

[tex134] Absolute temperature from measurements

Consider a compressible fluid in an insulating cylinder with a movable piston, a calibrated heat source, a pressure gauge, and a thermometer with arbitrary temperature scale θ . The experiment consists of measurements over a range of θ of the following quantities:

- rate $A(\theta) = (\delta V/\delta\theta)_p$ at which volume increases during isobaric heating up,
- rate $B(\theta) = (\delta Q/\delta p)_\theta$ at which heat is supplied during isothermal decompression.

Show that from the data of these two experiments we can infer the following differential relation between the thermometer reading θ and the absolute temperature T :

$$\frac{d \ln T}{d\theta} = -\frac{A(\theta)}{B(\theta)}.$$

The (undetermined) integration constant of $\ln T(\theta)$ can be used to fix the scale of the absolute temperature (e.g. by using the triple point of H₂O).

Solution: