Temperature and Pressure Calibration

A. Pressure

1. Reference: Hg manometer $\rightarrow$ 1 Torr $\approx$ 1 mm Hg
   
   $1 \text{ Torr} \equiv \frac{1}{760} \text{ atm} \equiv \frac{1}{760} 101325 \text{ Pa}$

2. Temperature correction (for $T$ dependence of $\rho$ for Hg)
   
   [Eqs. (6), p. 34 of CP; 2nd form adequate]

3. Open-ended manometer: $\Delta h(\text{mm})$ for Hg $\approx P_{\text{atm}} - P_{\text{sys}}$ (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: $\Delta P \equiv P_{\text{true}} - P_{\text{app}}$ vs. $P_{\text{app}}$; then
   
   $P_{\text{true}} = P_{\text{app}} + \Delta P$
B. Temperature

1. Reference: Hg thermometer → must check at ice point or refer to calibration data from manufacturer.

2. Device: Thermistor ("thermally sensitive resistor")
   a. \( R \approx R_\infty \exp(\Delta E/2kT) \) (\( T \) in K !!)
   b. Very sensitive but not very accurate.

3. Correction Plot: \( \Delta T \equiv T_{\text{true}} - T_{\text{app}} \) vs. \( T_{\text{app}} \); then
   \[
   T_{\text{true}} = T_{\text{app}} + \Delta T \quad [i.e., \text{same approach}]
   \]

C. Two-Point Formulas

1. Linear: \( y = a + b \, x \) → \( y_1 = a + b \, x_1 \) & \( y_2 = a + b \, x_2 \)
   solve for \( a \) and \( b \) → calculate \( y_i \) for any \( x_i \).

2. Exponential: Use logarithms and do same →
   \[
   \ln(R) = \ln(R_\infty) + \Delta E/2kT \equiv a + b/T .
   \]
D. Illustrations

\[ y = -0.109628 + 1.01612x \quad \text{R} = 0.999893 \]
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 $25^\circ$C. Most values beyond $25^\circ$ were recorded after the VP-ITC instrument had equilibrated at the specified temperature.