Physics 575 Exam 1 Due February 14, 2008

Explain the physics for each of the topics on page 2 in your own words. You do not have to write a perfect essay on each topic, but do write enough to convince me that you really understand the topic and that you could write a perfect essay given sufficient time. You should be able to do this for each topic in a paragraph or two.

Don't forget that equations, pictures, and graphs are more effective than words.
If a picture is worth a thousand words, and an equation is worth a thousand pictures, then ...

Use the applets on page 3 to cement your understanding of the basic physics.
Each writeup should be at least one page long.
Include figures that you make using the websites in your writeups.

You can submit your exam electronically by sending it to seattle@u.washington.edu
If you submit electronically, please use the Adobe .pdf or the Microsoft .doc format.

	A
1	What is a Bravais lattice, and what is it good for?
2	Position space, the direct lattice, and real space
3	Momentum space, the reciprocal lattice, and reciprocal space
4	Primitive cells and conventional cells
5	Explain why we use conventional cells
6	The 4 two-dimensional crystal classes
7	The 5 two-dimensional Bravais lattices
8	The 10 two-dimensional point groups
9	The 17 two-dimensional space groups
10	The 14 three-dimensional Bravais lattices
11	The 7 three-dimensional crystal classes
12	The 14 three-dimensional Bravais lattices
13	The 32 three-dimensional point groups
14	The 230 three-dimensional space groups
15	Quasicrystals
16	Miller indices
17	(hkl), [abc], {hkl}, and <abc>
18	Bragg reflections
19	x-ray diffraction, neutron diffraction, and electron diffraction
20	The Wigner-Seitz (aka, Voronoi) construction
21	What is the first Brillouin zone, and why is it so important for phonons?
22	The first, second, and third Brillouin zones
23	The zone center and the zone boundary
24	The extended, reduced, and repeated zone schemes
25	The phonon dispersion relation for the monoatomic 1d chain
26	Sketch the group and phase velocities versus k for the monoatomic 1d chain
27	The phonon dispersion relation for the diatomic 1d chain
28	Sketch the group and phase velocities versus k for the diatomic 1d chain
29	For 22 and 23, explain what happens near the zone boundaries
30	The phonon dispersion relation for a real polyatomic solid
31	Acoustic phonons
32	Optical phonons
33	The classical model of a solid and its heat capacity
34	The Debye model and its heat capacity
35	The Einstein model and its heat capacity
36	What fraction of the periodic table is metallic?

	A
1	http://escher.epfl.ch/fft/
2	use this applet to understand crystallography
3	pick your unit cell
4	draw your basis inside your cell
5	take the fourier transform of your unit cell
6	make the crystal based on your unit cell
7	take the fourier transform of your crystal
8	Turn in a writeup explaining crystallography--lattice, basis, structure factor, convolution theorem, phase ...
9	
10	http://www.jcrystal.com/steffenweber/JAVA/jwallpaper/J2DSPG.html
11	http://escher.epfl.ch/escher/
12	use these applets to understand the 17 2d space groups
13	pick an object without any 2d symmetry
14	use your object to make crystals with each of the 17 2d space groups
15	Turn in a writeup explaining the 17 2d space groups
16	
17	http://www.dsptutor.freeuk.com/aliasing/AliasingDemo.html
18	http://ocw.mit.edu/ans7870/18/18.06/javademo/Aliasing/
19	use these applets to understand the temporal Nyquist frequency
20	Turn in a writeup explaining the temporal Nyquist frequency
21	
22	http://ptolemy.eecs.berkeley.edu/eecs20/week13/aliasing.html
23	http://www.falstad.com/dfilter/index.html
24	use these applets to listen to the temporal Nyquist frequency
25	Turn in a writeup explaining the audio Nyquist frequency
26	
27	http://ptolemy.eecs.berkeley.edu/eecs20/week13/
28	http://ptolemy.eecs.berkeley.edu/eecs20/week13/images.html
29	http://ptolemy.eecs.berkeley.edu/eecs20/week13/moire.html
30	use these applets to visualize the spatial Nyquist frequency
31	Turn in a writeup explaining the spatial Nyquist frequency
32	
33	http://www.chembio.uoguelph.ca/educmat/chm729/Phonons/monatom.htm
34	http://en.wikipedia.org/wiki/Acoustic_phonon
35	Turn in a writeup explaining the longitudinal and transverse modes for 1d monoatomic chains
36	
37	http://fermi.la.asu.edu/ccli/applets/phonon/phonon.html
38	http://buckminster.physics.sunysb.edu/intlearn/phonon/phonon_dispersion.html
39	Turn in a writeup explaining the longitudinal and transverse modes for 1d diatomic chains
40	
41	http://physchem.ox.ac.uk/~rkt/tutorials/statmech/statMechanics_3.html
42	Turn in a writeup explaining the behavior of the heat capacity versus the parameters in the models
43	
44	http://escher.epfl.ch/diffractOgram/
45	Turn in a writeup explaining diffraction--the Ewald sphere, the Bragg and Laue equations, ...
46	
47	