

Pledge and signature:

Note: If you want your paper returned folded (i.e., score concealed), please print your name on the back.

A. (8) Calibration with 2-point functions.

1. A Baratron pressure gauge gives a reading of -0.27 V when $P = 0$, and 7.08 V when $P = 760$ torr. What is the apparent P when this gauge reads 4.44 V?

$$487 \text{ Torr} \quad [P = a + bV]$$

2. A particular thermistor shows a resistance of $13.27 \text{ k}\Omega$ at 10.0°C and $1.557 \text{ k}\Omega$ at 50.0°C . The resistance is measured to be $8.93 \text{ k}\Omega$ when the thermistor is immersed in an unknown bath. What is the apparent temperature of the bath?

$$16.6^\circ\text{C} \quad [\ln R = A + B/T(\text{K})]$$

B. (4) Calibration — Fitting the data. You obtain the illustrated results upon fitting your thermistor calibration data, obtained over the region 19 - 32°C .

1. Properly state the correction and its statistical error at 25°C .

$$T = 0.0509(12)^\circ\text{C} \quad [\text{recall } 10\% \text{ rule!}]$$

2. If there are 19 data points, what is the estimated standard deviation (s_y) of these data?

$$s_y = 0.0056^\circ\text{C}$$

C. (2) Calibration — Paying attention!

Suppose you obtained the illustrated thermistor calibration data at the BombCal station while warming up the bath, starting just below 20°C . What do you think happened at $\sim 27^\circ\text{C}$?

Most likely explanation: The stirbar got "stuck."

D. Inversion of pickanose.

1. (10) The figure to the right represents optical rotation data for a hypothetical sugar *pickanose*. From this figure, give approximate values for the following quantities: (a) α_0 , (b) α_∞ , (c) the inversion time (in s), (d) the half-life, and (e) the effective rate constant k_{eff} .

$$(a) 0.9^\circ \quad (b) -1.5^\circ \quad (c) 95 \text{ s} \quad (d) 135 \text{ s} \quad (e) 0.005/\text{s}$$

2. (3) The inversion of pickanose is an acid-catalyzed reaction, with a rate constant of $0.0824 \text{ L mol}^{-1} \text{ min}^{-1}$. A reaction is initiated by mixing 20.00 mL of 4.0 M HCl with 10.0 mL of an aqueous solution of pickanose. Assuming that volumes are additive, calculate the effective rate constant for this mixture.

$$k_{\text{eff}} = 0.22 \text{ min}^{-1}$$