

# Thermodynamics

## Heat expansion

$$\frac{\Delta L}{L} = \alpha \Delta T$$
$$\frac{\Delta V}{V} = \beta \Delta T$$
$$\beta = 3\alpha$$

## Heat

$$Q = mc\Delta T$$
$$l_s = \frac{Q_s}{m}$$
$$l_a = \frac{Q_a}{m}$$

## Fluid pressure

$$p_{tot} = p_{fluid} + p_{air} = \rho gh + p_{air}$$

## Ideal gas law

$$pV = NkT$$
$$pV = nRT$$

## Gas density and particle density

$$\rho = \frac{m_{tot}}{V} = \frac{pM}{RT}, \quad n_o = \frac{N}{V} = \frac{p}{kT}$$

## Barometric height formula

$$p = p_0 e^{-\rho_0 gh/p_0}, \quad h = \frac{p_0}{\rho_0 g} \ln \frac{p_0}{p}$$

## Relative humidity

$$R_M = \frac{p_{water}}{p_{saturation}}$$

## van der Waals' equation

$$\left(p + a \frac{n^2}{V^2}\right) (V - nb) = nRT$$

## Critical point

$$V_k = 3nb, \quad T_k = \frac{8a}{27Rb}, \quad p_k = \frac{a}{27b^2}$$