A. (3) **Calibration functions.** A Baratron pressure gauge gives a reading of \(-0.27\) V when \(P = 0\), and \(8.51\) V when \(P = 761\) torr. What is the apparent \(P\) when this gauge reads \(4.33\) V?

\[ P = a + bV \rightarrow P(4.33) = 398.7\text{ torr} \]

B. (3) **\(P\) calibration — away from mercury.** An oil manometer charged with dibutyl phthalate (\(\rho = 1.046\) g/mL) yields a level difference \(h = 42.3\) mm in a system where the reference arm is held at a pressure of \(P = 1.06\) torr. What is the pressure of the gas sample? (\(\rho_{\text{Hg}} = 13.595\) g/mL)

\[ \Delta P = 42.3\text{ torr} \times 1.046/13.595 = 3.25\text{ torr} \rightarrow P = 4.31\text{ torr} \]

C. (6) **Calibration — Fitting the data.** You obtain the illustrated results upon fitting your thermistor calibration data (true thermistor vs. thermistor), obtained over the region 19-32°C.

1. Properly state the correction and its statistical error at 25°C. \(\Delta T = 0.0509(12)°\)
2. If there are 24 data points, what is the estimated standard deviation \((s_y)\) of these data?

\[ s_y^2 = \text{Chisq}/v = 2.3765 \times 10^{-5} \rightarrow s_y = 0.004875° \]
3. If the thermistor reads 30.47°C, what is the corrected temperature? 30.52°C

D. (15) **Pickanose**-1.

1. (3) The acid-catalyzed inversion of pickanose has a rate constant of 0.0324 L mol\(^{-1}\) min\(^{-1}\). A reaction is initiated by mixing 10.00 mL of 4.0 M HCl with 20.0 mL of a solution of pickanose. Assuming that volumes are additive, calculate the effective rate constant for this mixture; or indicate if you think that this cannot be done.

\[ k_{\text{eff}} = 0.0432\text{ min}^{-1} \]

2. (3) This reaction is monitored by polarimetry. The optical rotation is initially 18.0° and is \(-8.0°\) when the reaction has gone to completion. Calculate the rotation (a) after one half-life, and (b) after two half-lives; or indicate if you think there is insufficient information to determine these quantities.

Rx is 1/2 completed after 1 half-life, 3/4 completed after 2. (1) 5.0° (2) \(-1.5°\)

3. (6) The reaction is studied at 20.0°C and at 45.0°C. Suppose that the \(k_{\text{H,20}}\) and \(k_{\text{H,45}}\) values are each uncertain by 8%, and their ratio is 4.5.

(a) Calculate the % uncertainty in their ratio; use this result to state this ratio and its uncertainty.

\[ (8^2 + 8^2)^{1/2} % = 11.3 % \quad r = 4.5(5) \]

(b) Calculate the uncertainty in \(\ln(k_{\text{H,45}}/k_{\text{H,20}})\).

\[ s(\ln r) = s_r/r = 0.113 \]

(c) Use the last result to calculate the uncertainty in the activation energy \(E_a\). (Take temperatures as error-free; \(R = 8.3145\) J mol\(^{-1}\) K\(^{-1}\))

\[ \ln r = E_a/R \left(1/T_1 - 1/T_2 \right) \rightarrow s_{E_a} = s(\ln r) R/(1/T_1 - 1/T_2) = 3.51\text{ kJ/mol} \]

4. (3) A solution of a different sugar, bashanose, is prepared by dissolving 23.71 g of bashanose in water and bringing the volume to 0.100 L in a volumetric flask. The optical rotation observed at \(\lambda_D\) for this solution in a 0.200-m polarimetry cell at 25°C is 14.7°. Calculate the specific rotation of bashanose (units deg mL g\(^{-1}\) dm\(^{-1}\)) at this wavelength and \(T\).

\[ 31.0\text{ deg mL g}^{-1}\text{ dm}^{-1} \]