

# Mass Matchup

Use mole ratios and mass totals to track atoms.

HIGH SCHOOL · HS-PS1-7

**HS-PS1-7** "Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships..."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## TRACK EVERY GRAM

A balanced equation gives mole ratios between reactants and products. Convert moles to grams when needed, then the total mass of the reactants equals the total mass of the products.

## WORKED EXAMPLE

$\text{Fe} + \text{S} \rightarrow \text{FeS}$ . If 7 mol Fe reacts with 7 mol S, find the mass of FeS.  
Fe = 56 g/mol, S = 32 g/mol.

1. 7 mol Fe  $\times$  56 g/mol = 392 g Fe.

2. 7 mol S  $\times$  32 g/mol = 224 g S.

3. 392 g + 224 g = 616 g FeS.

**Answer: 616 g FeS**

## PRACTICE 5 problems

**1**  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ . If 12 g Mg combines with 8 g O, what mass of MgO forms?

ANSWER \_\_\_\_\_

**2**  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ . If 4 mol  $\text{H}_2$  reacts completely, how many mol HCl form?

ANSWER \_\_\_\_\_

**3**  $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ . If 46 g Na reacts completely, how many grams  $\text{Cl}_2$  are used?  
Na = 23 g/mol, Cl = 35.5 g/mol.

ANSWER \_\_\_\_\_

**4**  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ . A 50 g sample forms 22 g  $\text{CO}_2$ . What mass CaO forms?

ANSWER \_\_\_\_\_

**5**  $2\text{Al} + 3\text{S} \rightarrow \text{Al}_2\text{S}_3$ . If 4 mol Al react completely, how many mol S are needed?

ANSWER \_\_\_\_\_

## APPLY IT Show your work

- 1** A robotics club tests a magnesium flare. In  $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ , 24 g Mg reacts completely. Find the mass of oxygen used and the mass of magnesium oxide made. Mg = 24 g/mol, O = 16 g/mol.

WORK SPACE

ANSWER \_\_\_\_\_

- 2** A climate club models carbon combustion in a sealed container:  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ . If 36 g C reacts completely, find the mass of  $\text{O}_2$  used and the mass of  $\text{CO}_2$  produced. C = 12 g/mol, O = 16 g/mol.

WORK SPACE

ANSWER \_\_\_\_\_

## CHALLENGE One step up

### CHALLENGE

$2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ . A reaction uses 54 g Al and 213 g  $\text{Cl}_2$ . Al = 27 g/mol and Cl = 35.5 g/mol. Write a mass argument that shows whether these amounts match the equation and proves mass is conserved.

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## PART 1 • PRACTICE

| # | PROBLEM                                                                                                                                                    | ANSWER                               |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 1 | $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ . If 12 g Mg combines with 8 g O, what mass of MgO forms?                                                | <b>20 g MgO</b>                      |
| 2 | $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ . If 4 mol $\text{H}_2$ reacts completely, how many mol HCl form?                                       | <b>8 mol HCl</b>                     |
| 3 | $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ . If 46 g Na reacts completely, how many grams $\text{Cl}_2$ are used? Na = 23 g/mol, Cl = 35.5 g/mol. | <b>71 g <math>\text{Cl}_2</math></b> |
| 4 | $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ . A 50 g sample forms 22 g $\text{CO}_2$ . What mass CaO forms?                                       | <b>28 g CaO</b>                      |
| 5 | $2\text{Al} + 3\text{S} \rightarrow \text{Al}_2\text{S}_3$ . If 4 mol Al react completely, how many mol S are needed?                                      | <b>6 mol S</b>                       |

## PART 2 • APPLY IT

- 16 g  $\text{O}_2$ ; 40 g MgO** 24 g Mg is 1 mol Mg, which uses  $\frac{1}{2}$  mol  $\text{O}_2$ , or 16 g. The product mass is 24 g + 16 g = 40 g.
- 96 g  $\text{O}_2$ ; 132 g  $\text{CO}_2$**  36 g C is 3 mol C, so it uses 3 mol  $\text{O}_2$ , or 96 g. The product mass is 36 g + 96 g = 132 g.

## CHALLENGE

**54 g Al = 2 mol and 213 g  $\text{Cl}_2$  = 3 mol, so the amounts match  $2\text{Al} + 3\text{Cl}_2$ . The reactants total 267 g, and 2 mol  $\text{AlCl}_3$  has a mass of 267 g, so mass is conserved.**

Accept equivalent ratio work and correctly labeled units. Students may show conservation by adding reactant masses or by calculating the product mass from moles.