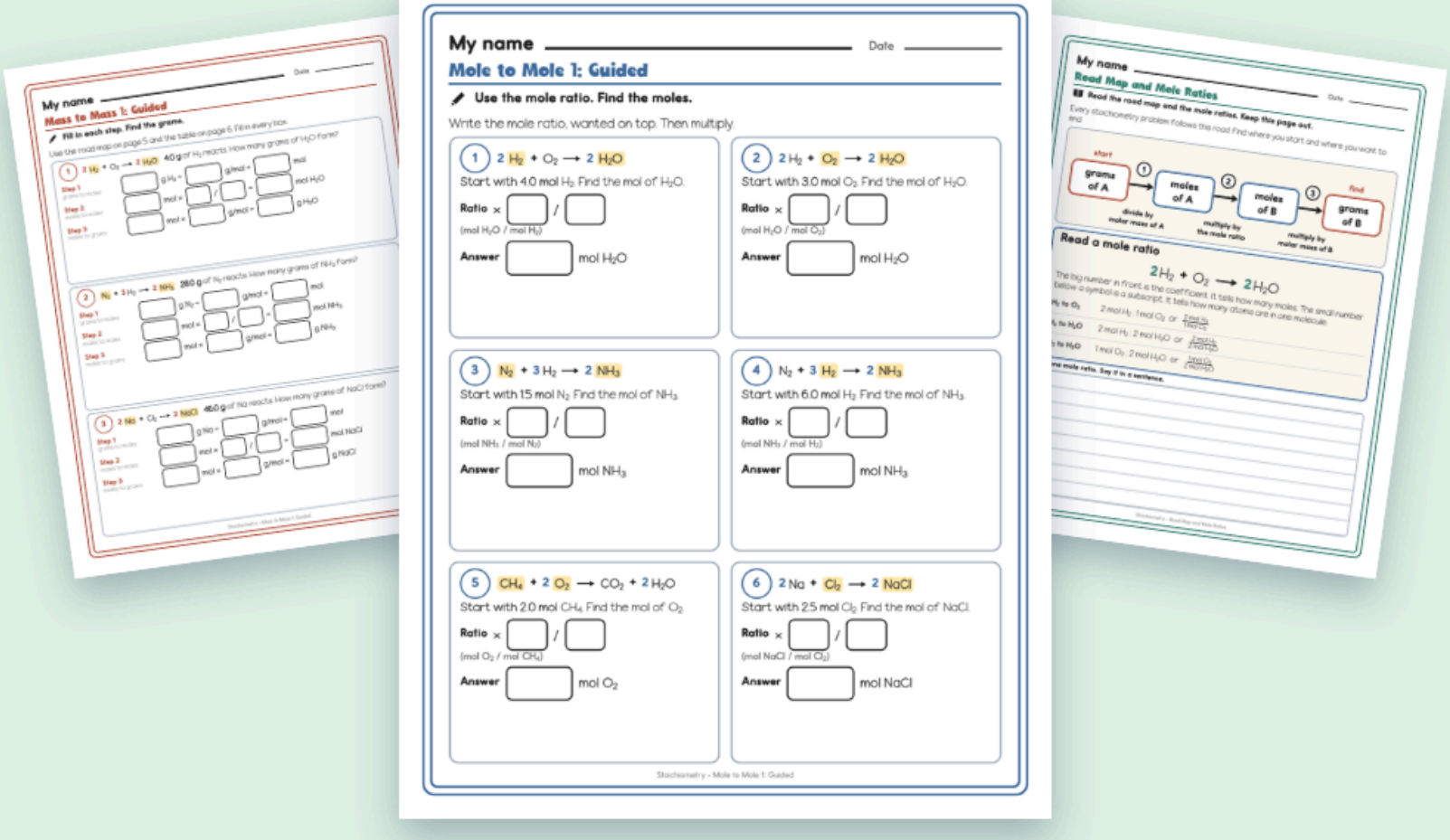
STOICHIOMETRY WORKSHEETS

MOLE RATIOS · MASS TO MASS · GRADES 9-11



23 pages + keys

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PREVIEW

How To Read a Page

The parts of a student page, then the kinds of sheet in the order they come.

The parts of a page

- **The answer box.** A bordered box for a number, a letter or a word. Click it to type, or print and write in it.
- **The ruled work box.** Lines 0.34 inch apart for steps and sentences. Write one step to a line.
- **The check box.** True or false, yes or no: click or mark.
- **The mole ratio.** Written as a fraction with the wanted substance on top, from the coefficients of the balanced equation.
- **The cut line.** Nine pieces in a short grid, edge to edge: two straight cuts across and two down.

Kind of sheet	How many	What the student does
References and words	3 sheets	The road map, the atomic mass table and six words to match.
Worked examples	2 sheets	One mole-to-mole and one mass-to-mass, every step shown, then a turn to try.
Molar mass and mole ratios	4 sheets, 34 items	Add up molar masses; read mole ratios off equations.
Mole to mole	2 sheets, 12 items	Guided with the ratio boxes, then on your own.
Mass to mass	4 sheets, 15 items	Order the six steps, then three steps of help down to none.
True or false and mistakes	2 sheets, 12 items	Check sentences, fix false ones, find Devon's mistakes.
Writing, quizzes, sorts	3 prompts, 12 items, 18 pieces	Explain-its with five ruled lines each, two quizzes, exit tickets, two sorts.

Untimed, unscored on the page

No student page has a timer or a score on it. The keys and the tracker are for you. The answer keys are on pages 28 to 31, and every key line shows the work, not only the answer.

Explain-its

Their keys (page 31) say what to look for, not one right sentence. Accept any answer that uses a mole ratio or a molar mass correctly.

Printing and the type-in fields

Every page prints clean in black and white. The name line, every answer box, every ruled box and every check box are type-in fields in any PDF reader: click one, type, then save. This is a fillable PDF, not a slideshow or a word-processor file.

Room to work

Mass-to-mass problems take three steps, so each problem has its own work box. If a student needs more room, hand over one page a day, or let students work on scrap paper and copy the steps into the box.

PREVIEW

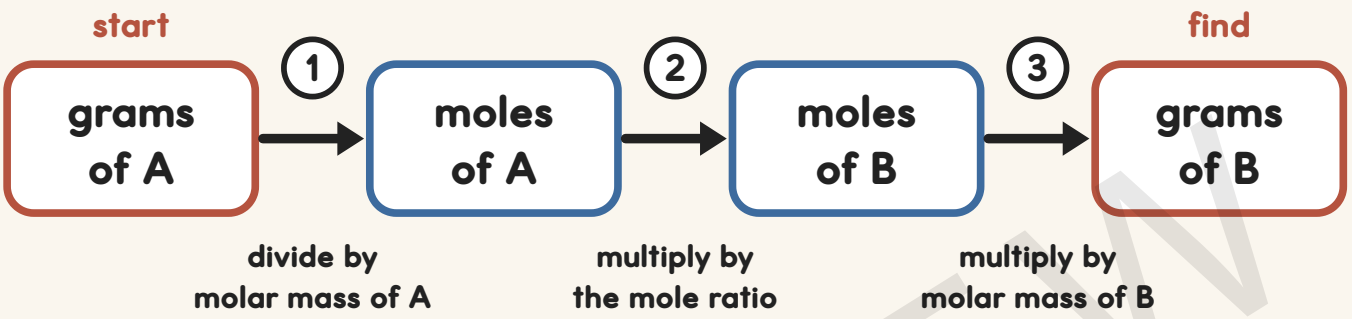
Preview · Bright Path Sped

My name _____ Date _____

Road Map and Mole Ratios

Read the road map and the mole ratios. Keep this page out.

Every stoichiometry problem follows this road. Find where you start and where you want to end.



Read a mole ratio

$$2H_2 + O_2 \rightarrow 2H_2O$$

The big number in front is the coefficient. It tells how many moles. The small number below a symbol is a subscript. It tells how many atoms are in one molecule.

H_2 to O_2	$2\ mol\ H_2 : 1\ mol\ O_2$ or	$\frac{2\ mol\ H_2}{1\ mol\ O_2}$
H_2 to H_2O	$2\ mol\ H_2 : 2\ mol\ H_2O$ or	$\frac{2\ mol\ H_2}{2\ mol\ H_2O}$
O_2 to H_2O	$1\ mol\ O_2 : 2\ mol\ H_2O$ or	$\frac{1\ mol\ O_2}{2\ mol\ H_2O}$

Pick one mole ratio. Say it in a sentence.

