
Free particles: the nature of gases

GAS

- no volume nor shape
- moleculs move undisturbed
- GAS PRESSURE – the average force per unit area that the gas exerts on the surface of the container (Pa = N/m^2)
- ideal gas – there is no attraction forces between molecules, molecular volume is negligible
- under conditions on Earth, gases behave ideally and equally:

  V ~ n p, T const.

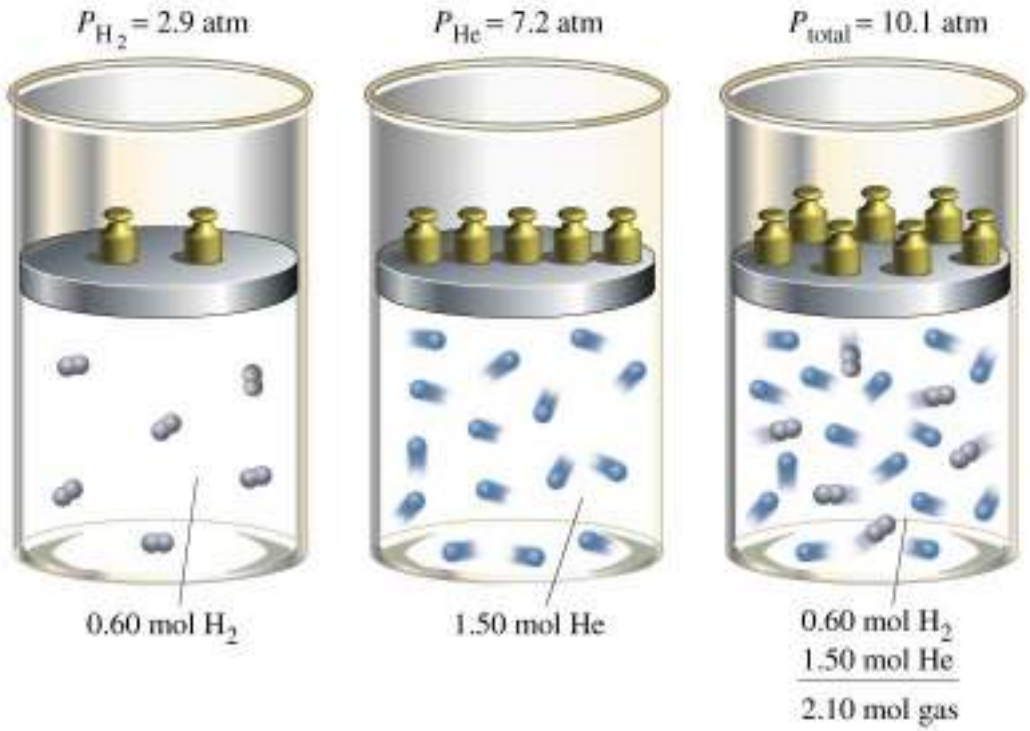
  V ~ 1/p n, T const.

  v ~ T n, p const.

$p V = n R T$ R = 8,314 J/Kmol

Mixture of gases

- MIXTURE OF GASES – The pressure of a mixture of gases is equal to the sum of the pressures of all of the constituent gases alone



Kinetic theory of gases

$$\overline{E}_k = \frac{m\overline{v}^2}{2}$$ T = const.

$\overline{E}_k$ .. mean kin. energy of particles, m ..particle mass, $\overline{v}^2$ …mean velocity of particle

$$\overline{E}_k = \frac{3}{2}kT$$ m = const.

