

# Temperature and Pressure Calibration

## A. Pressure

1. *Reference*: Hg manometer  $\square$  1 Torr  $\square$  1 mm Hg  
 $1 \text{ Torr} \equiv \frac{1}{760} \text{ atm} \equiv \frac{1}{760} 101\,325 \text{ Pa}$
2. *Temperature correction* (for  $T$  dependence of  $\square$  for Hg)  
[Eqs. (6), p. 34 of CP; 2nd form adequate]
3. *Open-ended manometer*:  $\square h(\text{mm})$  for Hg  $\square P_{\text{atm}} - P_{\text{sys}}$  (Torr);  
get  $P_{\text{atm}}$  from *barometer*.
4. *Device*: **Capacitance Manometer**
  - a.  $V \sim$  linear in  $P$  for any gas
  - b. Gives 10.0 V full scale (0-100 Torr or 0-1000 Torr)
5. *Correction Plot*:  $\square P \equiv P_{\text{true}} - P_{\text{app}}$  vs.  $P_{\text{app}}$ ; then  
$$P_{\text{true}} = P_{\text{app}} + \square P$$

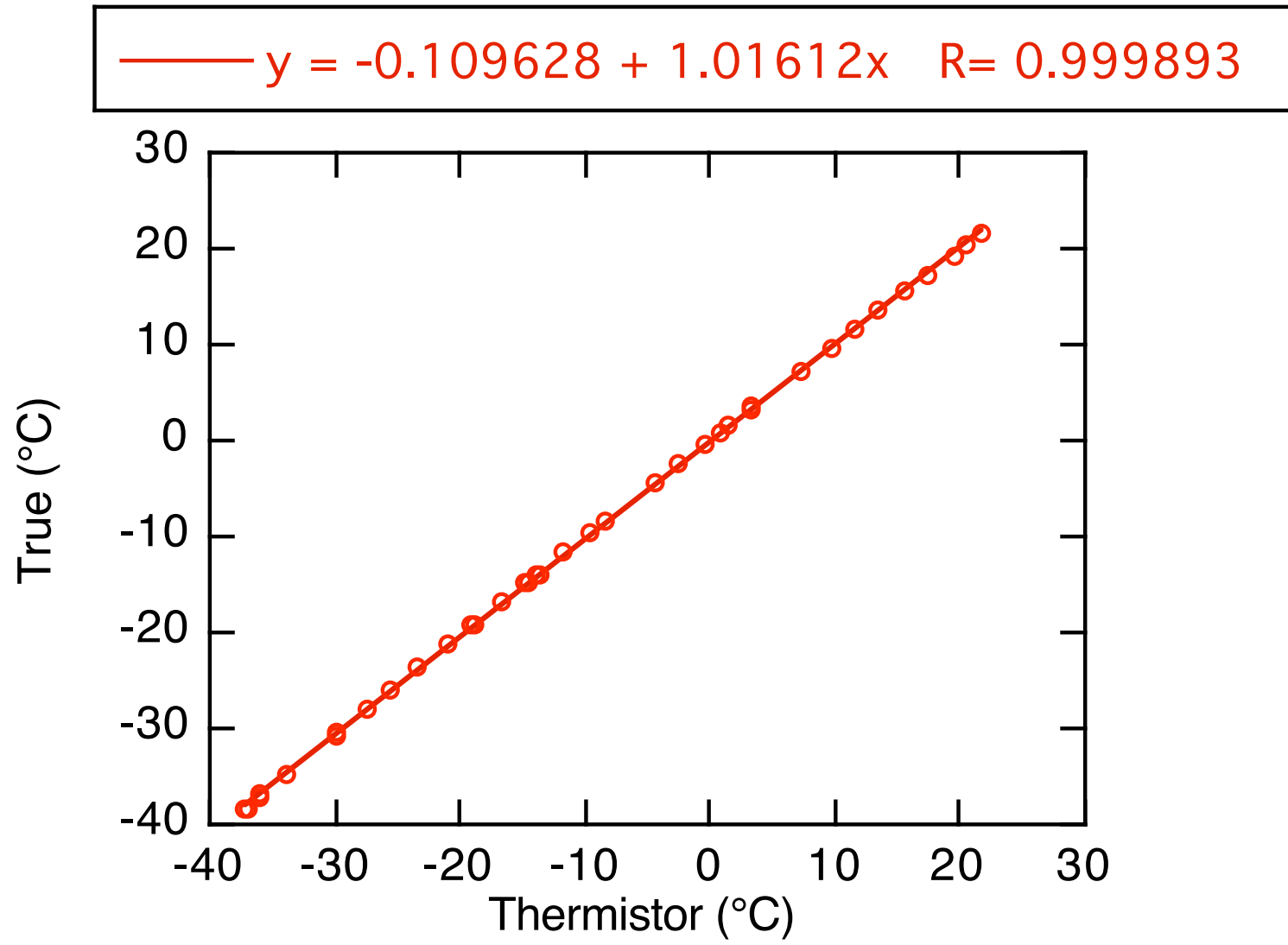
## B. Temperature

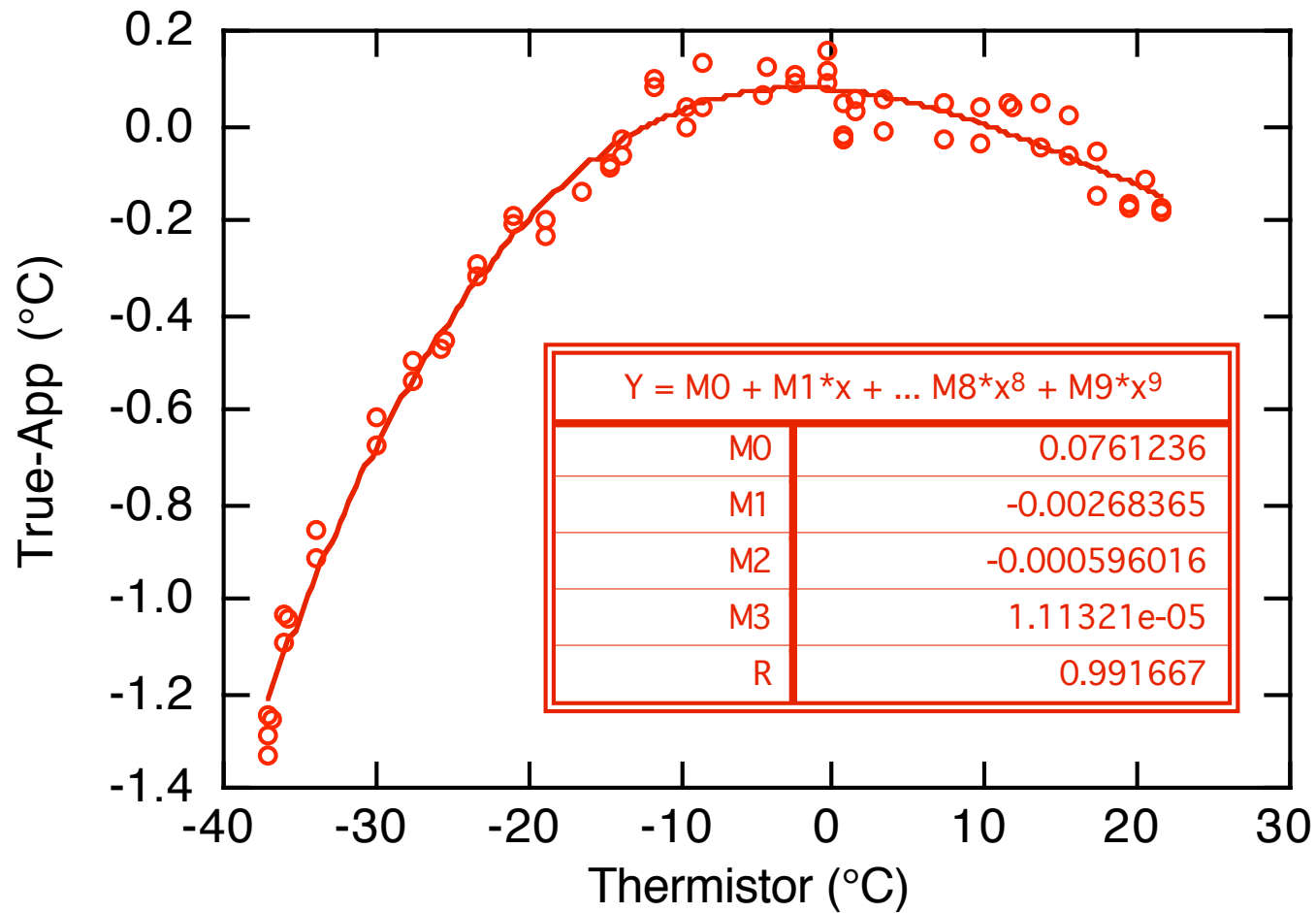
1. *Reference*: Hg thermometer  $\square$  must check at ice point or refer to calibration data from manufacturer.
2. *Device*: *Thermistor* (“thermally sensitive resistor”)
  - a.  $R \square R \exp(\square E/2kT)$  ( $T$  in K !!)
  - b. Very sensitive but not very accurate.
3. *Correction Plot*:  $\square T \equiv T_{\text{true}} - T_{\text{app}}$  vs.  $T_{\text{app}}$ ; then
$$T_{\text{true}} = T_{\text{app}} + \square T \quad [i.e., \text{ same approach}]$$

