Chemistry 236 -- Quiz 3

Lab Day ____

October 28, 2009 — Experiments 1 and 2

A. (6) Calibration with 2-point functions.

1. A Baratron pressure gauge gives a reading of 0.27 V when P = 0, and 8.07 V when P = 760 torr. What is the apparent P when this gauge reads 3.33 V?

   298.$_2$ torr

2. A particular thermistor shows a resistance of 19.27 kΩ at 10.0°C and 2.557 kΩ at 50.0 °C. The resistance is measured to be 8.93 kΩ when the thermistor is immersed in an unknown bath. What is the apparent temperature of the bath?

   24.0$_1$ °C

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

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

   0.0509(12)°C

2. If there are 29 data points, what is the estimated standard deviation (s_y) of these data?

   0.00438°

3. If the thermistor reads 20.47°C, what is the corrected temperature?

   corr = 0.019°; t_{cor} = 20.49°C

C. (14) Inversion of pickanose.

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 5.00 mL of 6.0 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_{eff} = 0.0389 min^{-1}

2. (4) This reaction is monitored by polarimetry. The optical rotation is initially 25.0° and is −5.0° when the reaction has gone to completion. Calculate the rotation after (a) one half-life, and (b) after two half-lives; or indicate if you think there is insufficient information to determine these quantities.

   10° (first half life) 2.5° (2nd)

3. (3) The rate constant k_H increases by a factor of 3.9 when the temperature is increased from 20.0° C to 40.0° C. Calculate the activation energy E_a. [R = 8.31451 J mol^{-1} K^{-1}]

   51.9$_4$ kJ/mol

4. (4) Suppose that the $k_{H,20}$ and $k_{H,40}$ values are each uncertain by 10%.

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

   14.$_1$% 3.9(6)

   (b) Calculate the uncertainty in ln($k_{H,40}/k_{H,20}$). 0.141

   (c) Use the last result to calculate the uncertainty in E_a. (Take temperatures as error-free.)

   rel err in E_a = 0.141/ln(3.9) = 0.1036 → 5.38 kJ/mol → 52(5) kJ/mol