A. All necessary integrals will be given on the exam

B. A formula sheet will be given out. See later this week

C. You can write a 3×5 index card of notes to supplement the sheet

1. **Fourier Analysis.** Be able to find the fourier series of real functions. See the problems associated with Fig.1 and Fig.2 of homework 6. Only the sin and cos form will be tested.

2. **Uncertainty Principle and DeBroglie Wavelength**.
   - You should be able to make estimates using the debroglie wavelength For instance problem 5.12, 5.24
   - Understand that bound states (like the hydrogen atom, molecules, nuclei, etc) are a balance between kinetic and potential energy. You should be able to use this balance to estimate the typical energies and sizes of bound states. For instance:
     - Use this to estimate the size and energies of the hdyrogen atom as done in class and in the HW#5
     - Or to determine the typical size of a particle attatched to harmonic oscillator (see problem set 8).
     - Or for nuclei problem 6.9

3. **Wave functions in 1D**
   - Understand that the wave functions are associated with a probability distribution and use this to compute various properties, such as the average position and spread in x space. See problems 6.29, 6.30, 6.31, 6.32
   - Understand how to compute the average kinetic energy associated with a wave function, See HW#8 additional problem on harmonic oscillator
   - Understand how to compute the average potential energy associated with a wave function, see HW#8 additional problem.

4. **Quantum Mechanics in 1D**
   - You should be able to write down the time independent Schrödinger equation and understand that it is a translation of the following statement
   $$(KE + PE)\psi_n = E_n\psi_n \tag{1}$$
   with the rule $\mathbb{P} = -i\hbar\frac{\partial}{\partial x}$
   - You should be able to verify that this or that wave function satisfyies the Schrödinger equation, see Problem 6.24 + extra problem in HW#8.

5. **Particle in Box, Problems 6.6, 6.9, 6.11, 6.12**
   - You should know the particle in the Box wave functions by heart and understand that the quantization of energies results from the condition that the wave function fit in the box.
   - You should be able to sketch these wave functions and there associated probabilities.
   - You should be able to use particle in box logic to estimate the energies associated with different things such as nuclei(problem 6.9)
   - You should understand qualitatively what happens in a finite box. You should be be able to sketch the wave functions in a classically allowed region and classically forbidden region and estimate the penetration depth. You should be able to say what are the classically allowed and forbidden regions. See problem 6.21

6. **3D Box**
   You should know what the wave functions are, how you count them, how you count them, and what the energies are. See problem 8.1

7. **Classification of Hydrogen Atom**
   - You should understand how to write down the different wave functions associated with different states of the hydrogen atom using tables and know the vocabulary. For instance if I ask you to write down the wave functions for the $2p$ electron you would know where to look to write it down. You should be able to sketch the radial wave function u_{nl} and the associated probabilities. Indicate on your graph the most likely radius, average radius, etc.

- You should be able to classify the states of hydrogen, count there numbers, and tell me what the energy, total angular momentum, and z component of angular momentum are (8.14, 8.16, 8. 18).
- You should understand that atoms are made up by filling these states. There are two electrons per state and this describes the periodic table.

8. **3D Schrödinger equations HW#9 extra problems**
    - You should be able to show that this or that wave function satisfies the radial Schrödinger equation, i.e. show that $2p$ state satisfies the radial Schrödinger equation and determine the energy. For this you have to differentiate carefully, check, check, check... . and know how kinetic and potential energies are related at a Bohr radius ($\hbar^2/(2ma_0^2) = k_c^2 e^2/(2a_0)$)

9. **Probability, 8.22, 8.24, 8.25, 8.26, 8.29**
    - You should understand that $P(r)\,dr = |u_{n\ell}|^2 dr$ is the probability to find an electron at a given radius r in a bin of size dr.
    - You should be able to calculate various physical quantities associated with this probability distribution. Average KE, Average PE, most likely radius, average radius, spread in radius.