

Preview Sheet for Test 3

Chapter 13 (plus a little bit of Chapter 9)

Lectures from 3/28 through 4/23; Problem Set 5; Experiment 3

The test will be on Thursday, May 1, in Olin-Rice 350, starting at 8:30 a.m. You will have three hours to work, and can consult a 1-page cheat sheet.

Studying strategies:

- Focus on your lecture notes, homework, and Experiment 3 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. The focus of the calculation problems will be the application, not the derivation, of equations.
- 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.

Preview of the test instructions:

1. Your exam booklet should have **eight pages** total, with questions on Pages 2-6, a periodic table, equations, and constants on Page 7, and a table of nuclei masses on Page 8. Check to see you have eight pages now. If you do not, ask for another copy of the exam.
2. Write your name in the space above and on the backs of Pages 2-6.
3. You may carefully remove Pages 7-8 from your exam booklet.
4. You may fill both sides of an 8.5" x 11" sheet of paper with whatever information you would like, and refer to it during the exam.
5. You should always demonstrate your thought process in writing unless told not to. You will be awarded credit only for work I can decipher.
6. You have a maximum of **3 hours** to work on this exam.

[Continued on the back side.]

Information that will be provided in the test booklet:

- A periodic table
- A table of the masses of common nuclei (Atkins and de Paula p. 991)
- The information below:

$$X_{\text{CM}} = \frac{m_1}{m_1 + m_2} X_1 + \frac{m_2}{m_1 + m_2} X_2 \quad \mu = \frac{m_1 m_2}{m_1 + m_2} \quad I = m_1 R_1^2 + m_2 R_2^2 = \mu R^2$$

$$\frac{E_{\text{rot}}}{hc} = F(J) = BJ(J+1) \quad \text{or} \quad \frac{E_{\text{rot}}}{hc} = F(J) = B_v J(J+1) - D_v J^2(J+1)^2$$

$$B = \frac{h}{8\pi^2 c \mu R^2} \quad \text{or} \quad B_v = \frac{h}{8\pi^2 c \mu R_v^2} \quad D_v = \frac{4B_v^3}{\tilde{\nu}^2}$$

$$N_i = (\text{constant}) g_i \exp(-E_i / kT) \quad g_{\text{rot}} = 2J + 1$$

$$\frac{E_{\text{vib}}}{hc} = G(v) = \left(v + \frac{1}{2}\right) \tilde{\nu} \quad \text{or} \quad \frac{E_{\text{vib}}}{hc} = G(v) = \left(v + \frac{1}{2}\right) \tilde{\nu} - \left(v + \frac{1}{2}\right)^2 x_e \tilde{\nu}$$

$$\omega = 2\pi\nu = 2\pi c \tilde{\nu} = \sqrt{\frac{k}{\mu}} \quad x_e = \frac{\tilde{\nu}}{4D_e}$$

$$V = \frac{1}{2} k(R - R_e)^2 \quad V = hcD_e \{1 - \exp[-a(R - R_e)]\}^2 \quad a = \sqrt{\frac{\mu\omega^2}{2hcD_e}}$$

$$h = 6.62608 \times 10^{-34} \text{ J s} \quad \hbar = 1.05457 \times 10^{-34} \text{ J s} \quad c = 2.99792 \times 10^{10} \text{ cm s}^{-1}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2} \quad 1 \text{ u} = 1.66054 \times 10^{-27} \text{ kg} \quad 1 \text{ eV} = 96.485 \text{ kJ mol}^{-1} = 8065.5 \text{ cm}^{-1}$$