LESSON MAKER PRO

Matter Adds Up

Balance reactions and track where the mass goes.

HIGH SCHOOL · PHS.4

PHS.4 "Students will analyze changes in matter and the relationship of these changes to the law of conservation of matter and energy. Design and conduct experiments to investigate physical and chemical changes of various household products (e.g...."

NAME _____ DATE _____

COUNT ATOMS, THEN MASS

A balanced equation has the same number of each kind of atom on both sides. Change coefficients in front of formulas to balance an equation, but never change subscripts. In a closed system, the total mass of the reactants equals the total mass of the products.

WORKED EXAMPLE

Balance K + Br_2 -> KBr. Then find the product mass when 78 g of K reacts with 160 g of Br_2. Use atomic masses K = 39 and Br = 80.

1. Balance the atoms: 2 K + Br_2 -> 2 KBr.
2. Check: each side has 2 K atoms and 2 Br atoms.
3. Add the reactant masses: 78 g + 160 g = 238 g.

Answer: 2 K + Br_2 -> 2 KBr; 238 g of KBr

PRACTICE 6 problems

1 Balance H_2 + Cl_2 -> HCl.

ANSWER _____

2 Balance Fe + O_2 -> FeO.

ANSWER _____

3 In a closed container, 14 g of iron reacts completely with 6 g of oxygen to form one product. What is the mass of the product?

ANSWER _____

4 Balance H_2 + O_2 -> H_2O. If 4 g of H_2 reacts completely with 32 g of O_2, what mass of water forms?

ANSWER _____

5 When 100 g of $CaCO_3$ breaks down, it forms 56 g of CaO and some CO_2. The balanced equation is $CaCO_3$ -> CaO + CO_2. What mass of CO_2 forms?

ANSWER _____

6 Balance N_2 + H_2 -> NH_3. If 28 g of N_2 reacts completely with 6 g of H_2, what mass of NH_3 forms?

ANSWER _____

APPLY IT Show your work

1 For a science fair demonstration, you seal 40 g of vinegar and 3 g of baking soda in a 6 g bag. They react and make a gas. What is the total mass of the sealed bag and its contents after the reaction? If you open the bag and exactly 1 g of gas escapes, what mass remains?

WORK SPACE

ANSWER _____

2 A school greenhouse tracks how much carbon dioxide its plants use. In photosynthesis, 6 CO_2 + 6 H_2O -> $C_6H_{12}O_6$ + 6 O_2. If the plants use 88 g of CO_2 and have enough water, what mass of O_2 do they produce? Use atomic masses C = 12 and O = 16.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Hydrogen peroxide breaks down in a closed container: 2 H_2O_2 -> 2 H_2O + O_2. If 68 g of H_2O_2 breaks down completely, find the mass of each product and show that mass is conserved. Use atomic masses H = 1 and O = 16.

WORK SPACE AND ANSWER

Matter Adds Up

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Balance $H_2 + Cl_2$ -> HCl.	**$H_2 + Cl_2$ -> 2 HCl**
2	Balance Fe + O_2 -> FeO.	**2 Fe + O_2 -> 2 FeO**
3	In a closed container, 14 g of iron reacts completely with 6 g of oxygen to form one product. What is the mass of the product?	**20 g**
4	Balance $H_2 + O_2$ -> H_2O. If 4 g of H_2 reacts completely with 32 g of O_2, what mass of water forms?	**2 H_2 + O_2 -> 2 H_2O; 36 g of water**
5	When 100 g of $CaCO_3$ breaks down, it forms 56 g of CaO and some CO_2. The balanced equation is $CaCO_3$ -> CaO + CO_2. What mass of CO_2 forms?	**44 g**
6	Balance $N_2 + H_2$ -> NH_3. If 28 g of N_2 reacts completely with 6 g of H_2, what mass of NH_3 forms?	**N_2 + 3 H_2 -> 2 NH_3; 34 g of NH_3**

PART 2 · APPLY IT

1. **49 g sealed; 48 g after the gas escapes** The sealed mass is 40 + 3 + 6 = 49 g. Opening the bag lets 1 g leave, so 49 - 1 = 48 g remains.
2. **64 g of O_2** CO_2 has a mass of 44 g per mole, so 88 g is 2 moles. The CO_2:O_2 mole ratio is 1:1, giving 2 moles of O_2 at 32 g per mole, or 64 g.

CHALLENGE

36 g of H_2O and 32 g of O_2; 36 g + 32 g = 68 g.

Accept equivalent balanced equations that omit coefficients of 1. In the challenge, students may use molar masses or atom counts to justify the product masses.