7.W Simple Harmonic Oscillator Wavefunctions

Instructions:

- □ Work in groups of 2 or 3 (or by yourself if you prefer).
- □ Work out loud on whiteboards (even if working by yourself). Take pictures of your whiteboards so you can get your work into your notes.
- □ Consult your textbook and reading/lecture notes.
- □ Please consult with neighboring groups and with me frequently and eagerly.
- □ When completing your QM PSN Log for QM PS#10, refer to this as 7.W. There won't be a CSS solution to compare it with. Keep it with your reading/lecture notes, not loose in your PSN.

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) Complete 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 we did for Problem 7.4, covered in class and on QM PS#9.

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

Fill in the appropriate boxes for equations for energy eigenfunctions of the quantum harmonic oscillator in position-space.

Initial the appropriate box if you determined the equation using operator methods (as in Section 7.4), differential equation methods (as in Section 7.9), or initial both boxes if you were able to do it both ways; if you looked it up, cite your source(s). The graphs were taken from your textbook.

Plot of energy eigenfunction	Equation of energy eigenfunction in position space	Operator Methods	DiffEq Methods