Preview Sheet for Test 3
Thursday, November 19, 3:00-4:30 p.m., OR 301

Chapter 2 (pp. 23-28; 29-36), Chapter 3 (pp. 45-61), Chapter 4 (pp. 80-82)
Lectures from 10/21 to 11/11; Problem Sets 6, 7, and 8

Studying strategies:

- Focus on your lecture notes and homework first, then look at the textbook. Anticipate some conceptual questions not based on the homework. Also understand the "big ideas" from the Molecular Vibrations experiment and the theory section of the Calorimetry experiment (pp. 79-81 in lab manual). (The latter matches my treatment of the first law of thermodynamics far better than what is in Chapter 4 of Hanson and Green.)
- If a topic was not covered in homework, lecture, or lab, you are not responsible for it! Please ask me if you are unsure about whether a particular topic is "fair game" for the exam.
- Expect a mixture of mathematical calculations (50 points) and discussion questions (50 points). You should be able to use equations not only to calculate numbers, but also to make qualitative arguments.

Instructions before starting the test:

1. Write your name in the space above and on the backs of the other pages.
2. This exam is closed-everything.
3. Your exam booklet should have **eight** pages total, with questions on pp. 2-6, equations and constants on p. 7, and a periodic table on p. 8. Check to see you have eight pages now. If you do not, ask for another copy of the exam.
4. You may use programmable calculators, but chemical data should not be stored in them.
5. To receive full credit for a mathematical problem, you must show the method by which you obtained the final answer, including dimensional analysis. However, you do not need to justify how you calculated molar masses.
6. Assume that the mass of an isotope (in amu) is given by its mass number to one decimal place. So, for example, assume ^{11}B weighs 11.0 amu.
7. A final numerical answer must contain the correct units and number of significant figures to receive full credit.
8. You have **90 minutes** to work on this exam. Do not start until you are instructed to.

What not to memorize (they will be provided in the test booklet):

(1) The periodic table
(2) The following information:

$$c = \lambda\nu \qquad \frac{1}{\lambda} \equiv \tilde{\nu} \qquad E = h\nu$$

$$W = \frac{N!}{N_0!N_1!N_2!...} \qquad \frac{N_j}{N_i} = \exp\left[-(E_j - E_i)/kT\right] \qquad \mu = \frac{m_1 m_2}{m_1 + m_2}$$

$$E_{\text{vib}} = \left(i + \frac{1}{2}\right) h\nu \quad \text{where} \quad \nu = \frac{1}{2\pi}\sqrt{\frac{k_f}{\mu}} \text{ and } i = 0, 1, 2, ...$$

$$E_{\text{rot}} = i(i+1)\frac{h^2}{8\pi^2}\left(\frac{1}{\mu R^2}\right) \quad \text{where} \quad i = 0, 1, 2, ...$$

$$E_{\text{trans}} = \left(n_x^2 + n_y^2 + n_z^2\right)\frac{h^2}{8}\left(\frac{1}{mV^{2/3}}\right) \quad \text{where} \quad n = 1, 2, 3...$$

$$\Delta U = \Delta U_{\text{C}} + \Delta U_{\text{T}} = q + w \qquad \Delta U_{\text{T}} = C\Delta T = m\hat{C}\Delta T = n\tilde{C}\Delta T$$

$$w = -p_{\text{surr}}\Delta V \qquad pV = nRT \qquad T\,(\text{K}) = T\,(^\circ\text{C}) + 273.15\ \text{K}$$

$N_{\text{A}} = 6.022 \times 10^{23}$ particle mol^{-1} $\quad c = 2.998 \times 10^{8}$ m s^{-1} $= 2.998 \times 10^{10}$ cm s^{-1}

$h = 6.626 \times 10^{-34}$ J s particle^{-1}

$k = 1.381 \times 10^{-23}$ J K^{-1} particle^{-1} $\quad 1$ amu $= 1.661 \times 10^{-27}$ kg particle^{-1}

1 m $= 10^{9}$ nm $= 10^{10}$ Å $\quad$ 1 mL $= 10^{-3}$ L $\quad$ 1 J $= 1$ kg m^2 s^{-2} $\quad$ 1 kJ $= 10^{3}$ J

$R = 0.08315$ L bar mol^{-1} K^{-1} $= 8.315$ J mol^{-1} K^{-1} $\quad$ 1 L bar $= 100$ J