- **1 Mole [mol]** of any substance contains the same number of molecules , called **Avogadro Number:**

$$N_A \approx 6.02 \cdot 10^{23} \frac{1}{mol}$$

- Molar Mass, **μ [g/mol]** is the mass of 1 mole of a given substance. To find it, you need to add up **atomic weights** of all the atoms in a single molecule. Those can be found in Periodic Table.

Example:

$$\mu_{H_20} = (2+16)\frac{g}{mol} = 18\frac{g}{mol}$$

	Volume	Mass	Amount of Substance	Number of Molecules
Symbol	**V**	**M**	**n**	**N**
Units	[m^3] or [cm^3]	[kg] or [g]	[mol]	**1**

$$\rho = \frac{M}{V}$$

Greek 'rho'

$$n = \frac{M}{\mu}$$

Greek 'mu'

$$\nu = \frac{N}{N_A}$$

Ideal Gas Law

$$PV = nRT$$

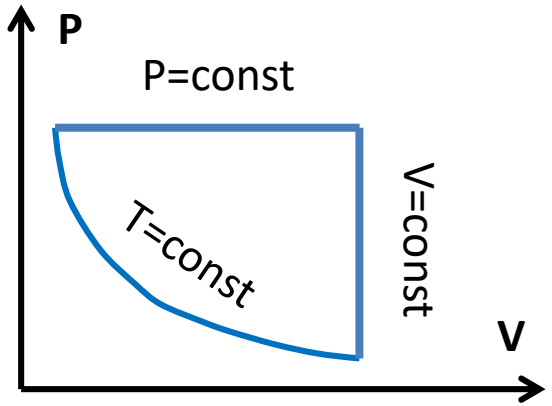
Here $n = \frac{m}{\mu}$ is amount of substance (in moles),

$R \approx 8.3 \frac{J}{mol \cdot K}$ is called Universal Gas Constant.

Boyle's Law:
PV=const when T=const

Charles's Law:
V/T=const when P=const

Gay-Lussac's Law:
P/T=const when V=const



P-V diagram

Homework

Problem 1 An air bubble in water had volume V= 10 ml at depth h=20m. Find its volume right before the bubble reaches the surface. Assume the temperature of the air inside to be constant (typically, not true!).

Problem 2 Density of a gas is ρ_0 at temperature T_0 (in Kelvin). Find the density at temperature T, and the same pressure.

Problem 3 Suppose you know density ρ (in g/ml) and molar mass μ (in g/mol) for certain substance. Find how many molecules are contained in volume V of this substance (you need to derive a general formular). Using this formula, determine how many molecules are there in V= 100 ml of each of the materials in the table (you will need to consult the Periodic table to find μ):

Substance	ρ (g/ml)	μ (g/mol)	# of molecules in V = 100 ml
liquid water, H_20	1		
liquid propane, C_3H_8	0.5		
Calcite (chalk)	2.7		
Aluminum*, Al	2.7		
Gold*, Au	19.3		