PREVIEW

My name _____ Date _____

Stoichiometry Words

Match each word to what it means.

Write the letter of the meaning in the box. Use the road map to help you.

1	mole		A	A substance that is used up; it is on the left of the arrow.
2	molar mass		B	The number written in front of a formula in an equation.
3	coefficient		C	A substance that is made; it is on the right of the arrow.
4	mole ratio		D	A counting unit chemists use for very large numbers of atoms or molecules.
5	reactant		E	A ratio of the moles of two substances, read from the coefficients.
6	product		F	The mass in grams of one mole of a substance, in g/mol.

Use two of the words in one sentence about an equation.

PREVIEW

Preview · Bright Path Sped

My name _____ Date _____

Worked Example: Mass to Mass

Read the example. Then try one.

Start

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

4.0 g of H_2 reacts. How many grams of H_2O form? (Made up for practice.)

Step 1

Grams to moles: 4.0 g ÷ 2.0 g/mol = **2.0 mol** H_2

Step 2

Moles to moles: 2.0 mol H_2 × $\frac{2\ \text{mol}\ H_2O}{2\ \text{mol}\ H_2}$ = **2.0 mol** H_2O

Step 3

Moles to grams: 2.0 mol H_2O × 18.0 g/mol = **36.0 g** H_2O

Check

36.0 g of water holds the 4.0 g of hydrogen plus 32.0 g of oxygen that joined it.

Your turn. Do the same steps.

Start

$N_2 + 3\ H_2 \rightarrow 2\ NH_3$

28.0 g of N_2 reacts. How many grams of NH_3 form?

Step 1

Grams to moles. ☐ g N_2 ÷ ☐ g/mol = ☐ mol

Step 2

Moles to moles. ☐ mol × ☐ / ☐ = ☐ mol NH_3

Step 3

Moles to grams. ☐ mol × ☐ g/mol = ☐ g NH_3

Check

Did you end in grams of the wanted substance? ☐ **yes** ☐ **no**

PREVIEW

My name _____ Date _____

Molar Mass 2

Add up the molar mass of each formula.

Count the atoms yourself. Use the atomic mass table on page 6.

1. Al_2O_3 aluminum oxide — **Work** _____ _____ g/mol
2. KCl potassium chloride — **Work** _____ _____ g/mol
3. CaO calcium oxide — **Work** _____ _____ g/mol
4. Fe_2O_3 iron oxide — **Work** _____ _____ g/mol
5. C_3H_8 propane — **Work** _____ _____ g/mol
6. $ZnCl_2$ zinc chloride — **Work** _____ _____ g/mol
7. $KClO_3$ potassium chlorate — **Work** _____ _____ g/mol
8. $CaCO_3$ calcium carbonate — **Work** _____ _____ g/mol

Pick one formula. Tell how you added it up.

PREVIEW

Preview · Bright Path Sped

My name _____ Date _____

Read the Mole Ratio 2

Read each mole ratio from the equation.

The coefficients are the mole ratio. Write the coefficient of each substance in its box.

$C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$

1. ☐ mol C_3H_8 : ☐ mol O_2
2. ☐ mol O_2 : ☐ mol CO_2
3. ☐ mol CO_2 : ☐ mol H_2O

$Zn + 2\,HCl \rightarrow ZnCl_2 + H_2$

4. ☐ mol Zn : ☐ mol HCl
5. ☐ mol HCl : ☐ mol $ZnCl_2$
6. ☐ mol HCl : ☐ mol H_2

$4\,Fe + 3\,O_2 \rightarrow 2\,Fe_2O_3$

7. ☐ mol Fe : ☐ mol O_2
8. ☐ mol Fe : ☐ mol Fe_2O_3
9. ☐ mol O_2 : ☐ mol Fe_2O_3

Pick one ratio. Tell where each number came from.

PREVIEW

Preview · Bright Path Sped

My name _____ Date _____

Mole to Mole 2: On Your Own

Use the mole ratio. Find the moles.

