CHEMISTRY

GAS LAWS - PART 4

THE IDEAL GAS LAW

Avogadro (*the guy that came up with the mole*) took a look at the works done by Boyle, Charles, and Gay-Lussac and added his mole ideas to their gas equations.

As it turns out, there is a relationship between moles and volume. The higher the volume of gas, the higher the amount of moles there are; A ***DIRECT*** Relationship.

$$V \alpha n$$

Recall: $V \alpha \frac{1}{P}$ ***and*** $V \alpha T$

Therefore: $V \alpha \frac{nT}{P}$

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$$V \alpha \frac{nT}{P}$$

Rearranging this relationship we get the following equation …

$$\frac{PV}{nT} = number$$

Since all gasses act in the same way, it turns out that every time this equation was performed, the same number kept coming out. That number is called the ***universal gas constant (R)*** and is equal to:

$$\boldsymbol{R = 8.314\ \frac{kPa \cdot L}{mol \cdot K}}$$

So …

$$\frac{PV}{nT} = 8.314 \qquad \frac{PV}{nT} = R$$

Rearrange …

$$PV = nRT$$

The Ideal Gas Law !!!

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Ex: *A cylinder of laughing gas (N_2O) has a volume of 58 L. The pressure is 108 kPa and the temperature is 294 K.*

a) *How many moles of laughing gas are in the tank?*

b) *How many grams of laughing gas are in the tank?*

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Possible Test/Exam Question???

A hydrocarbon gas used for fuel contains the elements carbon and hydrogen in percentages of 82.66% and 17.34%. Some of the gas, 1.77 g, was trapped in a 750 mL round-bottom flask.The gas was collected at a temperature of 22.1°C and a pressure of 99.7 kPa.

a. Determine the empirical formula for this gas.

b. Calculate the molar mass of the gas.

c. Determine the molecular formula for this gas.

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Pg. 556

Practice Problems

21. What is the volume of 5.65 mol of helium gas at a pressure of 98 kPa and a temperature of 18.0°C?

22. Propane, C_3H_8, is a common gas used to supply energy for barbecue cookers as well as energy-requiring appliances in cabins and cottages, and heavy equipment such as the forklift shown in the photograph below. If a tank contains 20.00 kg of propane, what volume of propane gas could be supplied at 22°C and 100.5 kPa?

Forklift trucks that run on propane are alternatives to those that run on gasoline or diesel fuel.

23. Find the Celsius temperature of nitrogen gas if a 5.60 g sample occupies 2.40×10^3 mL at 3.00 atm of pressure.

24. What is the pressure of 3.25 mol of hydrogen gas that occupies a volume of 67.5 L at a temperature of 295 K?

25. A weather balloon filled with helium gas has a volume of 960 L at 101 kPa and 25°C. What mass of helium was required to fill the balloon?

26. Find the molar mass of 6.24 g of an unknown gas that occupies 2.5 L at 18.3°C and 100.5 kPa.

27. A scientist isolates 2.366 g of a gas. The sample occupies a volume of 8.00×10^2 mL at 78.0°C and 103 kPa. Calculate the molar mass of the gas. Is the gas most likely to be bromine, krypton, neon, or fluorine?

28. What is the density of carbon dioxide gas, in grams per litre, at SATP?

29. A hydrocarbon gas used for fuel contains the elements carbon and hydrogen in percentages of 82.66 percent and 17.34 percent. Some of the gas, 1.77 g, was trapped in a 750 mL round-bottom flask. The gas was collected at a temperature of 22.1°C and a pressure of 99.7 kPa.

a. Determine the empirical formula for this gas.

b. Calculate the molar mass of the gas.

c. Determine the molecular formula for this gas.

30. A 10.0 g sample of an unknown liquid is vaporized at 120.0°C and 5.0 atm. The volume of the vapour is found to be 568.0 mL. The liquid is determined to be made up of 84.2% carbon and 15.8% hydrogen. What is the molecular formula of the liquid?

21. 140 L
22. 11 L
23. 166°C
24. 118 kPa
25. 160 g
26. 60 g/mol
27. 83.8 g/mol; element is most likely krypton
28. 1.77 g/L
29. a. C_2H_5
b. 58.1 g/mol
c. C_4H_{10}
30. C_8H_{18}