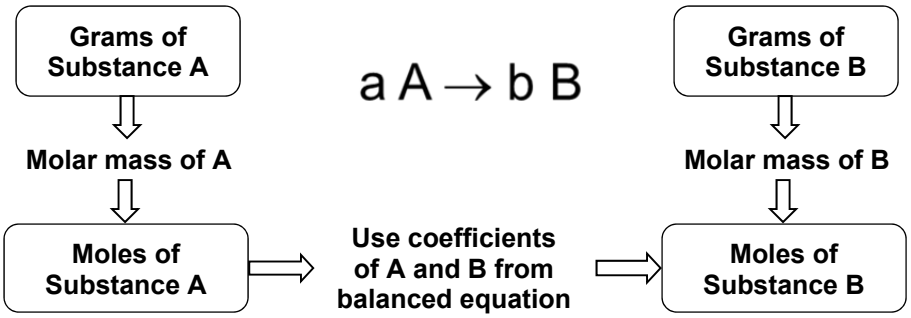
Reaction Stoichiometry



The coefficients in a balanced chemical equation specify the relative amounts in moles of each of the substances involved in the reaction.

$$2\ C_8H_{18}\ (l) + 25\ O_2(g) \rightarrow 16\ CO_2\ (g) + 18\ H_2O(g)$$

2 mol C_8H_{18} : 25 mol O_2 : 16 mol CO_2 : 18 mol H_2O

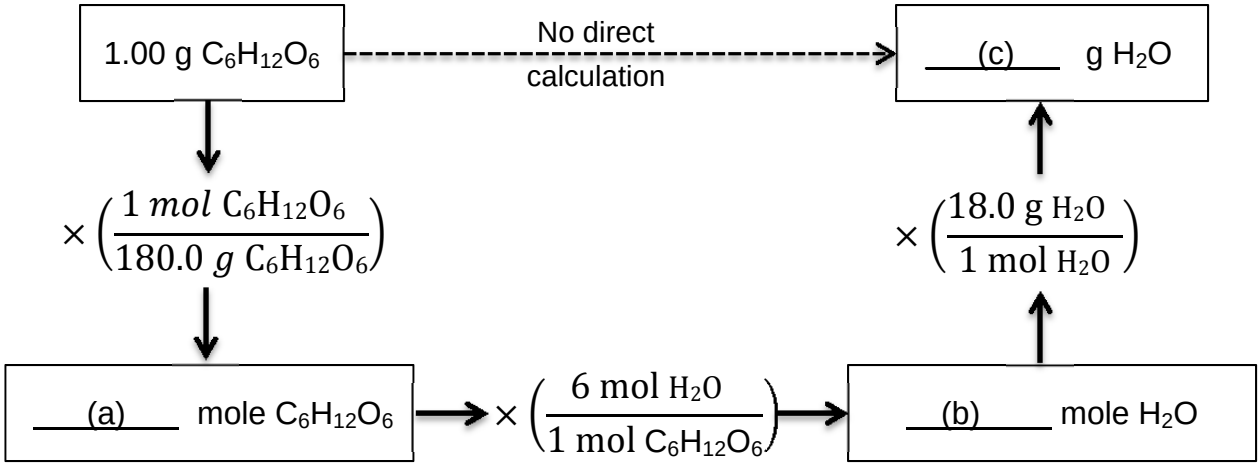
How many grams of glucose can be synthesized from 37.8 g of CO_2 in photosynthesis?	
Given **Find**	**6 CO_2 + 6 H_2O → $C_6H_{12}O_6$+ 6 O_2** 37.8 g CO_2 g $C_6H_{12}O_6$
Conceptual Plan:	g CO_2 ⟹ mol CO_2 ⟹ mol $C_6H_{12}O_6$ ⟹ g $C_6H_{12}O_6$ $\frac{1\ \text{mol}}{44.01\ \text{g}}$ $\frac{1\ \text{mol}\ C_6H_{12}O_6}{6\ \text{mol}\ CO_2}$ $\frac{180.2\ \text{g}}{1\ \text{mol}}$
Relationships:	1 mol $C_6H_{12}O_6$ = 180.2g, 1 mol CO_2 = 44.01g, **1 mol $C_6H_{12}O_6$: 6 mol CO_2**
Solution:	$37.8\ \text{g}\ CO_2 \times \frac{1\ \text{mol}\ CO_2}{44.01\ \text{g}\ CO_2} \times \frac{1\ \text{mol}\ C_6H_{12}O_6}{6\ \text{mol}\ CO_2} \times \frac{180.2\ \text{g}\ C_6H_{12}O_6}{1\ \text{mol}\ C_6H_{12}O_6}$ $= 25.8\ \text{g}\ C_6H_{12}O_6$

How many grams of O_2 can be made from the decomposition of 100.0 g of PbO_2?	
Given **Find**	**2 PbO_2 → 2 PbO + O_2** 100.0 g PbO_2 g O_2
Conceptual Plan:	g PbO_2 ⟹ mol PbO_2 ⟹ mol O_6 ⟹ g O_2 $\frac{1\ \text{mol}}{239.2\ \text{g}}$ $\frac{1\ \text{mol O2}}{2\ \text{mol}\ PbO_2}$ $\frac{32.00\ \text{g}}{1\ \text{mol}}$
Relationships:	1 mol O_2 = 32.00g, 1 mol PbO_2 = 239.2g, **1 mol O_2 : 2 mol PbO_2**
Solution:	$100.0\ \text{g}\ PbO_2 \times \frac{1\ \text{mol}\ PbO_2}{239.2\ \text{g}\ PbO_2} \times \frac{1\ \text{mol}\ O_2}{2\ \text{mol}\ PbO_2} \times \frac{32.00\ \text{g}\ O_2}{239.2\ \text{g}\ PbO_2}$ $= 6.689\ \text{g}\ O_2$

Practice Problems

1. How many grams of water produced in the oxidation of 1.00 g of glucose, $C_6H_{12}O_6$?

$$C_6H_{12}O_6\ (s) + 6\ O_2\ (g) \longrightarrow 6\ CO_2\ (g) + 6\ H_2O\ (l)$$



2. Automotive air bags inflate when sodium azide, NaN3, rapidly decomposes to its component elements;

$$2\ NaN_3\ (s) \longrightarrow 2\ Na\ (s) + 3\ N_2\ (g)$$

(a) How many moles of N_2 are produced by the decomposition of 1.50 mol of NaN_3?

(b) How many grams of NaN_3 are required to form 10.0 g of nitrogen gas?

References:

Tro, Chemistry: A Molecular Approach 2nd ed., Pearson

Brown/LeMay/Bursten, Chemistry: The Central Science, 12th ed., Pearson

Answers

1. (a) 5.56 x 10-3 mol $C_6H_{12}O_6$; (b) 3.33 x 10-3 mol H_2O; (c) 0.600 g H_2O

2. (a) 2.25 mol N_2; (b) 15.5 g NaN_3