Write the ratio, multiply, and show your work.

1 $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

Start with 2.0 mol C_3H_8. Find the mol of CO_2.

Work

Answer _____ mol CO_2

2 $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

Start with 10.0 mol O_2. Find the mol of H_2O.

Work

Answer _____ mol H_2O

3 $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

Start with 8.0 mol Al. Find the mol of Al_2O_3.

Work

Answer _____ mol Al_2O_3

4 $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

Start with 4.0 mol $KClO_3$. Find the mol of O_2.

Work

Answer _____ mol O_2

5 $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$

Start with 4.5 mol O_2. Find the mol of Fe_2O_3.

Work

Answer _____ mol Fe_2O_3

6 $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

Start with 3.0 mol HCl. Find the mol of H_2.

Work

Answer _____ mol H_2

PREVIEW

My name _____ Date _____

Mass to Mass 1: Guided

Fill in each step. Find the grams.

Use the road map on page 5 and the table on page 6. Fill in every box.

1 $2\ H_2 + O_2 \rightarrow 2\ H_2O$ 4.0 g of H_2 reacts. How many grams of H_2O form?

Step 1 grams to moles: [ ] g H_2 ÷ [ ] g/mol = [ ] mol

Step 2 moles to moles: [ ] mol × [ ] / [ ] = [ ] mol H_2O

Step 3 moles to grams: [ ] mol × [ ] g/mol = [ ] g H_2O

2 $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ 28.0 g of N_2 reacts. How many grams of NH_3 form?

Step 1 grams to moles: [ ] g N_2 ÷ [ ] g/mol = [ ] mol

Step 2 moles to moles: [ ] mol × [ ] / [ ] = [ ] mol NH_3

Step 3 moles to grams: [ ] mol × [ ] g/mol = [ ] g NH_3

3 $2\ Na + Cl_2 \rightarrow 2\ NaCl$ 46.0 g of Na reacts. How many grams of NaCl form?

Step 1 grams to moles: [ ] g Na ÷ [ ] g/mol = [ ] mol

Step 2 moles to moles: [ ] mol × [ ] / [ ] = [ ] mol NaCl

Step 3 moles to grams: [ ] mol × [ ] g/mol = [ ] g NaCl

PREVIEW

Preview · Bright Path Sped

My name _____ Date _____

Mass to Mass 3: On Your Own

Show your steps. Find the grams.

The equations are balanced for you. Plan the three steps, then write the answer.

7 $2\,H_2 + O_2 \rightarrow 2\,H_2O$ 90.0 g of H_2O forms. How many grams of H_2 were used up?

Work

Answer _____ g H_2

8 $CaCO_3 \rightarrow CaO + CO_2$ 200.2 g of $CaCO_3$ reacts. How many grams of CaO form?

Work

Answer _____ g CaO

9 $C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$

22.0 g of C_3H_8 reacts. How many grams of O_2 react with it?

Work

Answer _____ g O_2

PREVIEW

My name _____ Date _____

Explain It

Explain your thinking in sentences.

Use what you know about moles and mole ratios. Say why.

Start with: I know that ____ because ____.

1. Why can you not use a mole ratio straight on grams? Use an example.

2. Explain the difference between a coefficient and a subscript, using $2H_2O$.

3. A friend says 4.0 g of hydrogen makes 4.0 g of water. Tell your friend what to check.

PREVIEW

My name _____ Date _____

Quiz B

Pick the best answer. Write its letter.

Take your time. Guess if you are not sure.

7 What is the molar mass of Al_2O_3?

A 43.0 g/mol
B 113.0 g/mol
C 102.0 g/mol

8 In $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$ what is the mole ratio of O_2 to CO_2?

A 3 to 5
B 5 to 3
C 5 to 1

9 $N_2 + 3\ H_2 \rightarrow 2\ NH_3$ How many moles of H_2 go with 6.0 mol of NH_3?

A 9.0 mol
B 4.0 mol
C 6.0 mol

10 $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$ How many moles of $KClO_3$ go with 9.0 mol of O_2?

A 13.5 mol
B 6.0 mol
C 9.0 mol

11 $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$ How many grams of CO_2 go with 64.0 g of O_2?

