What is temperature?

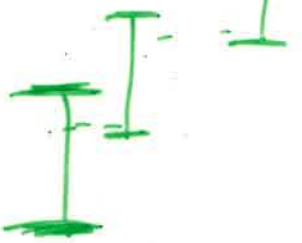
① How hot something feels. simple.
not quantitative. subject to perception.

② What a thermometer reads. quantitative

What kind? Mercury bulb thermometer
Alcohol bulb. IR., Galileo floating balls
(density of water), optical pyrometry.

overlap thermometer scales

Linear?



→ thermocouple. temp. diff → voltage
thermister temp. diff → changes Resistance

Arbitrariness

③ Measure of Average kinetic energy. $T \propto U$

ideal gas (monatomic): $U = \frac{3}{2}PV = \frac{3}{2}nRT$

↑ absolute temp.

Specific Heat at constant volume

$$C_V = \left(\frac{\partial U}{\partial T}\right)_V = \left(\frac{dU}{dT}\right)_V = \frac{3}{2}nR = \text{constant}$$

④ Ideal gas Thermometer Idealization

$$T = 273.16\,K \frac{\lim_{P\to 0}(PV)_{system}}{\lim_{P\to 0}(PV)_{\text{triple point of ice + water + vapor}}}$$

↑

0.01°C

$$[\Delta T = 1^\circ C = 1\,K] = 1 \text{ kelvin}$$

⑤ Thermodynamic temp. scale

Build a reversible heat engine = Carnot Engine Idealization

Carnot efficiency $\eta = 1 - \frac{T_C}{T_H}$

⑥ The thing that does not change when two systems in thermal equilibrium are placed in thermal contact. connected by diathermal walls. wall allow heat to flow through

⑦ $(k_B T)$ is the Lagrange multiplier that enforces the constraint that the average energy is fixed in a system with many energy levels.

$$\frac{1}{T} = \left(\frac{\partial S}{\partial U}\right)_{V,N}$$