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| CHEM 3322: Physical Chemistry II | Jonathan Riezman |
| Meeting 6 Quick Problems | 02/08/21 |

1) Let Ψ be a wave function that is not an eigenfunction of the energy operator but can be written as a sum of eigenfunctions of the energy operator, ψn, and expansion coefficients, cn, such that and therefore where the En are the eigenvalues of ψn with respect to the energy operator. We know from the 4th postulate of Quantum Mechanics that when a wave function is normalized the expectation (or average) value of an operator is given by thus the probability of measuring any particular Em is the square of its expansion coefficient. Specifically, in this case the probability of measuring E1 for a large set of identically prepared systems is .

2) Given that Ψ is normalized, . Using Ψ in terms of the expansion coefficients and eigenfunctions we have , but since all the the eigenfunctions of Ψ form an orthonormal set, so the above expression simplifies to for the average energy of a QM system described by Ψ.

3) We now calculate or the standard deviation of the energy measurement for this system. From above we see . Because , . Expanding this expression gives . So finally we have .