

Preview Sheet for Test 1
Isotope Exchange, Energy Distributions, and Energy Levels

- Lectures from 1/23 to 2/8
 - Probability, Isotope Exchange Reactions and Equilibrium: ~25 points
 - Energy Distributions and the Boltzmann Law: ~35 points
 - Energy Levels in Matter: ~40 points
(as always, test coverage is proportional to the time spent on the topic in class)
- Problem Sets 1 and 2 (see course web page for answer keys)
- Reading
 - Chapter 1: pp. 1-1 to 1-14; 1-17-19
(nothing on Le Chatelier)
 - Chapter 2: pp. 2-3 to 2-8; 2-10 to 2-18; 2-20 to 2-24, plus our discussion in class of the two laws of thermodynamics
(nothing on how to derive the thermodynamic probability equation, degeneracy and the Boltzmann law, why the Boltzmann distribution is the most probable, or estimating how many levels are populated.)
 - Chapter 3: pp. 3-1 to 3-3; 3-8 to 3-19; 3-30 to 3-31
(nothing on quantization of energy in a one-dimensional box, Sections 3.9 to 3.13)

Studying strategies:

- Focus on your lecture notes and homework. Use your textbook only as a reference.
- This test will consist entirely of short answer, essay, and mathematical questions. The implication of this test format is that you should focus on the “big ideas” and concepts from lecture, not the details.
- Do extra problems at the ends of the chapters. If you would like to look up an answer for a problem, please see the answer keys on the bulletin board next to Prof. Fischer’s office.
- It is also important to understand concepts from lecture not covered explicitly in the homework problems. These may be covered by short-answer or essay questions.
- If a topic was not covered in homework or in lecture, you are not responsible for it! Please ask me if you cannot figure out if a particular topic is “fair game” for the test.

Student Tutoring Schedule (in Olin-Rice 341)

Sunday: 1:00 – 10:00 p.m.

Extra Office Hours

Sunday: 7:00 – 9:00 p.m.

[Instructions from the test booklet:]

1. Your exam booklet should have **seven** pages total, with questions on pages 2-5, and a periodic table and other reference data on pages 6 and 7. Check to see you have seven pages now. If you do not, ask for another copy of the exam.
2. You may remove the last two pages.

- Write your name in the space above and on the backs of pages 2-5.
- This exam is closed-everything.
- You may use programmable calculators, but chemical data should not be stored in them.
- You have up to **90 minutes** to work on this exam, if you start work at 8:00 a.m.

What not to memorize (they will be provided):

- A periodic table
- The information below:

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

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

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

$$\Delta E = -\mathfrak{R}Z^2 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \quad \mu = \frac{m_1 m_2}{m_1 + m_2} \quad W = \frac{n!}{n_0! n_1! n_2! \dots}$$

$$\frac{n_j}{n_i} = e^{-(E_j - E_i)/kT} = e^{-\Delta E_{ij}/kT} \quad \frac{n_{j \text{ or above}}}{n} = \frac{n_j}{n_0} e^{-j(E_i - E_0)/kT} = e^{-\Delta E_{ij}/kT}$$

$$c = \lambda \nu \quad \frac{1}{\lambda} \equiv \tilde{\nu} \quad E = h\nu \quad T(\text{K}) = T(^{\circ}\text{C}) + 273.15 \text{ K}$$

$$k = 1.381 \times 10^{-23} \text{ J K}^{-1}$$

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

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ amu} = 1.661 \times 10^{-27} \text{ kg}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$$

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

$$c = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$1 \text{ m} = 10^9 \text{ nm} = 10^{10} \text{ \AA}$$

$$\mathfrak{R} = 2.178 \times 10^{-18} \text{ J}$$

Test-Taking Tips

- Pace yourself. Try to make your effort on a given problem proportional to the number of points that it is worth.
- Read the problems carefully.
- If you can't figure out how to begin a problem after thinking about it for a couple of minutes, go on to the next problem.
- Please ask me if a question doesn't make sense.