

**Chem 13H Exam #1**  
**Spring 2002 (corrections in 2002 and 2004)**

*Note that more points are awarded for your explanations than for the correct answer.  
Closed book exam. No calculators are required (or allowed!). A periodic table is supplied; you may not use your own.*

- 1) Choose two alkali atoms (from Li, Na, K, Rb, Cs).
  - a) Explain the relative reactivity of these elements with water.
  - b) For one of these elements, write the reactions that take place.(15 points)
  
- 2) Describe a set of *experiments* to determine (quantitatively) the relative atomic radii of Na, Mg, and Al. Describe what materials/molecules you will use and in what form.  
(20 points)
  
- 3) Energies -- for (a-c) use the same energy units (presumably your favorite)
  - a) What is the energy (or range) of a visible photon?
  - b) What is the energy of a typical covalent bond?
  - c) What is the energy of an X-ray photon used for determining crystal structures via diffraction (hint- by what factor is this different than a visible photon)?
  - d) Convert the visible photon energy you gave above into three of the following (that are not the same as you used above):  $\text{cm}^{-1}$ , eV, Hz, J, kcal/mole, kJ/mole(20 points)
  
- 4) Describe an experiment in the life sciences in which fluorescence is used. What key information can be obtained? How is this done? What actually fluoresces? How is it attached or related to the species of interest?  
(20 points)
  
- 5) How could you differentiate between water ( $\text{H}_2\text{O}$ ), nitrogen gas ( $\text{N}_2$ ) and carbon monoxide ( $\text{CO}$ ) using mass spectrometry? (All are 18 amu -- **ok, so  $\text{H}_2\text{O}$  is 18 and the other two are 28; that just made it easier and convinced me to start sleeping more before making up exams**) (10 points)
  
- 6) Rank the following in order of increasing pH and explain your answer:  
0.1 M  $\text{Al}(\text{NO}_3)_3$       0.1 M  $\text{HCl}$       0.1 M  $\text{NaNO}_2$       0.1 M  $\text{NaNO}_3$   
(15 points)

*Extra credit*

Give a chemical reaction that is used in nanofabrication/nanolithography. How is it used?