A 176.0 g
B 88.0 g
C 44.0 g

12 $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$ How many grams of H_2O go with 88.0 g of C_3H_8?

A 144.0 g
B 9.0 g
C 36.0 g

PREVIEW

My name _____ Date _____

Cut and Sort: Which Step?

Cut out the nine pieces. Sort each one into the right box.

Each piece is one step of a problem. Is it grams to moles, moles to moles, or moles to grams?

Grams to moles	Moles to moles	Moles to grams

Cut on the dashed lines: nine pieces, two cuts across and two cuts down.

1.0 mol N_2 × 2/1 = 2.0 mol NH_3	4.0 g H_2 ÷ 2.0 g/mol = 2.0 mol	2.0 mol NaCl × 58.5 g/mol = 117.0 g
46.0 g Na ÷ 23.0 g/mol = 2.0 mol	2.0 mol NH_3 × 17.0 g/mol = 34.0 g	2.0 mol H_2 × 2/2 = 2.0 mol H_2O
2.0 mol H_2O × 18.0 g/mol = 36.0 g	28.0 g N_2 ÷ 28.0 g/mol = 1.0 mol	2.0 mol Na × 2/2 = 2.0 mol NaCl

Which piece was hardest to sort? Why?

PREVIEW

Answer Key: Words, Molar Mass, Mole Ratios

Molar masses use the table on page 6. Every letter is the position of the right meaning in the printed list.

Stoichiometry Words page 7

Word	Letter	Meaning
1. mole	D	a counting unit chemists use for very large numbers of atoms or molecules
2. molar mass	F	the mass in grams of one mole of a substance, in g/mol
3. coefficient	B	the number written in front of a formula in an equation
4. mole ratio	E	a ratio of the moles of two substances, read from the coefficients
5. reactant	A	a substance that is used up; it is on the left of the arrow
6. product	C	a substance that is made; it is on the right of the arrow

Read the Mole Ratio pages 12, 13

Equation	Ratio 1	Ratio 2	Ratio 3
$2\ H_2 + O_2 \rightarrow 2\ H_2O$	1. $H_2 : O_2 = 2 : 1$	2. $H_2 : H_2O = 2 : 2$	3. $O_2 : H_2O = 1 : 2$
$N_2 + 3\ H_2 \rightarrow 2\ NH_3$	4. $N_2 : H_2 = 1 : 3$	5. $H_2 : NH_3 = 3 : 2$	6. $N_2 : NH_3 = 1 : 2$
$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$	7. $CH_4 : O_2 = 1 : 2$	8. $O_2 : H_2O = 2 : 2$	9. $CO_2 : H_2O = 1 : 2$
$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$	10. $C_3H_8 : O_2 = 1 : 5$	11. $O_2 : CO_2 = 5 : 3$	12. $CO_2 : H_2O = 3 : 4$
$Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$	13. $Zn : HCl = 1 : 2$	14. $HCl : ZnCl_2 = 2 : 1$	15. $HCl : H_2 = 2 : 1$
$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$	16. $Fe : O_2 = 4 : 3$	17. $Fe : Fe_2O_3 = 4 : 2$	18. $O_2 : Fe_2O_3 = 3 : 2$

Molar Mass (g/mol) pages 10, 11

Item	Formula	Add up
10.1	H_2O	$2 \times 1.0 + 16.0 = 18.0$
10.2	CO_2	$12.0 + 2 \times 16.0 = 44.0$
10.3	NaCl	$23.0 + 35.5 = 58.5$
10.4	NH_3	$14.0 + 3 \times 1.0 = 17.0$
10.5	CH_4	$12.0 + 4 \times 1.0 = 16.0$
10.6	MgO	$24.3 + 16.0 = 40.3$
10.7	O_2	$2 \times 16.0 = 32.0$
10.8	HCl	$1.0 + 35.5 = 36.5$
11.1	Al_2O_3	$2 \times 27.0 + 3 \times 16.0 = 102.0$
11.2	KCl	$39.1 + 35.5 = 74.6$
11.3	CaO	$40.1 + 16.0 = 56.1$
11.4	Fe_2O_3	$2 \times 55.8 + 3 \times 16.0 = 159.6$
11.5	C_3H_8	$3 \times 12.0 + 8 \times 1.0 = 44.0$
11.6	$ZnCl_2$	$65.4 + 2 \times 35.5 = 136.4$
11.7	$KClO_3$	$39.1 + 35.5 + 3 \times 16.0 = 122.6$
11.8	$CaCO_3$	$40.1 + 12.0 + 3 \times 16.0 = 100.1$

