Chemistry 20	Unit 2
Lesson 8 - Ideal Gas Law	84 mins

Ideal Gas Law

Real Gas	Ideal Gas
- Have Mass - Have forces of Attraction - Move in curved lines - Have inelastic collisions	- Have no (point) mass - Have no forces of Attraction - Move in straight lines - Have perfectly elastic collisions

The ideal gas law is the equation of state of a hypothetical ideal gas. It is a good approximation to the behaviour of many gases under many conditions, although it has several limitations. It was first stated by Emile Clapeyron in 1834 as a combination of Boyle's law and Charles's law and Avogadro's Hypothesis.

Avogadro and Moles

$6.02 \times 10^{23}\ molecules\ = 1\ mole$	Example: Moles of CH_3OH in 0.250 g $m = Mn$ $n = m/M = (0.250\ g) \times (1\ mol/32.05\ g) = 0.00780\ moles$ $= 7.80 \times 10^{-3}\ moles\ or\ 7.80\ mmol$

Formula

At the same temperature and pressure, the same number of moles will occupy the same volume of space. Applications: - Hot Air Balloon - Lungs	$PV = nRT$ $R = the\ ideal\ gas\ CONSTANT$ GENERALLY: $8.31451\ LkPa/molK$ Can be: $8.31451\ J/molK$ $0.0820578\ Latm/molK$ $62.364\ LmmHg/molK$

Chemistry 20 - Unit 2 - Ideal Gas Law

Name: _____

You may find the following formulas and constants useful:

$$PV = nRT$$

760.000 mmHg = 101.325 kPa = 1.00000 atm

1000 mL = 1.000 L

$R = 8.31451\ LkPa/molK$ ← NOTE UNITS

$m = Mn$ $d = \frac{m}{V}$

1. What is the volume of 2.50 mol of methane gas (CH_4) at 25.0 C and 95.00 kPa?

2. What is the mass of 3302.94 mL of carbon dioxide at 30.0 C and 194 kPa?

3. What is the volume of 33.25 g of butane gas (C_4H_{10}) at -253.99 C and 10.934 kPa?

4. To what temperature must 23.840 g of hydrogen gas be heated at 120.00 kPa to occupy a volume of 345 L?

5. What is the mass of 39.88 L of oxygen gas at 39.84 C and 93.48 kPa?

6. What is the mass of 210.0 mL of gas assuming it is oxygen at SATP?

7. What is the molar mass of 214 g of gas, requiring a volume of 19.03 L at STP?

8. If a steel cylinder with a volume of 1.50 L containers 10.0 moles of oxygen, under what pressure is the oxygen, if the temperature is 27.0 C?

9. A gas was found to have a density of 1.76 mg/L at 24.0 C and a pressure of 98.8 kPa. What is its molecular mass? (Reminder: $d = \frac{m}{V}$)

10. How many millilitres of nitrogen, N_2, would have to be collected at 99.19 kPa and 28 C to have a sample containing 0.015 moles of N_2?

11. The pressure exerted on a diver by the water increases by about 100 kPa for every 10 m of depth. A scuba diver uses air at the rate of 8 L/min at a depth of 10 m where the pressure is 200 kPa (100 kPa due to the atmosphere and 100 kPa due to the water pressure) and a temperature of 8 C. If the diver's 10 L air tank is filled to a pressure of $2.1 \times 10^4\ kPa$ at a dockside temperature of 32 C, how long can the diver remain safely submerged?

12. You want to send chlorine gas, Cl_2, safely from Edmonton to LLB. Chlorine gas is very poisonous and corrosive. You have a 500 L truck cylinder that will withstand a pressure of 100 atm. The cylinder will be kept at 2.00 C throughout the trip. How many moles of chlorine gas can you safely ship?

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$m = Mn$ $d = \frac{m}{V}$

1. A mixture of nitrogen and neon gases contains equal moles of each gas and has a total mass of 10.0 g. What is the density of this gas mixture at 500 K and 15.0 atm? Assume ideal gas behavior.
2. 20.0 g each of helium and an unknown diatomic gas are combined in a 1500. mL container. If the temperature is 298 K, and the pressure inside is 86.11 atm, what is the unknown gas?
3. Three 1.00 L flasks at 25.0 °C and 1013 hPa pressure contain: CH_4 (flask A), CO_2 (flask B) and NH_3 (flask C). Which flask (or none) contains 0.041 mol of gas?

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