Review for Final Exam

This review packet is not meant to be comprehensive. For the exam you should also review your class notes, book, and ABCD questions (posted with the PPT slides in the course website). Focus on *concepts* and trying to understand relationships between variables. Remember that you must justify all of your answers.

The final exam will consist of 40 multiple choice or short answer questions, as follows:

- 20 questions from previous exams and review packets
- 10 questions written by students
- 10 questions similar to previous exam and review packet questions

No equations will be given in the final exam. Only the following constants will be listed:

$h = 6.626 \times 10^{-34}$ J s	$hc = 1240$ eV nm	$k_B = 8.62 \times 10^{-5}$ eV / K
$k = 8.99 \times 10^{9}$ N m^2/C^2	1 eV = 1.602×10^{-19} J	$k_B = 1.38 \times 10^{-23}$ J / K
$e = 1.602 \times 10^{-19}$ C	$R = 8.31$ J/(K mol)	$k_B = R / N_A$
$m_e = 9.11 \times 10^{-31}$ kg		

Equations / relationships / constants you should know:

Exam 1:

$$\Delta KE = q\Delta V \qquad PE = -\frac{kZe^2}{r} \qquad KE = \frac{1}{2}mv^2$$

$$E = h\upsilon = \frac{hc}{\lambda} \qquad PV \propto T \qquad U = \frac{1}{2}kT \times \begin{pmatrix} \#\, quadratic \\ terms \end{pmatrix}$$

definition of *eV* $\quad c = 3 \times 10^8$ m/s

Exam 2:

$$I \propto E_0^{\,2} \propto (number\ \ of\ \ photons)$$

Infinite square well: $E_n \propto \frac{n^2}{mL^2}$ Hydrogen like atoms: $E_n \propto -\frac{Z^2}{n^2}$

Solutions to Schrödinger equation: $E < V$, decreasing exponential
$E > V$, sines and cosines

Intensity = Power/Area *Power = Energy/time* $N_{photons} = E_{total} / E_{photon}$

Constructive/ destructive interference: $\Delta L = n\lambda$ $\Delta L = \left(n + \frac{1}{2}\right)\lambda$

$KE_{\max} = h\upsilon - \Phi$ $p = \hbar k = h/\lambda$ $k = 2\pi/\lambda$

$probability \sim e^{-E/kT}$

Exam 3:

$g(E) \propto E^{1/2}$ $E_{ave}(T = 0K) = (3/5)\, E_{F0}$

Exam 4:

$\sigma = en\mu_e + ep\mu_h$

$np = n_i^2$

$voltage \propto (electric \quad field)(w_p + w_n)$

Sketches:

You should be able to sketch

- energy vs. inter-atomic distance for ionic and secondary bonding
- the Maxwell-Boltzmann distribution
- the Boltzmann probability function
- the Fermi-Dirac probability function at T = 0K and T > 0K
- linear combinations of atomic orbitals
- density of states as a function of energy
- energy band diagrams for conductors, insulators and semi-conductors
- energy band diagrams and depletion layers for PN junctions
- charge density, electric field, voltage for PN junctions
- control voltage vs. current for a transistor