PREVIEW

Answer Key: Mass to Mass and Mistakes

Each step is shown. Devon in Find the Mistake is invented. Accept any wording that fixes the mistake. A table that rounds the atomic masses differently can change a last digit.

Mass to Mass pages 17, 18, 19

Item	Equation	Work and answer
17.1	$2\ H_2 + O_2 \longrightarrow 2\ H_2O$	4.0 g ÷ 2.0 = 2.0 mol H_2 2.0 mol × 2/2 = 2.0 mol H_2O 2.0 mol × 18.0 = **36.0 g** H_2O
17.2	$N_2 + 3\ H_2 \longrightarrow 2\ NH_3$	28.0 g ÷ 28.0 = 1.0 mol N_2 1.0 mol × 2/1 = 2.0 mol NH_3 2.0 mol × 17.0 = **34.0 g** NH_3
17.3	$2\ Na + Cl_2 \longrightarrow 2\ NaCl$	46.0 g ÷ 23.0 = 2.0 mol Na 2.0 mol × 2/2 = 2.0 mol NaCl 2.0 mol × 58.5 = **117.0 g** NaCl
18.4	$CH_4 + 2\ O_2 \longrightarrow CO_2 + 2\ H_2O$	32.0 g ÷ 16.0 = 2.0 mol CH_4 2.0 mol × 2/1 = 4.0 mol H_2O 4.0 mol × 18.0 = **72.0 g** H_2O
18.5	$4\ Al + 3\ O_2 \longrightarrow 2\ Al_2O_3$	54.0 g ÷ 27.0 = 2.0 mol Al 2.0 mol × 3/4 = 1.5 mol O_2 1.5 mol × 32.0 = **48.0 g** O_2
18.6	$2\ KClO_3 \longrightarrow 2\ KCl + 3\ O_2$	245.2 g ÷ 122.6 = 2.0 mol $KClO_3$ 2.0 mol × 3/2 = 3.0 mol O_2 3.0 mol × 32.0 = **96.0 g** O_2
19.7	$2\ H_2 + O_2 \longrightarrow 2\ H_2O$	90.0 g ÷ 18.0 = 5.0 mol H_2O 5.0 mol × 2/2 = 5.0 mol H_2 5.0 mol × 2.0 = **10.0 g** H_2
19.8	$CaCO_3 \longrightarrow CaO + CO_2$	200.2 g ÷ 100.1 = 2.0 mol $CaCO_3$ 2.0 mol × 1/1 = 2.0 mol CaO 2.0 mol × 56.1 = **112.2 g** CaO
19.9	$C_3H_8 + 5\ O_2 \longrightarrow 3\ CO_2 + 4\ H_2O$	22.0 g ÷ 44.0 = 0.5 mol C_3H_8 0.5 mol × 5/1 = 2.5 mol O_2 2.5 mol × 32.0 = **80.0 g** O_2

Find the Mistake page 21

Item	What went wrong	Right work
21.1	The mole ratio is upside down. The wanted substance goes on top.	6.0 × 2/3 = 4.0 mol
21.2	The moles were never changed to grams.	4.0 mol × 18.0 g/mol = 72.0 g
21.3	The mole ratio was used on grams. Change to moles first.	4.0 g ÷ 2.0 = 2.0 mol, then 2.0 mol × 18.0 = 36.0 g
21.4	The subscript 2 was left out. There are 2 oxygen atoms.	2 × 16.0 = 32.0 g/mol

PREVIEW

Stoichiometry Tracker

One student, every scored sheet. Filled example: page 36.