k ..Boltzmann constant; $1{,}38 \cdot 10^{-23}$ JK^{-1}

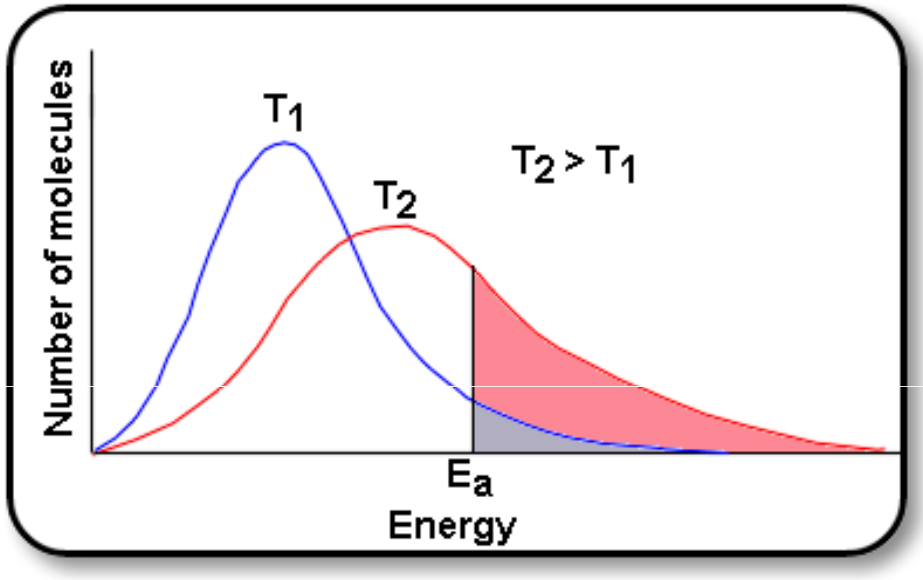
$$\frac{m\overline{v}^2}{2} = \frac{3}{2}kT$$

$$\overline{v} = \sqrt{\frac{3kT}{m}}$$ m ~ M

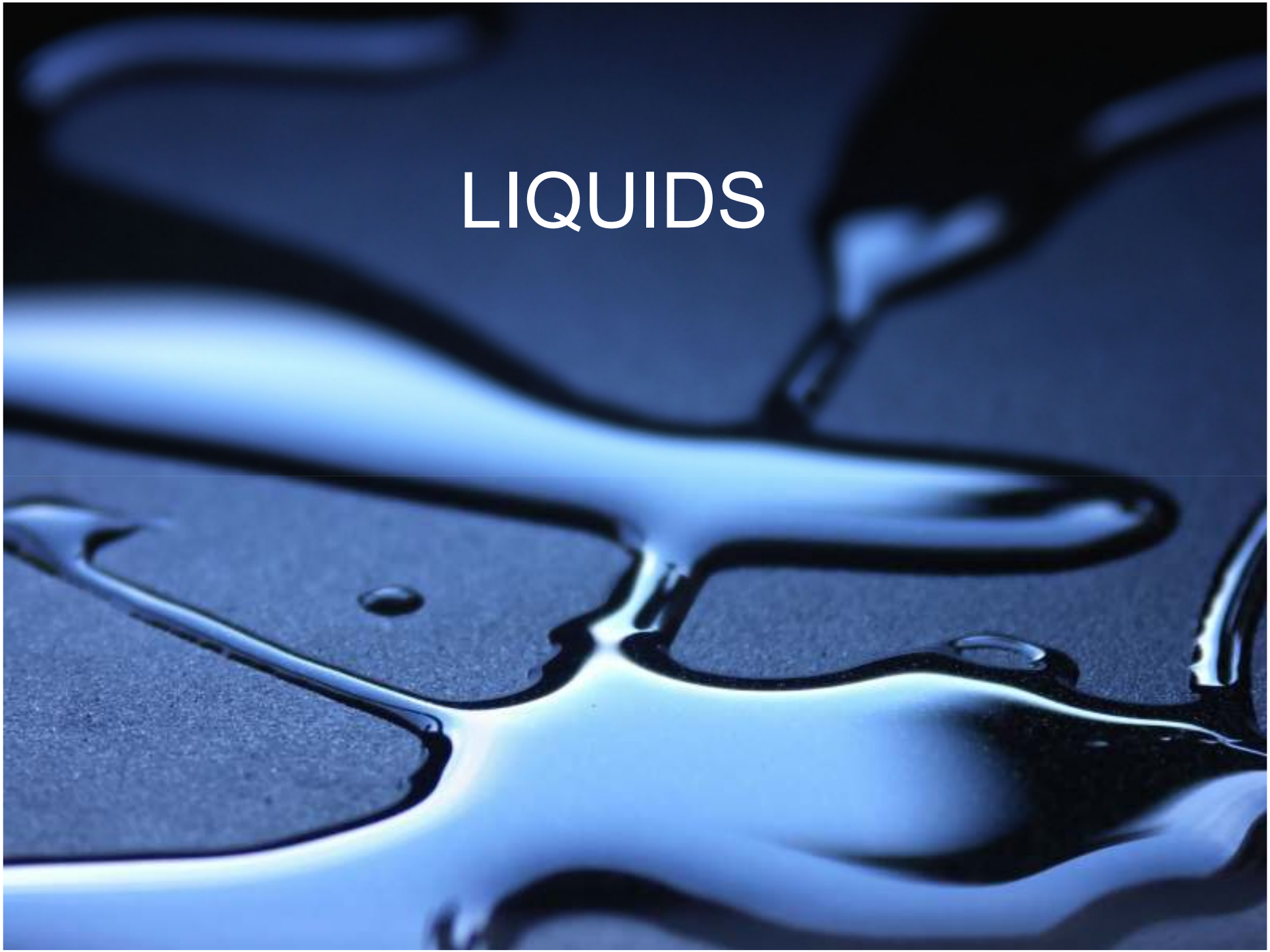
Graham's law applies for the movement of molecules A and B:

