Preview Sheet for Test 3

Chapters 5 and 6 (plus ideas from Chapters 1-4 invoked in class or homework)
Lectures from 11/2 through 11/30; Problem Sets 5 and 6

The test will be on Tuesday, December 4, in Olin-Rice 100 (our normal classroom), starting at **7:00 p.m.** (unless you have made other arrangements with me).

Studying Strategies:

- Focus on your lecture notes and homework first, then look at your textbook. (See the course web page for class overheads and homework keys.)
- If a topic was not covered in homework or in lecture, you are not responsible for it!
- Do extra problems at the ends of the chapters.
- It is important to understand concepts from lecture not covered explicitly in the homework problems. These will typically be covered by short essay questions.

Test Format: ~50 points based on calculations, and ~50 points based on short essay and other qualitative questions.

Here's a preview of the instructions:

1. Write your name in the space above and on the backs of the other pages.
2. Your exam booklet should have **nine pages** total, with questions on pages 2-7, formulas on p. 8, and constants and a periodic table on p. 9. Check to see you have nine pages now. If you do not, ask for another copy of the exam.
3. You may carefully remove pages 8 and 9 from your exam booklet.
4. When answering questions on this test, you do not need to re-derive any equation on p. 8 unless I explicitly tell you otherwise.
5. You may use programmable calculators, but chemical data should not be stored in them.
6. Bring a ruler to the exam.
7. You should always demonstrate your thought process in writing. You will be awarded credit only for work I can decipher.
8. You have a maximum of **2 hours and 30 minutes** to work on this exam.

Also note the constants and formulas you will be given on the exam (please check for validity!):

$1\ \text{Pa} = 1\ \text{kg m}^{-1}\ \text{s}^{-2}$ $1\ \text{bar} = 10^{5}\ \text{Pa}$ $1\ \text{atm} = 1.01325 \times 10^{5}\ \text{Pa} = 760\ \text{torr} = 760\ \text{mm Hg}$

$R = 0.0820574\ \text{L atm mol}^{-1}\ \text{K}^{-1} = 8.31447\ \text{J mol}^{-1}\ \text{K}^{-1}$ $k = 1.38065 \times 10^{-23}\ \text{J K}^{-1}$

$101.325\ \text{J} = \text{L atm}$ $1\ \text{J} = 1\ \text{kg m}^{2}\ \text{s}^{-2}$ $g = 9.80665\ \text{m s}^{-2}$

$N_A = 6.02214 \times 10^{23}\ \text{mol}^{-1}$ $1\ \text{L} = 1\ \text{dm}^{3} = 10^{3}\ \text{mL}$ $T\ (\text{K}) = T(°\text{C}) + 273.15$

For H_2O: $T_f = 0.00°\text{C}$; $\Delta_{fus}H° = 6.008\ \text{kJ mol}^{-1}$; $T_b = 100.00°\text{C}$; $\Delta_{vap}H° = 40.656\ \text{kJ mol}^{-1}$

$$pV = nRT \qquad p = p_A + p_B \qquad \frac{N_f}{N_i} = \exp\left(-(U_f - U_f)/kT\right)$$

$$\frac{dV}{V} = \alpha dT \qquad \alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_{n,p} \qquad \frac{dV}{V} = -\kappa_T dp \qquad \kappa_T = -\frac{1}{V}\left(\frac{\partial V}{\partial p}\right)_{n,T}$$

$$\Delta U = q + w \qquad dU = nC_{v,m}dT = dq_v \qquad dw = -Fdl = -p_{ext}dV$$

$$H = U + pV \qquad dH = nC_{p,m}dT = dq_p \qquad w = -RT\Delta n_g$$

$$dS = \frac{dq_{rev}}{T} \qquad dS \geq \frac{dq}{T} \qquad \Delta S_{sys} + \Delta S_{surr} = \Delta S_{univ} \geq 0$$

$$A = U - TS \qquad G = H - TS \qquad dA_{T,V} \leq 0 \qquad dG_{T,p} \leq 0$$

$$dU = TdS - pdV \qquad dG = Vdp - SdT \qquad \frac{dp}{dT} = \frac{\Delta_{trs}S}{\Delta_{trs}V}$$

$$\ln\left(\frac{p}{p^*}\right) = -\frac{\Delta_{vap}H}{R}\left(\frac{1}{T} - \frac{1}{T^*}\right) \qquad G_m = G_m^\circ + RT\ln\frac{p}{p^\circ}$$

$$x_A = \frac{n_A}{n_A + n_B} \qquad x_B = 1 - x_A$$

$$\Delta_{mix}G = nRT\left(x_A \ln x_A + x_B \ln x_B\right) \qquad \Delta_{mix}S = -nR\left(x_A \ln x_A + x_B \ln x_B\right) \qquad \Delta_{mix}H = 0$$

$$p_A = x_A(l)p_A^{pure} \qquad \Delta vp = -x_B(l)p_A^{pure} \qquad \left[\frac{\partial}{\partial T}\left(\frac{G}{T}\right)\right]_p = -\frac{H}{T^2}$$

$$\left(\frac{\partial \ln x_A(l)}{\partial T_b}\right)_p = -\frac{\Delta_{vap}H^\circ}{RT_b^{\ 2}} \qquad \ln x_A(l) = \frac{\Delta_{vap}H}{R}\left(\frac{1}{T_b} - \frac{1}{T_b^*}\right)$$

$$\left(\frac{\partial \ln x_A(l)}{\partial T_f}\right)_p = \frac{\Delta_{fus}H^\circ}{RT_f^{\ 2}} \qquad \ln x_A(l) = -\frac{\Delta_{fus}H}{R}\left(\frac{1}{T_f} - \frac{1}{T_f^*}\right)$$

$$y_A(g) = \frac{x_A(l)p_A^{pure}}{p_B^{pure} + (p_A^{pure} - p_B^{pure})x_A(l)} \qquad y_B(g) = 1 - y_A(g)$$

$$F = C - P + 2 \geq 0 \qquad \frac{n(\alpha)}{n(\beta)} = \frac{y_A(\beta) - z_A}{z_A - x_A(\alpha)}$$