one will be in excess.

If you are making sandwiches and each sandwich needs one piece of cheese and two slices of bread, how many sandwiches can you make if you have 24 slices of cheese and 20 slices of bread? What will be leftover? How much will be leftover?

- A. 10 sandwiches, 14 extra slices of cheese
- B. 20 sandwiches, 4 extra slices of cheese
- C. 24 sandwiches, nothing extra
- D. 12 sandwiches, 2 extra slices of bread
- E. None of these

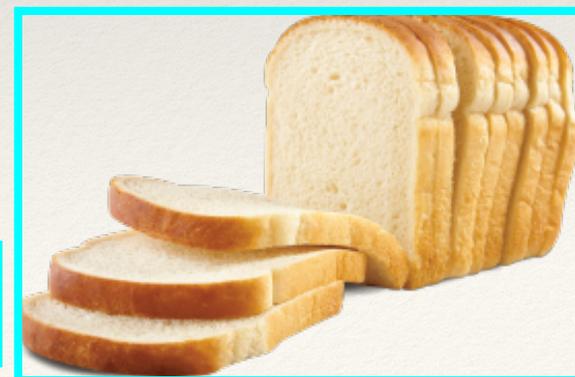


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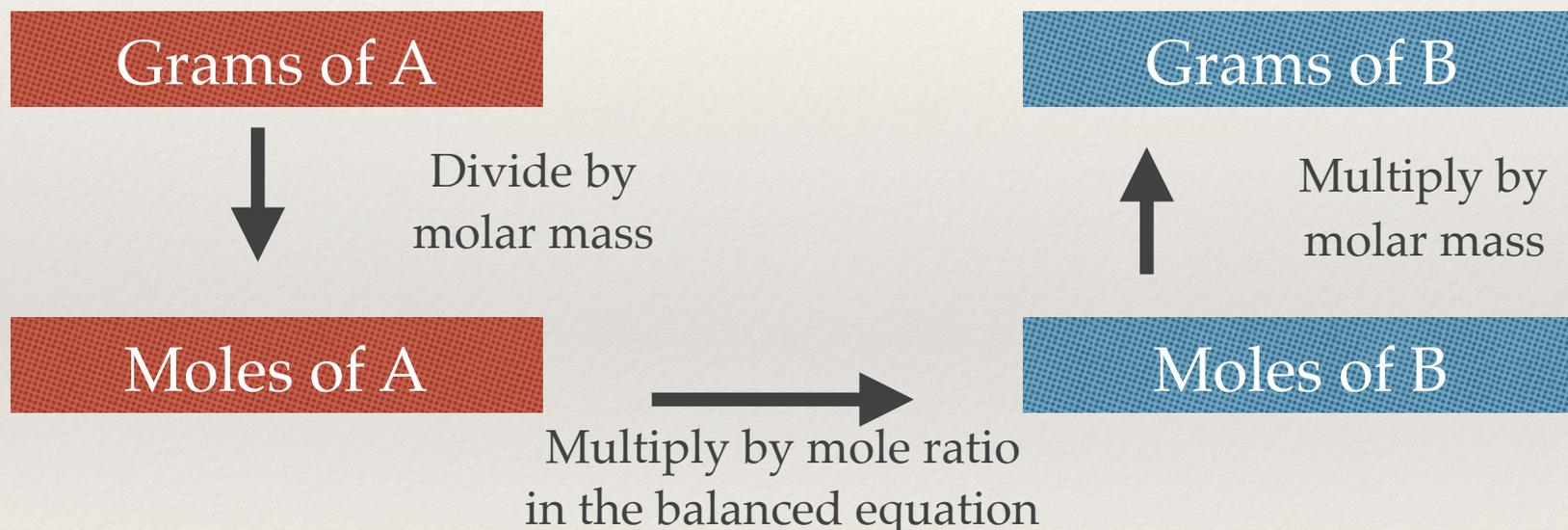
- A. 10 sandwiches, 14 extra slices of cheese
- B. 20 sandwiches, 4 extra slices of cheese
- C. 24 sandwiches, nothing extra
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**Bread is the limiting reagent**

# What is Limiting?

Sulfur trioxide and water react to form sulfuric acid ( $\text{H}_2\text{SO}_4$ ). How much sulfuric acid can be made from the reaction of 20 grams of sulfur trioxide and 10 grams of water?



Use the mole map for both reactants, the reactant that gives the smallest amount of product is the limiting reagent.

# What are the steps?

❖ Translate the words to symbols

❖ Balance the equation  $\text{SO}_3 + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_4$

❖ Use the mole map for each reactant

❖ The reactant that gives the smallest amount of product is the limiting reagent.

20 grams $\text{SO}_3$ x	mole $\text{SO}_3$ x	1 moles $\text{H}_2\text{SO}_4$ x	98 grams	= 24.5 g
	80 grams	1 mole $\text{SO}_3$	mole $\text{H}_2\text{SO}_4$	
10 grams $\text{H}_2\text{O}$ x	mole $\text{H}_2\text{O}$ x	1 moles $\text{H}_2\text{SO}_4$ x	98 grams	= 54.44 g
	18 grams	1 mole $\text{H}_2\text{O}$	mole $\text{H}_2\text{SO}_4$	

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How much carbon dioxide can be formed from the combustion of 26 grams of propane ( $C_3H_8$ ) with 100 grams of oxygen?

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A. 30

B. 23

C. 43

D. 45

E. None of these

# How much water can be formed from the combustion of 26 grams of propane (C<sub>3</sub>H<sub>8</sub>) with 52 grams of oxygen?

❖ Translate the words to symbols

❖ Balance the equation 
$$\text{C}_3\text{H}_8 + 5 \text{O}_2 \longrightarrow 3 \text{CO}_2 + 4 \text{H}_2\text{O}$$

❖ Use the mole map for each reactant

❖ The reactant that gives the smallest amount of product is the limiting reagent.

26 grams C <sub>3</sub> H <sub>8</sub> x	mole C <sub>3</sub> H <sub>8</sub> x	4 moles H <sub>2</sub> O x	18 grams	= 43 g
	44 grams	1 mole C <sub>3</sub> H <sub>8</sub>	mole H <sub>2</sub> O	
52 grams O <sub>2</sub> x	mole O <sub>2</sub> x	4 moles H <sub>2</sub> O x	18 grams	= 23 g
	32 grams	5 mole O <sub>2</sub>	mole H <sub>2</sub> O	

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How much carbon dioxide can be formed from the combustion of 26 grams of propane ( $C_3H_8$ ) with 100 grams of oxygen?

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E. None of these