

**Preview Sheet for Test 3**  
**Hybridization, Boltzmann Distribution, Energy Levels, and the First Law**  
**Thursday, November 15, 9:00 – 11:00 a.m., OR 101**

Atkins/Jones: Chapter 3 (pp. 106-115—but focus on class notes)  
Hanson/Green: Chapter 2 (pp. 2-11 to 2-18), Chapter 3 (pp. 3-1 to 3-19)  
Chapter 4 (pp. 4-4 to 4-14), Chapter 5 (pp. 5-1 to 5-9)  
Lectures from 10/12 (end of class) to 11/7; Problem Sets 7, 8, and 9

Studying strategies:

- Focus on your lecture notes and homework first, then look at the textbooks. Anticipate some conceptual questions not based on the homework.
- If a topic was not covered in homework or in lecture, you are not responsible for it! Please ask me if you are unsure about whether a particular topic is “fair game” for the exam.
- You will not be tested on constructing energy level population diagrams (as in Hanson and Green Problems 2.2 and 2.4 from Problem Set 7). As we saw in class on November 9, these diagrams come up again when we talk about entropy. You should know how to construct these diagrams for Test 4!
- You are responsible for the other major topic of Chapter 2, the Boltzmann distribution law.
- Expect a mixture of mathematical and short explanation questions. You should be able to use equations not only to calculate numbers, but also to make qualitative arguments.

Chem Major Tutoring Schedule  
(in Olin-Rice 341):  
Sunday: 1:00 – 10:00 p.m.  
Monday –Thursday: 7:00 – 10:00 p.m.

MAX Center Tutoring:  
Sunday –Thursday: 7:00 – 10:00 p.m.  
Monday –Friday: 9:00 a.m. – 4:30 p.m.

My Office Hours:  
Monday: After 2:30 p.m.  
Tuesday: All day (barring a few advising appointments)  
Wednesday: 2:30 – 3:30 p.m.

[From the test booklet:]

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 **z** pages total, with questions on pp. 2-x, equations and constants on p. y, and a periodic table and a table of bond dissociation energies on p. z. Check to see you have z pages now. If you do not, ask for another copy of the exam.

- You may use programmable calculators, but chemical data should not be stored in them.
- 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.
- A final numerical answer must contain the correct units and number of significant figures to receive full credit.
- You have **120 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):

- The periodic table
- A table of bond dissociation energies
- The information below:

$$c = \lambda\nu \quad \frac{1}{\lambda} \equiv \tilde{\nu} \quad E = h\nu \quad \Delta E = -\mathfrak{R}Z^2 \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$W = \frac{N!}{N_0!N_1!N_2!\dots} \quad \frac{N_j}{N_i} = \exp\left(-\frac{E_j - E_i}{kT}\right) \quad \mu = \frac{m_1m_2}{m_1 + m_2}$$

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

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

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

$$\Delta U = \Delta U_C + \Delta U_T = q + w \quad \Delta U_T = C\Delta T$$

$$w = -P_{\text{surr}}\Delta V \quad PV = nRT \quad T(\text{K}) = T(^{\circ}\text{C}) + 273.15 \text{ K}$$

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

$$h = 6.626 \times 10^{-34} \text{ J s particle}^{-1} \quad \mathfrak{R} = 2.179 \times 10^{-18} \text{ J particle}^{-1}$$

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

$$1 \text{ m} = 10^9 \text{ nm} = 10^{10} \text{ \AA} \quad 1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2} \quad 1 \text{ kJ} = 10^3 \text{ J}$$

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