Chemistry: *Stoichiometry*

1. How many moles of O2 should be supplied to

burn 1 mol of C3H8 (propane) molecules in a camping stove?

1. How many moles of O2 molecules should be

supplied to burn 1 mol of CH4 molecules in a domestic furnace?

1. Sodium thiosulfate (Na2S2O3), photographer’s

“hypo” reacts with unexposed silver bromide in the film emulsion to form sodium bromide and a compound of formula Na5[Ag(S2O3) 3]. How many moles of Na2S2O3 formula units are needed to make 0.10 mol of AgBr soluble?

1. Calculate the mass of alumina (Al2O3)

produced when 100 g of aluminum burns in oxygen.

1. “Slaked lime,” Ca(OH) 2, 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?

1. Camels store the fat tristearin (C57H110O6) 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

2 C57H110O6(*s*) + 163 O2(*g*) 🡪

114 CO2(*g*) + 110 H2O(*l*)

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

1. The compound diborane (B2H6) 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 B2O3 and H2O.)

1. Given the balanced chemical equation

Br2 + 2 NaI 🡪 2 NaBr + I2

How many moles of sodium bromide (NaBr) could be produced from 0.172 mol of bromine (Br2)?

1. How many formula units of calcium oxide

(CaO) can be produced from 4.9 x 105 molecules of oxygen gas (O2) that react with calcium (Ca) according to this balanced chemical equation?

2 Ca(*s*) + O2 (*g*) 🡪 2 CaO(*s*)

1. Aluminum metal (Al) reacts with sulfur (S) to

produce aluminum sulfide (Al2S3) according to this balanced chemical equation:

2 Al(*s*) + 3 S(*s*) 🡪 Al2S3(*s*)

How many atoms of aluminum will react completely with 1.33 x 1024 atoms of sulfur?

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LIMITING REAGENTS

1. What is the maximum mass of methane (CH4)

that can be burned if only 1.0 g of oxygen is available?

1. What is the maximum mass of glucose

(C6H12O6) 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:

6 NH4ClO4(*s*) + 10 Al(*s*) 🡪 5 Al2O3(*s*) +

3 N2(*g*) + 6 HCl(*g*) + 9 H2O(*g*)

What mass of aluminum should be mixed with 5.0

x 103 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?

1. Given the balanced chemical equation

2 Ag + I2 🡪 2 AgI

How many atoms of silver metal (Ag) are required to react completely with 531.8 g of iodine (I2) 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?

1. Calculate the volume occupied by 16.3 moles of

nitrogen gas (N2) at STP.

1. How many moles of fluorine gas (F2) are

contained in 0.269 dm3 container at STP?

1. Assuming that the gases are all at STP, find the

volume of nitrogen dioxide gas (NO2) that could be produced from 71.11 dm3 of nitrogen gas (N2) according to this balanced chemical equation.

N2(*g*) + 2 O2(*g*) 🡪 2 NO2(*g*)

1. How many moles of oxygen (O2) would be

needed to produce 79.60 moles of sulfur trioxide (SO3) according to the following balanced chemical equation?

2 SO2 + O2 🡪 2 SO3

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 C(s) + O2(g) 🡪 2 CO(g) releases 113 kJ of heat. How much heat will be released by the combustion of 100 g of C according the the above information?

1. 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?

Cu(*s*) + 2 AgNO3(*aq*) 🡪 Cu(NO3) 2(*aq*) + 2 Ag(*s*)

1. According to the balanced chemical equation;

how many moles of SO2(g) will be produced when 1.5 x 108 molecules of zinc sulfide react with 1000 dm3 of oxygen gas? Assume a 75% yield.

2 ZnS(*s*) + 3 O2 (*g*) 🡪 2 ZnO(*s*) + 2 SO2(*g*)

1. I need to produce 500 g of lithium oxide(Li2O)
   1. how many grams of Lithium AND
   2. how many liters of oxygen do I need

The balanced equation is: Li + O2 🡪 LiO2

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24. According to the balanced chemical equation;

how many moles of SO2(g) will be produced when 1.5 x 108 molecules of zinc sulfide react with 1000 dm3 of oxygen gas? Assume a 75% yield.

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25. I need to produce 500 g of lithium oxide(Li2O)

* 1. how many grams of Lithium AND
  2. how many liters of oxygen do I need

The balanced equation is: Li + O2 🡪 LiO2

26. A tin ore contains 3.5% SnO2. How much tin is produced by reducing 2.0 kg of the ore with carbon?

SnO2 + C 🡪 Sn + CO2

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

2 HCl + Zn 🡪 ZnCl2 + H2

* 1. Determine which reactant is the limiting reactant,
  2. Find the mass of ZnCl2 formed,
  3. Find the volume of H2 (@ STP) formed,
  4. Determine which reactant is in excess and by how much.

28. Many plants synthesize glucose by photosynthesis as follows:

CO2(*g*) + H2O(*l*) + energy 🡪 C6H12O6(*s*) + O2(*g*)

1. Write a balanced equation for this process,
2. How many molecules of water are needed to make one molecule of glucose?
3. How many liters of oxygen (@STP) are given off when 2.50 mol of glucose is synthesized?
4. How many moles of CO2 are needed for a plant to make 2.50 mole of glucose?
5. How many carbon atoms are used to produce 2.50 mole of glucose?
6. How many dm3 of oxygen gas are produced from 9.32 dm3 of CO2 (all @ STP)?

29. Assume that the human body requires daily energy that comes from metabolizing 816 g of sucrose, C12H22O11, using the following reaction:

C12H22O11(*s*) + 12 O2(*g*) 🡪 12 CO2(*g*) +

11 H2O(*l*) + energy

How many dm3 of pure oxygen (@ STP) is consumed by a human being in 24 hours?

30. A student has a mixture of KClO3, K2CO3, and KCl. She heats 50 g of the mixture and determines that 5 g O2 and 7 g CO2 are produced by these reactions:

2 KClO3(*s*) 🡪 2 KCl(*s*) + 3 O2(*g*)

K2CO3(*s*) 🡪 K2O(*s*) + CO2(*g*)

KCl is not affected by the heat. What is the percent composition of the original mixture?

**ANSWERS**:

1. 5 mol O2

2. 2 mol O2

3. 0.3 mol Na2S2O3

4. 189 g Al2O3

5. 3214 g H2O and 13.2 kg slaked lime [Ca(OH) 2]

6. 998 g water

7. 34,783 g O2

8. 0.344 mol NaBr

9. 9.8 x 105 molecules CaO

10. 8.9 x 1023 atoms Al

11. 0.25 g CH4

12. 9.375 g C6H12O6

13. 1915 kg Al

14. silver nitrate

15. 2.5 x 1024 atoms Ag

16. 87.3 % yield

17. 365 L N2

18. 0.012 mol F2

19. 142 L NO2

20. 39.8 mol O2

21. 56.25 g H2O

22. 942,000 J

23. 7.1 x 1023 atoms Ag

24. 1.9 x 10-16mol (NOT 2.5 x 10-16mol: 75% Yield)

25a. g Li b. L O2

26.

27a. b. c. d.

28a. b. 6 c. 336 d. 15 e. 9 x 1024 f. 9.32

29. 641 L O2

30. 15.2 g KCl