Tue. Apr. 25, 2017
PSAM – QM Class 24.2

Worksheet: ONE-DIMENSIONAL HARMONIC OSCILLATOR WAVE FUNCTIONS

Instructions:
- □ Work in groups of 2 or 3 (or by yourself if you prefer)
- □ Feel free to consult your textbook and reading/lecture notes.
- □ Work out loud on whiteboards (even if working by yourself), and also get your work in your reading/lecture notes.
- □ Please consult with neighboring groups and with me frequently and eagerly.

For questions 1) – 6), study and follow along with the derivation in section 7.9 Solving the Schrödinger Equation in Position Space.

1) Re-write eq (7.95) using (7.97). Show that this can be written in the form (7.98) using the dimensionless variables y and ε, given in (7.96) and in the line after (7.98).

2) Follow the steps that connect starting two sentences before (7.99) to (7.102). I think this requires quite a bit of unraveling, especially between (7.100) and (7.101).

3) Substitute (7.102) into (7.98) to obtain (7.103).

4) Substitute (7.104) into (7.103) to obtain (7.105).

5) Follow the steps that lead from (7.105) to (7.108). I think this requires quite a bit of attention.

6) Follow the steps that lead from (7.109) to (7.114). Again, I think this requires significant work.

7) Study Example 7.5.

8) Work on Problem 7.15. Compare your results to a table of Hermite polynomials.

For questions 9) – 10), study and follow along with the derivation in section 7.4 Position-Space Wave Functions

9) Follow the steps that lead from eq (7.38) to (7.44), and fill in the many gaps. Note: this is similar to what you did for Problem 7.4, due last week.

10) Applying (7.45) to (7.44), carry out the calculations to arrive at (7.46) and (7.47).

Follow-up: Turn these questions/tasks into Learning Goals. For example: "I can use operator methods to determine the energy eigenfunctions of the harmonic oscillator in position-space."

Fill in the appropriate boxes for equations for energy eigenfunctions of the quantum harmonic oscillator in position-space. Check the box for if you determined the equation using operator methods, diffeq methods, or both boxes if both.

Plots of energy eigenfunctions	Equations of energy eigenfunctions in position space	Operator Methods	DiffEq Methods