Chemistry 20	Unit 4
Lesson 3 - Gas Stoichiometry	84 mins

Gas Stoichiometry

- gas volume, pressure and temperature, molar volume, and the ideal gas law PV = nRT 760.000 mmHg = 101.325 kPa = 1.00000 atm R = 8.31451 LkPa/molK STP = 0.00 °C, 101.325 kPa SATP = 25.00 °C, 100.00 kPa	If 275 g of propane burns in a gas barbecue, what volume of oxygen measured at STP is required for the reaction? $C_3H_{8(g)}$ + 5 $O_{2(g)}$ → 3 $CO_{2(g)}$ + 4 $H_2O_{(g)}$ 275 g $44.11 g/mol$ V = ?? 32.00 g/mol $n_{C3H8} = 275g \times \frac{1\ mol}{44.11 g/mol} = 6.23\ mol$ $n_{O2} = 6.23\ mol \times \frac{5\ mol\ of\ O2}{1\ mol\ of\ C3H8} = 31.2\ mol$ $V_{O2} = \frac{nRT}{P} = \frac{31.2\ mol \times 8.31451 \times 273.15K}{101.325\ kPa} = 699\ L$

Gravimetric and Gas Stoichiometry Overview

1. Write a balanced chemical equation and list the measurements, unknown quantity symbol, and conversion factors for the measured and required substances. 2. Convert the measured quantity to a chemical amount using the appropriate conversion factor. 3. Calculate the chemical amount of the required substance using the mole ratio from the balanced equation. 4. Convert the calculated chemical amount to the final quantity requested using the appropriate conversion factor.	A typical Alberta home heated with natural gas (assume methane, $CH_{4(g)}$) consumes 2.00 ML of natural gas during the month of December. What volume of oxygen at SATP is required to burn 2.00 ML of methane measured at 0 °C and 120 kPa? $CH_{4(g)}$ + 2 $O_{2(g)}$ → $CO_{2(g)}$ + 2 $H_2O_{(g)}$ 2.00 ML = $2.00 \times 10^6 L$ M = 16.05 g/mol V = ??? M = 32.00g/mol $n_{CH4} = \frac{PV}{RT} = \frac{(120 kPa)(2.00 \times 10^6 L)}{(8.31451)(273.15K)} = 1.06 \times 10^5 mol$ $n_{O2} = 1.06 \times 10^5 mol \times \frac{2\ mol\ of\ O2}{1\ mol\ of\ CO2} = 2.11 \times 10^5 mol$ $V_{O2} = \frac{nRT}{P} = \frac{(2.11 \times 10^5 mol)(8.31451)(298.15K)}{(100.00\ kPa)} = 5.24 \times 10^6 L = 5.24\ ML$

Chemistry 20 - Unit 4 - Gas Stoichiometry

Name: _____

1.00000 atm = 760.000 mmHg = 101.325 kPa R = 8.314 (L*kPa)/(K*mol) pV = nRT $\quad T_K = T_{°C} + 273.15$

1) A balanced chemical equation includes simple coefficients in front of the chemical formulas.
    a) What do these coefficients represent?

    b) What is the term for the overall relationship of chemical amounts of all reactants and products?

2) A chemical laboratory technician plans to react 3.50 g of lead(II) nitrate with excess potassium bromide in solution. Predict the mass of precipitate expected.

3) When calculating a percent yield for a reaction, where do the values for the actual yield and for the predicted yield come from?

4) A solution made by dissolving 9.8 g of barium chloride is to be completely reacted with 2.00 L of 0.127M sodium sulfate solution containing dissolved sodium sulfate.
    a) Predict the mass of precipitate expected.

If 10.0 g of precipitate actually formed, calculate the percent yield.	Does the percent yield result indicate the reaction went as expected?

5) What volume of oxygen at STP is needed to completely burn 15 g of methanol in a fondue burner?

6) As recently as the early 20th century, pinches of sulfur were sometimes burned in sickrooms. The pungent choking fumes produced were supposed to be effective against the “evil humours” of the disease. In fact, the sulfur dioxide gas produced is toxic and extremely irritating to lung tissue, where it dissolves to form sulfurous acid. Even today, a surprising number of people still believe that medicines are more likely to be effective if they have unpleasant tastes or odours.

   a) What volume of $SO_{2(g)}$ at SATP will be produced from the burning of 1.0g of sulfur?

7) When 340.8 grams of ammonia ($NH_{3(g)}$) combusts, it produces the highly toxic $NO_{2(g)}$ and $H_2O_{(g)}$.

   a) Write a balanced chemical equation detailing this reaction.

   b) Calculate how many moles of ammonia combust.

   c) If this reaction takes place at a pressure of 100.0 kPa and a temperature of 35.85 °C, what volume of nitrogen dioxide is produced?