Chemistry 236 -- Quiz 3 Lab Day ____

September 19, 2007 — Least Squares and Error Propagation

Pledge and signature:

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

1. (5) A quantity x is uncertain by 2.0% and y is uncertain by 3.0%. Give the % uncertainties for z in each of the following cases:

   a. $z = 5/y$ 3.0%

   d. $z = 5\,x^2/y$ 5.0%

   b. $z = 11x^3$ 6.0%

   c. $z = 1/\sqrt{7y}$ 1.5%

   e. $z = \sqrt{4xy}$ 1.8%

2. (4) An unweighted fit of 22 thermistor calibration correction values yields the results shown here. Calculate s_y^2 and s_y. (Give at least four significant figures.)

   $s_y^2 = 2.6266\times10^{-5}$ $s_y = 0.0051251$

y = a + b*(x-25) + c*(x-25)^2		
	Value	Error
a	0.050861789	0.001247068
b	0.0036498518	0.0002037433
c	-0.00074572609	3.839555e-05
Chisq	0.00049905721	NA
R	0.96765516	NA

3. (3) In the triple-point experiment, we will estimate the heat of fusion of ice from the sublimation and vaporization heats using $\Delta H_{fus} = \Delta H_{sub} - \Delta H_{vap}$. If $\Delta H_{vap} = 40.738 \pm 0.107$ kJ/mol and $\Delta H_{sub} = 47.597 \pm 0.072$ kJ/mol, calculate ΔH_{fus} and its uncertainty, and use the 10% rule to properly express these results.

   $s_{\Delta H_{fus}} = 0.129$ kJ/mol $\Delta H_{fus} = 7.86(13)$ kJ/mol

4. (4) We learned last week that Arrhenius activation energies can be estimated from two values of the rate constant, at T_1 and T_2, using $\ln(k_2/k_1) = E_a/R\,(T_1^{-1} - T_2^{-1})$.

   a. If k_2 has 2.0 % uncertainty and k_1 has 1.5 % uncertainty, what is the % uncertainty in their ratio?
   2.5%

   b. Assuming T_1 and T_2 have negligible uncertainty, use these results to give an expression for the uncertainty in E_a. (<u>Hint:</u> To help keep things straight, let $y = k_2/k_1$ and $z = \ln y$; then express E_a in terms of z.)

   $s_z = s_y/y = 0.025$ $E_a = R/(T_1^{-1} - T_2^{-1})\,z$ $s_{E_a} = 0.025\ R/(T_1^{-1} - T_2^{-1})$