

## Chemistry: Stoichiometry

Name \_\_\_\_\_ Hr \_\_\_\_\_

1. How many moles of O<sub>2</sub> should be supplied to burn 1 mol of C<sub>3</sub>H<sub>8</sub> (propane) molecules in a camping stove?

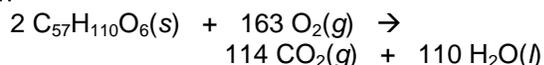
2. How many moles of O<sub>2</sub> molecules should be supplied to burn 1 mol of CH<sub>4</sub> molecules in a domestic furnace?

3. Sodium thiosulfate (Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>), photographer's "hypo" reacts with unexposed silver bromide in the film emulsion to form sodium bromide and a compound of formula Na<sub>5</sub>[Ag(S<sub>2</sub>O<sub>3</sub>)<sub>3</sub>]. How many moles of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> formula units are needed to make 0.10 mol of AgBr soluble?

4. Calculate the mass of alumina (Al<sub>2</sub>O<sub>3</sub>) produced when 100 g of aluminum burns in oxygen.

5. "Slaked lime," Ca(OH)<sub>2</sub>, is formed from "quick-lime" (CaO) by adding water. What mass of water is needed to convert 10 kg of quicklime to slaked lime? What mass of slaked lime is produced?

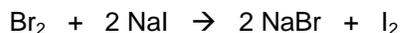
6. Camels store the fat tristearin (C<sub>57</sub>H<sub>110</sub>O<sub>6</sub>) in the hump. As well as being a source of energy, the fat is a source of water, because when it is used the reaction



takes place. What mass of water is available from 1.0 kg of fat?

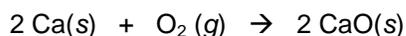
7. The compound diborane (B<sub>2</sub>H<sub>6</sub>) was at one time considered for use as a rocket fuel. How many grams of liquid oxygen would a rocket have to carry to burn 10 kg of diborane completely? (The products of the combustion are B<sub>2</sub>O<sub>3</sub> and H<sub>2</sub>O.)

8. Given the balanced chemical equation

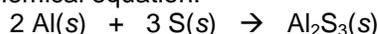


How many moles of sodium bromide (NaBr) could be produced from 0.172 mol of bromine (Br<sub>2</sub>)?

9. How many formula units of calcium oxide (CaO) can be produced from 4.9 x 10<sup>5</sup> molecules of oxygen gas (O<sub>2</sub>) that react with calcium (Ca) according to this balanced chemical equation?



10. Aluminum metal (Al) reacts with sulfur (S) to produce aluminum sulfide (Al<sub>2</sub>S<sub>3</sub>) according to this balanced chemical equation:



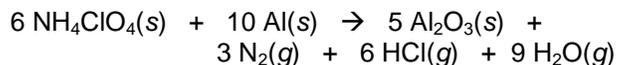
How many atoms of aluminum will react completely with 1.33 x 10<sup>24</sup> atoms of sulfur?

## LIMITING REAGENTS

11. What is the maximum mass of methane (CH<sub>4</sub>) that can be burned if only 1.0 g of oxygen is available?

12. What is the maximum mass of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) that can be burned in 10 g of oxygen?

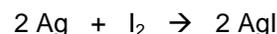
13. The solid fuel in the booster stage of the space shuttle is a mixture of ammonium perchlorate and aluminum powder, which react as follows:



What mass of aluminum should be mixed with 5.0 x 10<sup>3</sup> kg of ammonium perchlorate, if the reaction proceeds as stated?

14. A solution containing 5.0 g of silver nitrate was mixed with another containing 5.0 g of potassium chloride. Which was the limiting reagent for the precipitation of silver chloride?

15. Given the balanced chemical equation



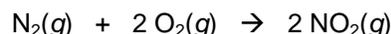
How many atoms of silver metal (Ag) are required to react completely with 531.8 g of iodine (I<sub>2</sub>) to produce silver iodide (AgI)?

16. The theoretical yield of ammonia in an industrial synthesis was 550 tons, but only 480 tons was obtained. What was the percentage yield of the reaction?

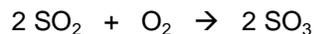
17. Calculate the volume occupied by 16.3 moles of nitrogen gas (N<sub>2</sub>) at STP.

