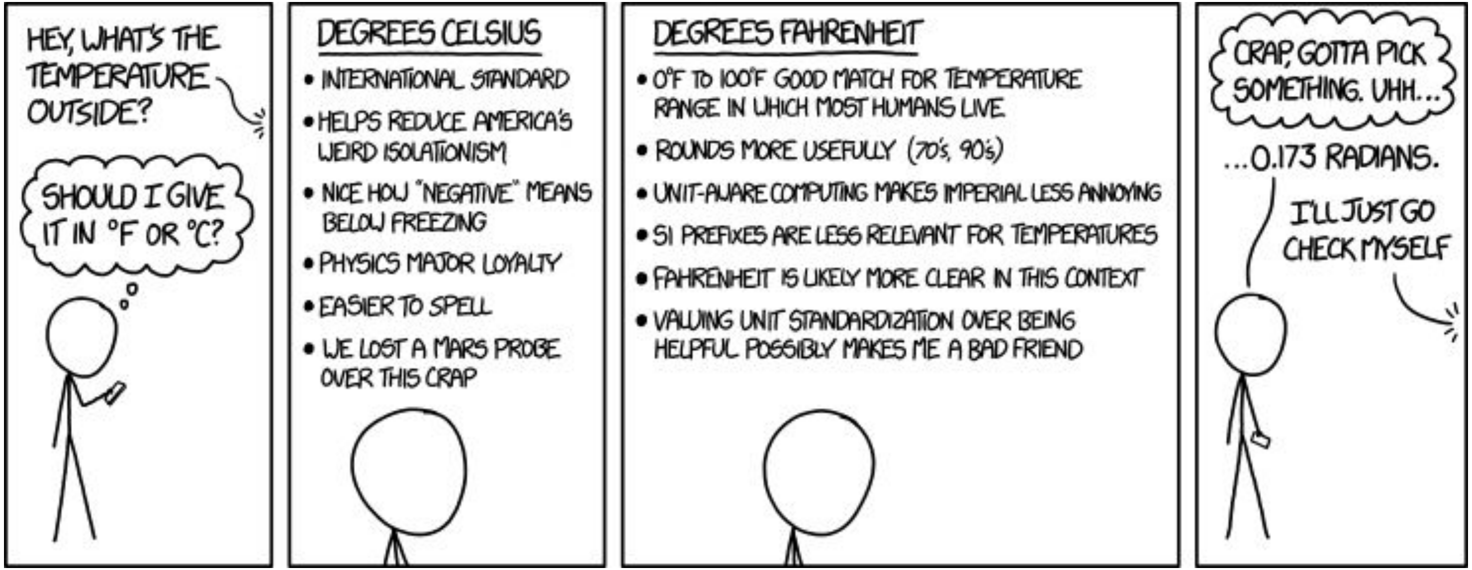
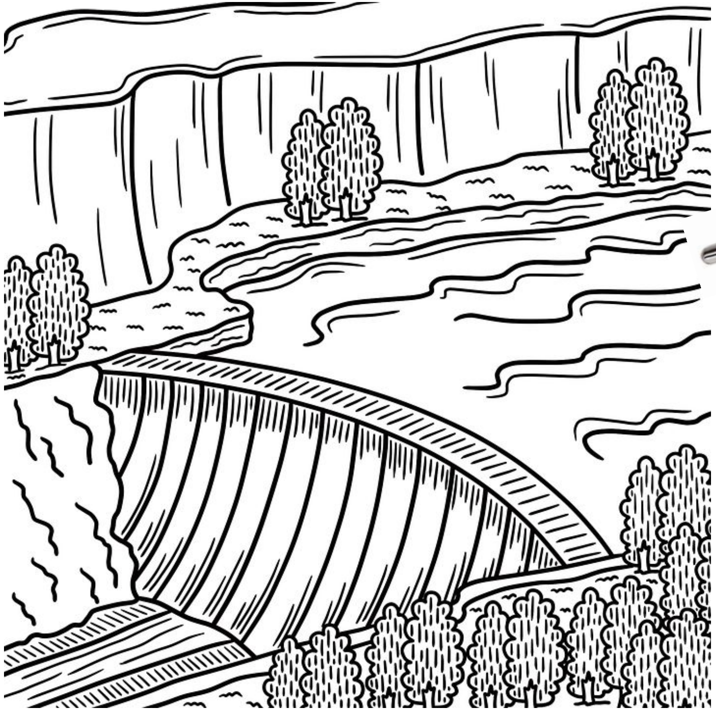
Absolute Temperature???

- Angad Singh, 3rd year BSMS



Powered by Fundamentals of Statistical and Thermal Physics, by F.Reif
~ For a summer reading project under Prof.Deepak Dhar

Thermodynamics: *Good old Thermometers*



Any small macroscopic system can be used to compare other larger 'Reservoirs' by comparing a linked macroscopic parameter.

Not to scale*

Most Probable Distribution

Ω is the count of the number of 'states' a system could be in, given what we know about its macroscopic parameters, like Length, Pressure, Magnetization, Energy etc.

Ω (E) = # of possible states of a system having an energy between E and E+δE.

