Thermo Intro

temperature

Fahrenheit

Celcius

Rankine

Kelvin

Room temp 20°C (~70°F)

↓

293K

$\Delta F = \frac{9}{5}\Delta C$

$T_F = \frac{9}{5}T_C + 32$

$T_K = T_C + 273.15$

Number, moles, molar mass, density

1 mole of things = $6.022 \cdot 10^{23}$ things

particle

atom

molecule

$N \rightarrow$ number of particles

$n \rightarrow$ number of moles

C^{12} → 12 protons and neutrons

→ 6 protons

1 mole is a gram of protons and neutrons

Ex. mass of one proton?

mass of one proton × number of proton = mass of collection

M → total mass of a collection

m → mass of one particle

$$m \times N = M$$

$$m = \frac{M}{N} = \frac{1 \text{ gram}}{N_A}$$

N_A → Avogadro's number $6.022 \cdot 10^{23}$

$$m = 1.7 \cdot 10^{-24} \text{ grams}$$

$$= 1.7 \cdot 10^{-27} \text{ kg}$$

What about N_2?

$$1 \text{ mole of } N_2 = 2 \cdot \left(14 \frac{g}{mol}\right) = 28\, g$$

Dry air?

78% N_2, 21% O_2, 1% Ar

$$0.78 \cdot \left(28 \frac{g}{mol}\right) + 0.21\left(32 \frac{g}{mol}\right) + 0.01\left(40 \frac{g}{mol}\right) = 29 \frac{g}{mol}$$

Ideal Gas Law → an equation of state
↳ state variables

- experimental law

number of particles (microscopic)

$$PV = Nk_BT$$

Boltzmann's constant

$$k_B = 1.38 \cdot 10^{-23} \frac{J}{K}$$

$P = \frac{F}{Area}$ $[Pa] = \left[\frac{N}{m^2}\right]$ $[m^3]$ Temperature $[K]$

Alternative form → $PV = nRT$ (macroscopic)

↳ universal gas constant

$$N k_B = n \cdot R$$

$$N = n \cdot N_A \leftarrow \text{definition of moles}$$

$$n \cdot N_A \cdot k_B = n \cdot R$$

$$N_A \cdot k_B = R = 6.022 \cdot 10^{23} \frac{\text{part}}{\text{mol}} \; 1.38 \cdot 10^{-23} \frac{J}{K}$$

$$R = 8.31 \frac{J}{K \cdot \text{mol}}$$

Volume of 1 mole of air at room temp and atmospheric pressure

↳ 293K or 300K ↳ 1 atm = $1.013 \cdot 10^5$ Pa

$$V = \frac{nRT}{P} = \frac{1\,\text{mol} \cdot 8.31\,J/K\text{mol} \cdot 300K}{10^5\,Pa} = 0.024\,m^3$$