18. How many moles of fluorine gas (F<sub>2</sub>) are contained in 0.269 dm<sup>3</sup> container at STP?

19. Assuming that the gases are all at STP, find the volume of nitrogen dioxide gas (NO<sub>2</sub>) that could be produced from 71.11 dm<sup>3</sup> of nitrogen gas (N<sub>2</sub>) according to this balanced chemical equation.



20. How many moles of oxygen (O<sub>2</sub>) would be needed to produce 79.60 moles of sulfur trioxide (SO<sub>3</sub>) according to the following balanced chemical equation?



21. How many grams of water will be produced from 50 g hydrogen reacting with 50 g oxygen?

Think Critically

22. The reaction of 1 mol of C to form carbon monoxide in the reaction  $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$  releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according to the above information?

23. According to the balanced chemical equation; how many atoms of silver will be produced from combining 100 g of copper with 200 g of silver nitrate?



24. According to the balanced chemical equation; how many moles of  $\text{SO}_2\text{(g)}$  will be produced when  $1.5 \times 10^8$  molecules of zinc sulfide react with  $1000\text{ dm}^3$  of oxygen gas? Assume a 75% yield.



25. I need to produce 500 g of lithium oxide( $\text{Li}_2\text{O}$ )
- how many grams of Lithium AND
  - how many liters of oxygen do I need

The balanced equation is:  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$

26. How many grams of water will be produced from 50 g hydrogen reacting with 50 g oxygen?

Think Critically:

22. The reaction of 1 mol of C to form carbon monoxide in the reaction  $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$  releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according to the above information?

23. According to the balanced chemical equation; how many atoms of silver will be produced from combining 100 g of copper with 200 g of silver nitrate?



24. According to the balanced chemical equation; how many moles of  $\text{SO}_2\text{(g)}$  will be produced when  $1.5 \times 10^8$  molecules of zinc sulfide react with  $1000\text{ dm}^3$  of oxygen gas? Assume a 75% yield.



25. I need to produce 500 g of lithium oxide( $\text{Li}_2\text{O}$ )
- how many grams of Lithium AND
  - how many liters of oxygen do I need

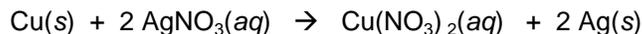
The balanced equation is:  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$

26. How many grams of water will be produced from 50 g hydrogen reacting with 50 g oxygen?

Think Critically:

22. The reaction of 1 mol of C to form carbon monoxide in the reaction  $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$  releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according to the above information?

23. According to the balanced chemical equation; how many atoms of silver will be produced from combining 100 g of copper with 200 g of silver nitrate?



24. According to the balanced chemical equation; how many moles of  $\text{SO}_2\text{(g)}$  will be produced when  $1.5 \times 10^8$  molecules of zinc sulfide react with  $1000\text{ dm}^3$  of oxygen gas? Assume a 75% yield.



25. I need to produce 500 g of lithium oxide( $\text{Li}_2\text{O}$ )
- how many grams of Lithium AND
  - how many liters of oxygen do I need

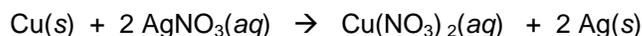
The balanced equation is:  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$

26. How many grams of water will be produced from 50 g hydrogen reacting with 50 g oxygen?

Think Critically:

22. The reaction of 1 mol of C to form carbon monoxide in the reaction  $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$  releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according to the above information?

23. According to the balanced chemical equation; how many atoms of silver will be produced from combining 100 g of copper with 200 g of silver nitrate?



24. According to the balanced chemical equation; how many moles of  $\text{SO}_2\text{(g)}$  will be produced when  $1.5 \times 10^8$  molecules of zinc sulfide react with  $1000\text{ dm}^3$  of oxygen gas? Assume a 75% yield.



25. I need to produce 500 g of lithium oxide( $\text{Li}_2\text{O}$ )
- how many grams of Lithium AND
  - how many liters of oxygen do I need

The balanced equation is:  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$

26. How many grams of water will be produced from 50 g hydrogen reacting with 50 g oxygen?

### Think Critically

22. The reaction of 1 mol of C to form carbon monoxide in the reaction  $2\text{C(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CO(g)}$  releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according to the above information?

23. According to the balanced chemical equation; how many atoms of silver will be produced from combining 100 g of copper with 200 g of silver nitrate?