Now consider two systems (A and B) in contact with each other and nothing else ($E_A + E_b = E_{tot}$)

We can get the states available for a particular internal distribution simply by multiplying their individual Ω(E) counts.

$$\Omega_0(E, E_{tot} - E) = \Omega_A(E)\Omega_B(E_{tot} - E)$$

Entropy: Probability in Disguise

$\beta \stackrel{\text{def}}{=} \partial Ln(\Omega)/\partial E$

$1/\beta \stackrel{\text{def}}{=} kT$

$S \stackrel{\text{def}}{=} kLn(\Omega)$

$1/T = \partial S/\partial E$

For a 'typical' system

$\Omega(E) \propto (E - E_0)^f$

$kT = 1/(\partial S/\partial E) \propto (E - E_0)/f$

Some sense of average energy per 'particle'

Non-Typical Systems

What if the number of states don't increase very very exponentially with more energy?

Introducing… Spin Systems! [You do have to forget that Kinetic energy exists]

Imagine a large number (N) of weakly interacting magnetic moments in a system, and then put an identical copy next to it.

Each system now has an upper cap on energy, and only 2^N states overall.

$$N! / n!(N-n)!$$

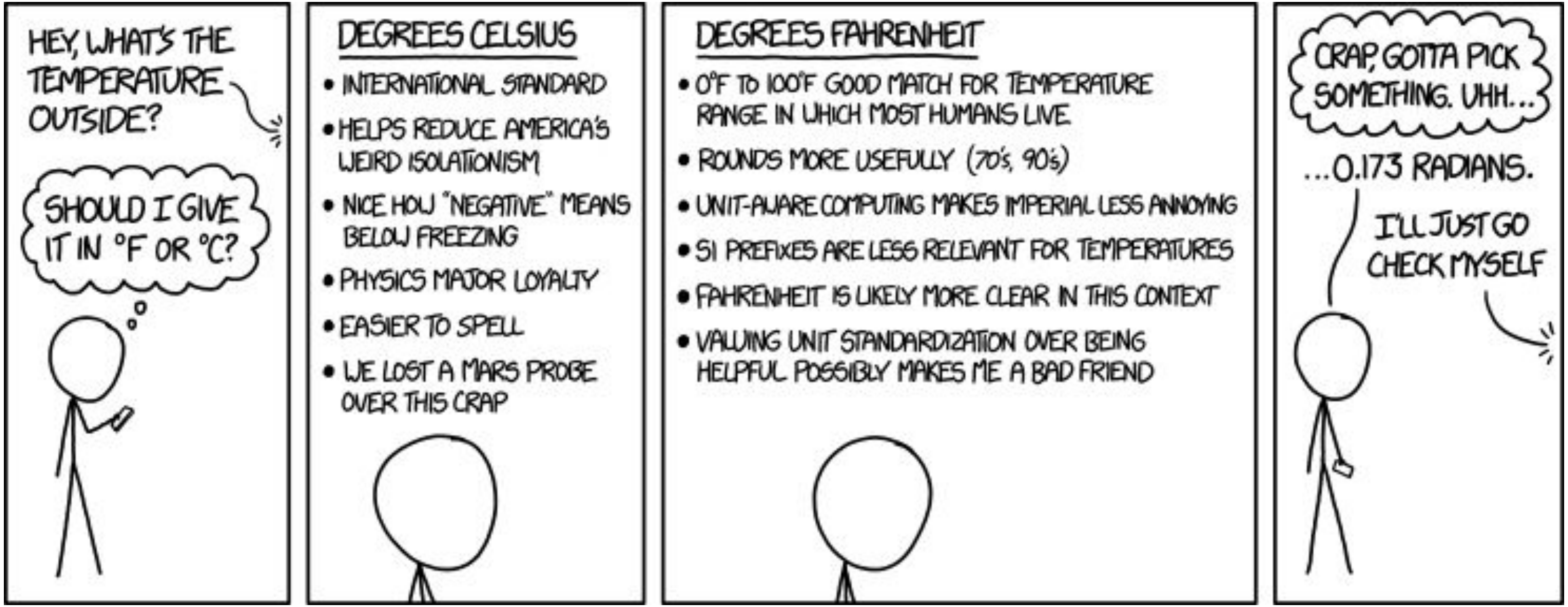
Where n is the number of spins pointing up, for instance.

Some deference to practicalities

The kelvin scale for temperature is defined with respect to the Boltzmann constant, exactly equal to 1.380 649 × 10^{-23}

For example, through the ideal gas law by measuring the average kinetic energy,or pressure and volume.

$$\bar{p} = nkT$$



The answer Cueball gives of 0.173 radians corresponds to a geometric angle 9.91° ($0.173 \times {}^{360°}/_{2\pi}$). If this were "radians Celsius" it would be 9.91 °C corresponding to 49.8 °F and if it were "radians Fahrenheit" it would be 9.91 °F corresponding to -12.3 °C. Given the temperatures in Massachusetts (where Randall lives) when this comic came out, the day after Valentine's Day 2016, Cueball was probably giving his answer in radians Fahrenheit.