Student _____ Teacher _____ Month _____

Page	Page type and set	Items	Right	Date	Notes
7	Stoichiometry Words	6			
10	Molar Mass 1	8			
11	Molar Mass 2	8			
12	Read the Mole Ratio 1	9			
13	Read the Mole Ratio 2	9			
14	Mole to Mole 1: Guided	6			
15	Mole to Mole 2: On Your Own	6			
16	Put the Steps in Order	6			
17	Mass to Mass 1: Guided	3			
18	Mass to Mass 2: Less Help	3			
19	Mass to Mass 3: On Your Own	3			
20	True or False	8			
21	Find the Mistake	4			
23	Quiz A	6			
24	Quiz B	6			
26	Cut and Sort: Which Step?	9			
27	Cut and Sort: Which Ratio?	9			

PREVIEW

How to fill this in

Write how many items the student got right with no prompt, and the date. A blank means not tried yet, never wrong. There are 109 items on the 17 scored sheets. Answer keys: pages 28 to 31. Filled example: page 36.

This unit we are working on (your own standard or wording)

Team Note

Use this page between team meetings or when a student moves classes, to hand off what changed without writing a note from scratch. Everything below is observable, with a blank for the number or the wording your team already uses.

Student _____ Team member _____ Date _____

Kind of sheet	Covered since last note (Y/N)	Items right	Still blank
Words and molar mass			
Reading mole ratios			
Mole to mole			
Mass to mass			
True or false			
Find the mistake			
Quizzes			
Sorts			

What I saw (observable, not a conclusion)

- Added up ___ of 16 molar masses (pages 10, 11).
- Read ___ of 18 mole ratios off an equation (pages 12, 13).
- Solved ___ of 12 mole-to-mole problems (pages 14, 15).
- Solved ___ of 9 mass-to-mass problems (pages 17 to 19).
- Changed grams to moles first without a reminder: yes / no / with a reminder.

Next step

- Next page or set: ___, because ___ (what you saw).
- What to try in another class or at home: ___.
- What to keep doing because it is working: ___.
- Anything for the team meeting to decide: ___ (this page records what happened, never a label or a plan).

Summary, in one or two sentences, for whoever reads this next

A filled-in line, for reference

"Got 7 of 8 true or false sentences right on 10/20. Next step: reread the road map on page 5 and ask what the mole ratio works on." That is the level of detail this page is built for. It matches the filled example on page 36.

PREVIEW

Riley's Tracker (Invented Student)

Riley T. is invented; nothing on this page describes a real student. The blank tracker is on page 32.

Student: Riley T. (an invented student)

Teacher: Ms. Patel (invented)

Month: October

Page	Page type and set	Items	Right	Date	Notes
7	Stoichiometry Words	6	5	10/6	Mixed up reactant and product
10	Molar Mass 1	8	7	10/7	Left out the subscript on O2
11	Molar Mass 2	8	6	10/8	Counted aluminum once, not twice
12	Read the Mole Ratio 1	9	8	10/9	Flipped one ratio
13	Read the Mole Ratio 2	9	7	10/10	Read a ratio for the wrong pair
14	Mole to Mole 1: Guided	6	5	10/13	Used the ratio upside down
15	Mole to Mole 2: On Your Own	6	4	10/14	Used the ratio upside down twice
16	Put the Steps in Order	6	5	10/15	Swapped steps 3 and 4
17	Mass to Mass 1: Guided	3	3	10/16	-
18	Mass to Mass 2: Less Help	3	2	10/17	Skipped the molar mass step
19	Mass to Mass 3: On Your Own	3	-	-	-
20	True or False	8	7	10/20	Thought a ratio works on grams
21	Find the Mistake	4	3	10/21	Missed the left-out subscript
23	Quiz A	6	5	10/22	Missed one mass item
24	Quiz B	6	-	-	-
26	Cut and Sort: Which Step?	9	-	-	-
27	Cut and Sort: Which Ratio?	9	-	-	-

PREVIEW

How to read it

Riley T. has done **13 of 17** scored sheets and got **67 of 82** items right with no prompt. **1** sheet was all right and **12** carry a note. Every number comes from the table.

What the table points to

The lowest sheets are Mole to Mole 2: On Your Own (4 of 6) and Mass to Mass 2: Less Help (2 of 3). That is where the next practice goes. The 4 sheets left blank are not tried yet, never wrong.