$$\frac{v(B)}{v(A)} = \sqrt{\frac{M(A)}{M(B)}}$$ T = const., p = const.

Maxwell-Boltzmann distribution for speed of particle constituting the gas

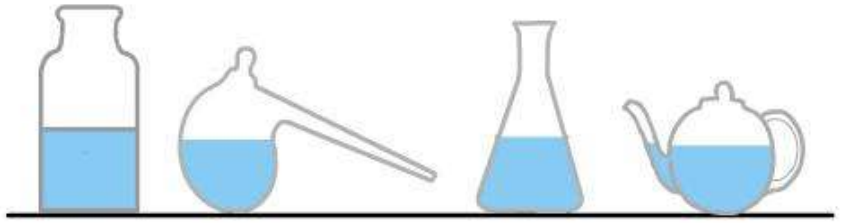


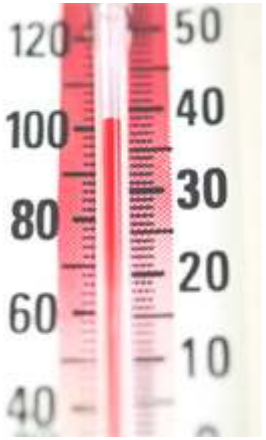
- At a higher temperature the higher the proportion of molecules with high speed
- DIFFUSION - the spread of gas particles from the field of higher concentration to lower concentration
- EFFUSION – leaking of gas through a small hole


LIQUIDS

LIQUID STATE

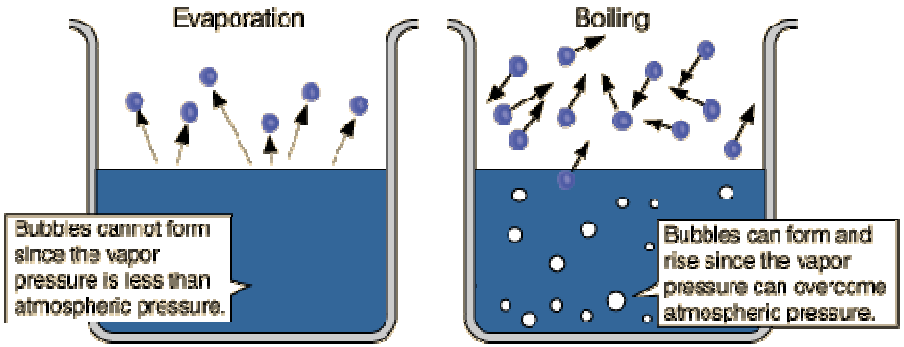
- Liquid – has volume, no shape
- Molecule is surrounded with exact number of other molecules, but that number is changeable (in crystal is constant)
- Change of pressure and temperature cause small volume change, but any liquid acts specifically (gases all equally!)

