Chemistry 236 -- Quiz 2

Lab Day ____

February 5, 2013 — Experiments 1 and 2

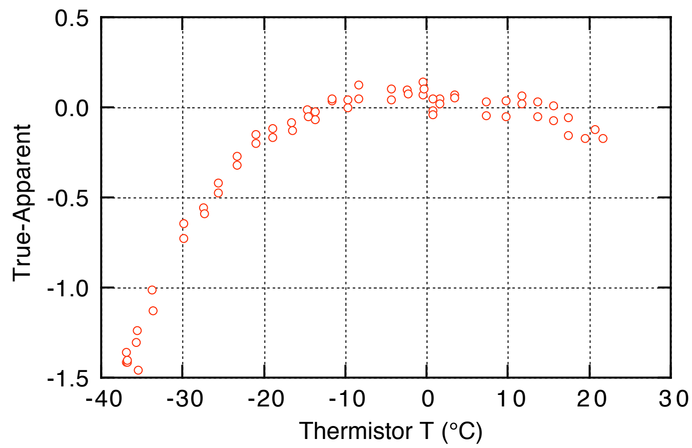
Pledge and signature:

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

A. (12) Calibration.

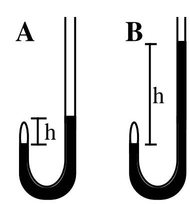
1. (3) A Baratron gauge (capacitance manometer) gives a reading of –0.27 V when $P = 0$, and 7.08 V when $P = 760$ Torr. What is the apparent P when the gauge reads 4.44 V?

2. (2) Calibration data for a thermistor are as shown in the accompanying graph. If the thermistor reads –27.0°C, what is the true temperature?



3. (4) A thermistor has a resistance of 11.27 kΩ at 10.0°C and 1.257 kΩ at 50.0°C. If the thermistor behaves in accord with the simplest theoretical relationship between temperature and resistance, what should its resistance be when the temperature is 30.0° C?

4. (3) A J-tube experiment (pictured to right) is carried out under a constant atmospheric pressure of 732 torr and a constant temperature of 25°C. Initially (diagram **A**) a 52.1-cm^3 sample of gas is trapped in the closed end, such that the difference of the mercury column heights on the two sides is $h = 80.0$ mm. Then additional mercury is added, reducing the volume to 40.0 cm^3 (**B**). Neglecting temperature corrections for the density of Hg, what is h in **B**?



B. (16) Pickanose^{-1}.

1. (6) Polarimetry is used to study the inversion process for a newly discovered sugar, pickanose. Like sucrose, this sugar changes the sign of its optical rotation as it undergoes acid-catalyzed hydrolysis (*i.e.*, it "inverts").

   (a) Write the general equation for the time dependence of the rotation $\alpha(t)$, as a sum of a constant (B) and an exponentially decaying term of initial magnitude A with effective rate constant k_{eff}.

   (b) Re-express this equation in terms of the rotations α_0 and α_∞ for $t = 0$ and $t = \infty$, respectively.

   (c) Suppose the inversion point is reached at time t_{inv}. Obtain an expression for k_{eff} in terms of t_{inv}, α_0, and α_∞ (or A and B if you are unsure of your results for α_0 and α_∞).

2. (4) Initially a 20.0-cm polarimeter tube is charged with a solution of pickanose and HCl(*aq*) prepared by mixing 25.0 mL of the stock sugar solution with 15.0 mL of 4.0 M HCl. At the start of the inversion reaction, the measured rotation of the polarimeter is $-12.4°$. The specific rotation $[\alpha]^T_\lambda$ for pickanose is -26.4 degree dm^{-1} mL g^{-1} at the temperature and wavelength used in the experiment. Calculate the initial concentrations in the polarimeter tube, of (a) pickanose, and (b) HCl. [Assume volumes are additive.]

3. (4) The reaction is found to reach the inversion point in 23 min; after 15 hours, the rotation is found to be 19.2°. Calculate (a) the effective rate constant k_{eff} and (b) the rate constant k_{H}.

4. (2) Having trouble with her error propagation, Honey Sweetwater decides to follow the suggestion in the writeup — to use weighted nonlinear LS fitting in KG to obtain her activation energy and uncertainty from estimates of k_{H} at 22° and 40°C. She finds that KG won't work with just her two points, so she copies each entry line again in the data sheet, giving 4 points total and success with KG. What must she then do to correct her results for the E_a uncertainty, and why?