Structure of matter: Series 3

Due on November 9th 2017 after the lecture

Please indicate your name and the name of your seminar group leader on the solution sheets!

1. Show that the expectation values of the spatial coordinate **r** and the momentum **p** of a free moving particle with mass m satisfy the "classical" relation: $\frac{d\langle \boldsymbol{r} \rangle}{dt} = \frac{1}{m}\langle \boldsymbol{p} \rangle$ (4 Points)
2. Assume that the wavefunction $\Psi(\mathbf{r};t)$ of a particle is real. Show that then the expectation value of the momentum is zero. (2 Points)
3. Consider a particle trapped in a one-dimensional box potential with length L and infinitely high potential walls, i.e.
   $U = 0; \quad 0 \le x \le L$
   $U \to \infty; \quad x < 0 \text{ or } x > L$
   Calculate the expectation value of the x-coordinate in the state n = 1! (3 Points)
4. Prove the commutation relation: $\left[\hat{L}_x, \hat{L}_y\right] = i\hbar\hat{L}_z$. $\hat{L}_x, \hat{L}_y \text{ and } \hat{L}_z$ are here operators of the components of the angular momentum. (3 points)