CHEM352: PHYSICAL CHEMISTRY II
HOMEWORK SET I - DUE 22^{th} OF FEB, 3.00 PM
Each problem is worth 5 points, 25 pts in total.

Instructor: Dr. Mateusz Marianski

Room#: HN-1321B
email: *mmarians@hunter.cuny.edu*
Office hours: Thu, 4-6 pm, HN-1321B

Problem I

1. Show (calculate) from Rydberg formula the wavelength limits of Lyman, Balmer and Paschen series. Identify the spectral regions of these wavelengths.
2. Generalize the Rydberg formula for $\bar{\nu}$ for a nucleus of atomic number Z.

Problem II

Using your favorite web-search engine, social network or encyclopedia to find the work function for chromium, gold, sodium and cesium. Next, calculate the kinetic energy of electrons emitted from a metal surface that is irradiated with radiation of wavelength of 200 nm.

Problem III

1. (Warm-up) Prove that:
   - $$e^{i\pi} = 1$$
   - $$\cos\alpha = \frac{e^{i\alpha} + e^{-i\alpha}}{2}$$
   - $$\sin\alpha = \frac{e^{i\alpha} - e^{-i\alpha}}{2}$$
2. Solve the equation:
   $$\frac{d^2x}{dt^2} + \omega^2 x(t) = 0$$
   Subject to the initial conditions $x(0) = A$ and $\frac{dx}{dt} = v_0$ at $t = 0$.
3. The general solution to the above differential equation is:
   $$x(t) = c_1 \cos\omega t + c_2 \sin\omega t$$
   Fot convenience, the solution is often presented in the equivalent forms: $x(t) = A\sin(\omega t + \phi)$ or $x(t) = B\cos(\omega t + \psi)$. Using trigonometric identities, derive expressions for A and ϕ (and B and ψ) in terms of c_1 and c_2.

Problem IV

1. Calculate $< x >$,$< x^2 >$, $< p >$ and $< p^2 >$ for the n=2 state of a particle in one dimensional box. Next, compute respective standard deviations and show that Heisenberg uncertainty principle holds.
2. Use partice in a box model to estimate the electronic excitation energies in a haxatriene. Compare predicted and experimental values.

Problem V

Choose one from the three **challenging** problems posted on blackboard (4-33: energy barrier, 4-35: tunneling or 4-38: finite well), analyze the problem and... well - show the solution. The problems are mostly self-explanatory however the solution require your independent work. Don't leave until last moment.