Problem set 1, Due Sep 8 in class

1. Particle's wave function is
$$\psi(x) = C \exp\{ip_0 x/\hbar - (x - x_0)^2/(2a^2)\} \quad (1)$$
(all parameters are real). Find average values of coordinate x, momentum p and their fluctuations.

   Find WF (1) in momentum representation

2. For a given WF $\Psi(x, y, z)$ find a probability for a particle to be in the range $z_1 < z < z_2$ and $p_1 < p_y < p_2$.

3. Find eigenvalues and eigenfunctions of a quantity $\hat{f} = \alpha\hat{p}_x + \beta\hat{x}$, where $\hat{p}_x$ and $\hat{x}$ are momentum and coordinate operators

4. Using dimensional analysis, estimate Bohr's orbit for the motion of electron around proton. Disregard numerical factors of the order of a few. (Hints: Proton is heavy - not moving, its mass is not important. Assume velocity is $\ll$ speed of light - c is not important. Only electron mass, elementary charge and Planck's constant are the important quantities. Also, for a bound orbit potential electric energy is of the order of the kinetic energy.) Clearly explain your steps - do not just write down the answer.