24. According to the balanced chemical equation; how many moles of  $\text{SO}_2\text{(g)}$  will be produced when  $1.5 \times 10^8$  molecules of zinc sulfide react with  $1000\text{ dm}^3$  of oxygen gas? Assume a 75% yield.



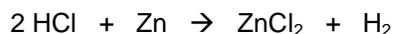
25. I need to produce 500 g of lithium oxide ( $\text{Li}_2\text{O}$ )
- how many grams of Lithium AND
  - how many liters of oxygen do I need

The balanced equation is:  $\text{Li} + \text{O}_2 \rightarrow \text{Li}_2\text{O}$

26. A tin ore contains 3.5%  $\text{SnO}_2$ . How much tin is produced by reducing 2.0 kg of the ore with carbon?

$$\text{SnO}_2 + \text{C} \rightarrow \text{Sn} + \text{CO}_2$$

27. If 36.5 g of HCl and 73 g of Zn are put together:



- Determine which reactant is the limiting reactant,
- Find the mass of  $\text{ZnCl}_2$  formed,
- Find the volume of  $\text{H}_2$  (@ STP) formed,
- Determine which reactant is in excess and by how much.

28. Many plants synthesize glucose by photosynthesis as follows:



- Write a balanced equation for this process,
- How many molecules of water are needed to make one molecule of glucose?
- How many liters of oxygen (@STP) are given off when 2.50 mol of glucose is synthesized?
- How many moles of  $\text{CO}_2$  are needed for a plant to make 2.50 mole of glucose?
- How many carbon atoms are used to produce 2.50 mole of glucose?
- How many  $\text{dm}^3$  of oxygen gas are produced from  $9.32\text{ dm}^3$  of  $\text{CO}_2$  (all @ STP)?

29. Assume that the human body requires daily energy that comes from metabolizing 816 g of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , using the following reaction:  
$$\text{C}_{12}\text{H}_{22}\text{O}_{11}\text{(s)} + 12\text{O}_2\text{(g)} \rightarrow 12\text{CO}_2\text{(g)} + 11\text{H}_2\text{O(l)} + \text{energy}$$

How many  $\text{dm}^3$  of pure oxygen (@ STP) is consumed by a human being in 24 hours?

30. A student has a mixture of  $\text{KClO}_3$ ,  $\text{K}_2\text{CO}_3$ , and  $\text{KCl}$ . She heats 50 g of the mixture and determines that 5 g  $\text{O}_2$  and 7 g  $\text{CO}_2$  are produced by these reactions:



$\text{KCl}$  is not affected by the heat. What is the percent composition of the original mixture?

### ANSWERS:

- 5 mol  $\text{O}_2$
- 2 mol  $\text{O}_2$
- 0.3 mol  $\text{Na}_2\text{S}_2\text{O}_3$
- 189 g  $\text{Al}_2\text{O}_3$
- 3214 g  $\text{H}_2\text{O}$  and 13.2 kg slaked lime [ $\text{Ca(OH)}_2$ ]
- 998 g water
- 34,783 g  $\text{O}_2$
- 0.344 mol  $\text{NaBr}$
- $9.8 \times 10^5$  molecules  $\text{CaO}$
- $8.9 \times 10^{23}$  atoms  $\text{Al}$
- 0.25 g  $\text{CH}_4$
- 9.375 g  $\text{C}_6\text{H}_{12}\text{O}_6$
- 1915 kg  $\text{Al}$
- silver nitrate
- $2.5 \times 10^{24}$  atoms  $\text{Ag}$
- 87.3 % yield
- 365 L  $\text{N}_2$
- 0.012 mol  $\text{F}_2$
- 142 L  $\text{NO}_2$
- 39.8 mol  $\text{O}_2$
- 56.25 g  $\text{H}_2\text{O}$
- 942,000 J
- $7.1 \times 10^{23}$  atoms  $\text{Ag}$
- $1.9 \times 10^{-16}$  mol (NOT  $2.5 \times 10^{-16}$  mol: 75% Yield)
- 25a. g  $\text{Li}$     b. L  $\text{O}_2$
- 26.
- 27a.                    b.                    c.                    d.
- 28a.    b. 6    c. 336    d. 15    e.  $9 \times 10^{24}$     f. 9.32
29. 641 L  $\text{O}_2$
30. 15.2 g  $\text{KCl}$