Preview Sheet for Test 2

Chapters 3 and 4 (plus key ideas from 1 and 2)
Lectures from 10/3 through 10/31; Problem Sets 3 and 4

The test will be on Monday, November 5, in Olin-Rice 100 (our normal classroom), starting at **7:30 a.m.** You will have 2 hours to work on the exam. (You cannot work past 9:30 a.m., out of fairness to those who have 9:40 classes, and to those who got up early enough to start at the specified time!)

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: 55 points based on calculations, and 45 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. You should always demonstrate your thought process in writing. You will be awarded credit only for work I can decipher.
7. You have a maximum of **2 hours** to work on this exam.

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

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

R = 0.0820574 L atm mol^{-1} K^{-1} = 8.31447 J mol^{-1} K^{-1} k = 1.38065 x 10^{-23} J K^{-1}

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

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

$$pV = nRT \qquad p = \frac{nRT}{V - nb} - a\left(\frac{n}{V}\right)^2 \qquad \frac{N_\mathrm{f}}{N_\mathrm{i}} = \exp\left(-(U_\mathrm{f} - U_\mathrm{f})/kT\right)$$

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

$$dU = \left(\frac{\partial U}{\partial V}\right)_\mathrm{T} dV + \left(\frac{\partial U}{\partial T}\right)_\mathrm{V} dT \qquad \left(\frac{\partial U}{\partial V}\right)_\mathrm{T} = \pi_\mathrm{T} \qquad \left(\frac{\partial U}{\partial T}\right)_\mathrm{V} = C_\mathrm{V} = nC_\mathrm{v,m}$$

$C_\mathrm{V} = \frac{1}{2}nR$ for each continuous way to store energy $\qquad dU = nC_\mathrm{v,m} dT = dq_\mathrm{v}$

$$\Delta U = q + w \qquad dw = -Fdl = -p_\mathrm{ext} dV \qquad pV^\gamma = \text{constant} \qquad \gamma = \frac{C_\mathrm{p,m}}{C_\mathrm{V,m}}$$

$$H = U + pV \qquad dH = \left(\frac{\partial H}{\partial p}\right)_\mathrm{T} dp + \left(\frac{\partial H}{\partial T}\right)_\mathrm{p} dT \qquad \left(\frac{\partial H}{\partial T}\right)_\mathrm{p} = C_\mathrm{p} = nC_\mathrm{p,m}$$

$$C_\mathrm{V} + nR = C_\mathrm{p} \qquad dH = nC_\mathrm{p,m} dT = dq_\mathrm{p} \qquad w = -RT\Delta n_\mathrm{g}$$

$$\varepsilon = \frac{|w_\mathrm{net}|}{q_\mathrm{h}} = 1 - \frac{T_\mathrm{c}}{T_\mathrm{h}} \qquad dS = \frac{dq_\mathrm{rev}}{T} \qquad dw - dw_\mathrm{rev} \geq 0 \qquad dq - dq_\mathrm{rev} \leq 0$$

$$dS \geq \frac{dq}{T} \qquad \Delta S_\mathrm{sys} + \Delta S_\mathrm{surr} = \Delta S_\mathrm{univ} \geq 0 \qquad \Delta U_\mathrm{trans} \sim \frac{1}{V^{2/3}}$$

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

$$dU = TdS - pdV \qquad \left[\frac{\partial}{\partial V}\left(\frac{\partial U}{\partial S}\right)_\mathrm{V}\right]_\mathrm{S} = \left[\frac{\partial}{\partial S}\left(\frac{\partial U}{\partial V}\right)_\mathrm{S}\right]_\mathrm{V} \qquad \left(\frac{\partial H}{\partial p}\right)_\mathrm{T}\left(\frac{\partial p}{\partial T}\right)_\mathrm{H}\left(\frac{\partial T}{\partial H}\right)_\mathrm{p} = -1$$

$$\left(\frac{\partial T}{\partial V}\right)_\mathrm{S} = -\left(\frac{\partial p}{\partial S}\right)_\mathrm{V} \qquad \left(\frac{\partial T}{\partial p}\right)_\mathrm{S} = \left(\frac{\partial V}{\partial S}\right)_\mathrm{p} \qquad \left(\frac{\partial p}{\partial T}\right)_\mathrm{V} = \left(\frac{\partial S}{\partial V}\right)_\mathrm{T} \qquad \left(\frac{\partial V}{\partial T}\right)_\mathrm{p} = -\left(\frac{\partial S}{\partial p}\right)_\mathrm{T}$$

$$dG = Vdp - SdT \qquad \frac{dp}{dT} = \frac{\Delta_\mathrm{trs} S}{\Delta_\mathrm{trs} V} \qquad \ln\left(\frac{p}{p^*}\right) = -\frac{\Delta_\mathrm{vap} H}{R}\left(\frac{1}{T} - \frac{1}{T^*}\right)$$