

**Academic Honesty:** The answers on this test are my own and I am using only the allowed set of notes as described in the syllabus. I have not discussed the test questions with anyone before or during the test nor have I seen the test questions prior to the exam. If you violate any of the preceding items or do not sign, your semester grade is a F.

Signature: \_\_\_\_\_

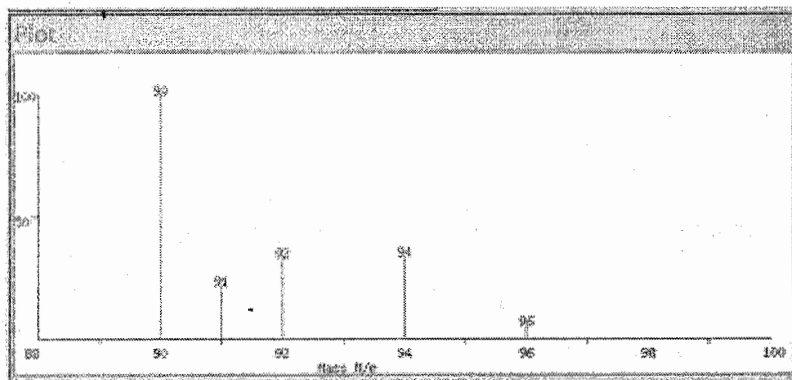
In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), (iii) put the proper units in your calculations and answer, and (iv) have the proper number of significant figures in your answer.

Feel free to adjust the amount of spacing between problems to fit your answer.

1. What's an alloy and describe the two types of alloys. [10 points]

- 4 pt i) mixture of metal = alloy  
 3 pt ii) subst alloy = similar structure  
 3 pt iii) interst alloy: different size atoms

2. Based on the below mass spectrum of an atom, what is its average atomic mass? [10 points]



Data table

90	100
91	21.9
92	33.4
94	33.7
96	5.4

$\Sigma = 194.4$

2+4pt  $\bar{x} = \Sigma m_i p_i = 90 P_{90} + 91 P_{91} + 92 P_{92} + 94 P_{94} + 96 P_{96}$   
 $= 90 \frac{100}{194.4} + 91 \frac{21.9}{194.4} + 92 \frac{33.4}{194.4} + 94 \frac{33.7}{194.4} + 96 \frac{5.4}{194.4}$   
 $= 46.296 + 10.252 + 15.867 + 16.295 + 2.667$   
 $= 91.3$

1s 2s 2p 3s 3p

3. Sketch the photoelectron spectrum (PES) of aluminum and silicon on the same graph. Label the axis (include convention on horizontal axis – increasing or decreasing as you go to the right or left) and identify the signals in the spectrum – corresponding to which atom / atomic orbital and the relative area or peaks in each signal. [10 points]



4. What is the relative position of 1s atomic orbital in the PES spectrum of aluminum versus silicon? Basis / rationale? [5 points]

Al Si energy to remove e-  
 high low Si > Al

Al has ↑ Z } → ↑ Z\_eff → ↑ K\_eff → hard to remove e-  
 ignore s }  
 Al 1s AO → energy to remove e-

continue onto next page

5. In regards to lattice energy, [10 points]

a. what is it?

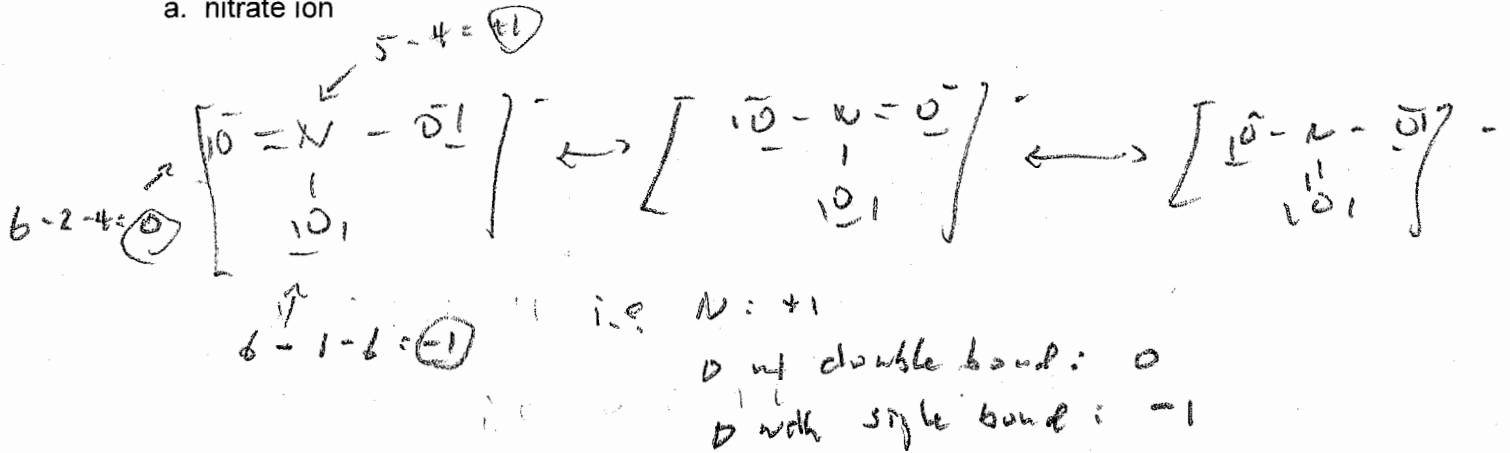
2 pt energy to separate/separate ions in ionic comp

b. what is the relative lattice energy between sodium chloride versus sodium fluoride? basis / rationale?

2 lattice energy:  $NaCl < NaF$  b/c more Fattr  
 2 b/c distance between ions  $\uparrow$  for NaCl  
 2 b/c  $Cl^- > F^-$  ion size  
 2 b/c Cl has more shells of  $e^-$

6. Sketch / draw the Lewis structure(s) of the below (hypothetical?) species      and the formal charges of all of the atoms in the species (i.e. ion or molecule). [20 points]

a. nitrate ion



b. NHFBr