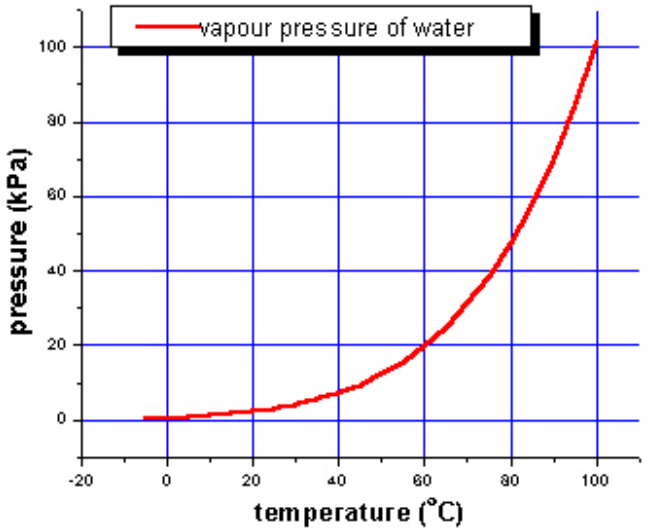




Vapor pressure of the liquid

- Vapor pressure is proportional to the temperature
- H_2O vapor pressure:
  - at 25ºC is 3,2 kPa
  - at 100ºC is 101 kPa (boiling point)
- Liquid He reaches vapor pressure 101 kPa at 4,2 K

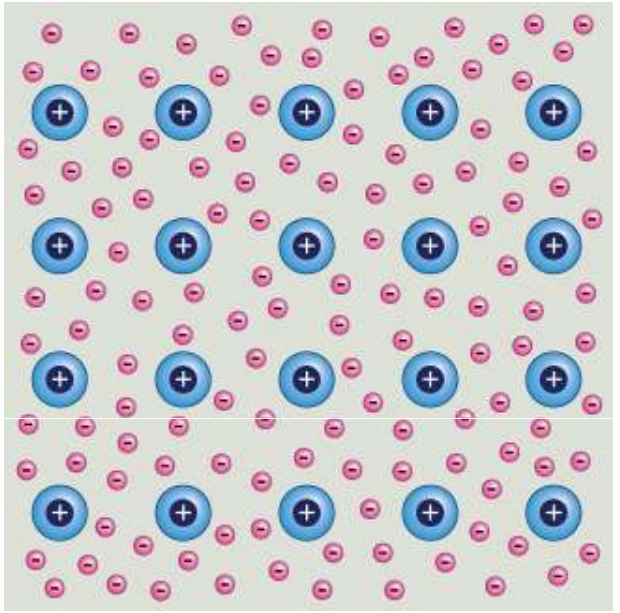




METALS

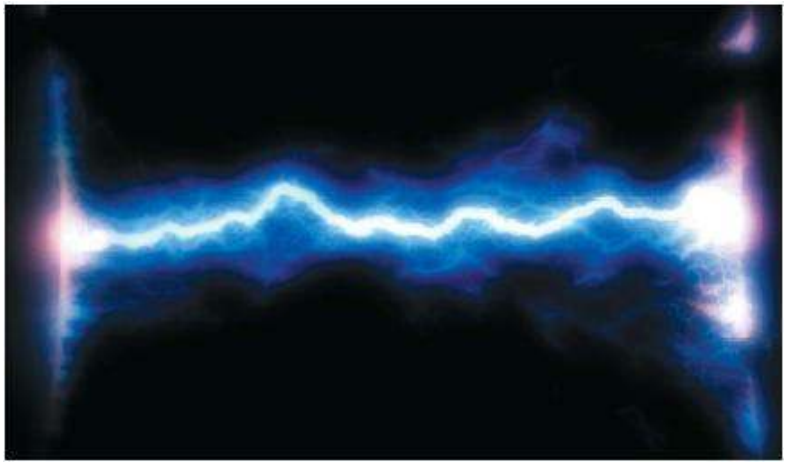
METALLIC BOND

- Metal properties: strength, electrical and thermal conductivity, luster, malleability... are explained by the presence of free and easy-moving electrons
- A piece of metal can be represented as ordered structure of positive ions in a sea of electrons. Bonds between opposite charges are not directed, nor rigid. Therefore it is possible to move a group of positive ions in a sea of electrons - metal bending, forging, rolling…



Conductivity of metals

- Electrical - if the potential difference is applied at the ends, the electrons begin to move



- Thermal - transfer of kinetic energy