## C. Two-Point Formulas

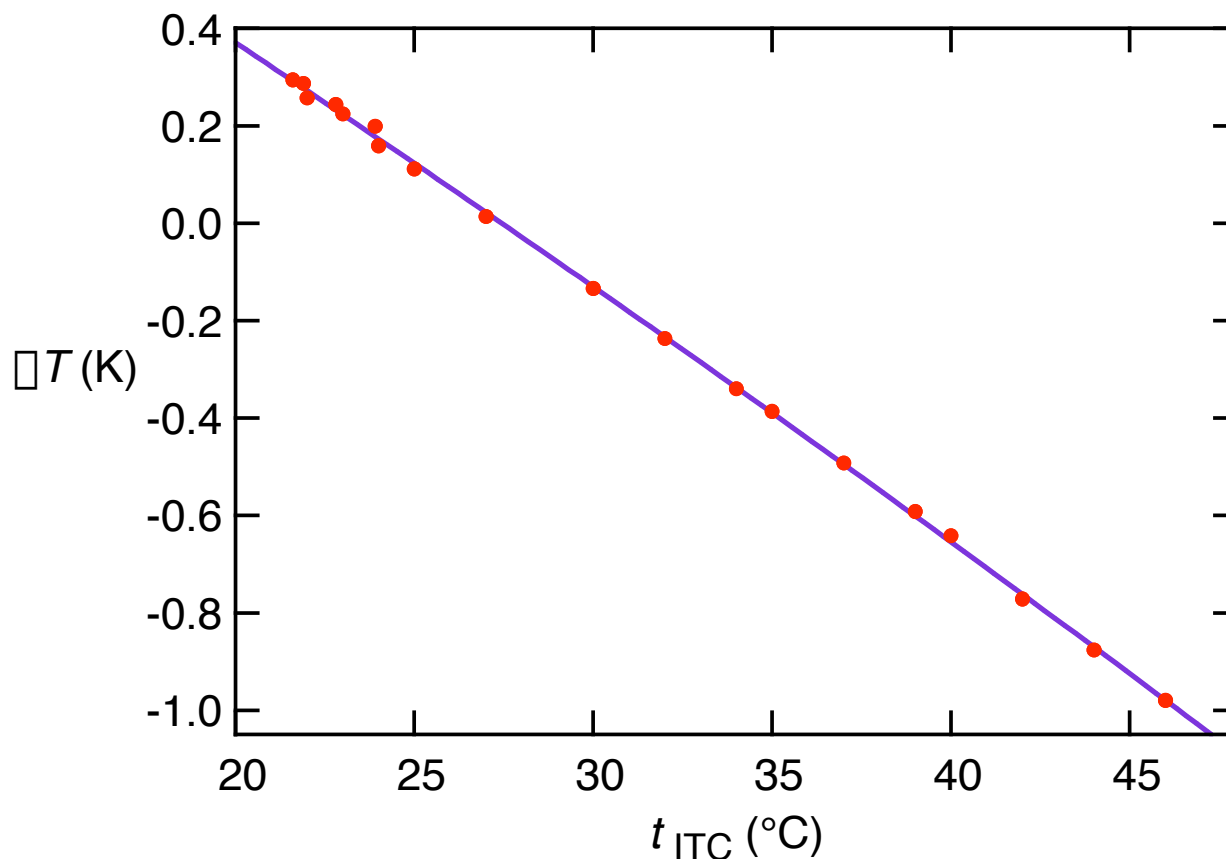
1. *Linear*:  $y = a + b x$   $\square$   $y_1 = a + b x_1$  &  $y_2 = a + b x_2$   
solve for  $a$  and  $b$   $\square$  calculate  $y_i$  for any  $x_i$ .
2. *Exponential*: Use logarithms and do same  $\square$ 
$$\ln(R) = \ln(R \ ) + \square E/2kT \equiv a + b/T .$$

## D. Illustrations





**E. Required Submission?** — virtually NO writeup here, but we do want figures and tables with good, descriptive, self-contained *captions*.



**Figure 5.** VP-ITC temperature correction (true - fiducial) over the stated range. The curve is a fitted quadratic in the argument  $(t - 25^{\circ})$  and gives an error of 0.123(3) K at  $25^{\circ}\text{C}$ . Most values beyond  $25^{\circ}$  were recorded after the VP-ITC instrument had equilibrated at the specified temperature.