

Tutorial: The Parity Operator¹

Physics 564 – Advanced Quantum Mechanics II

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Parity

- 1.) What is the meaning of parity? To be sure we're all on the same page, what is the parity of the position coordinate x ? The parity of p ?
- 2.) For a particle in an energy eigenstate of a square well extending over $-\frac{a}{2} < x < \frac{a}{2}$, you are calculating the expectation value of the following quantity: $x^2p^3 + x^6px^2 + x^5p^3$. Without doing any calculation, look at each term and decide whether or not any calculation would be necessary. Explain.
- 3.) Give the parity of the following functions and variables (A, k, a, b, c are assumed to be constants).
 - a. $\psi(x) = A\cos(kx)$
 - b. $\psi(x) = Ae^{-ikx}$
 - c. $xp - px$
 - d. $i\hbar$
 - e. $ax^2 + bp^2 + cpx$
- 4.) In problems with spherical symmetry (later), you may be asked to determine the parity of things in spherical coordinates. Give the parity of $\cos(\theta)$, where θ is the angle from the z axis. Careful! Parity is ALMOST the same as being an even or odd function of some variable... but you have to be very precise!

¹ This is based on: C. D. Porter and A. F. Heckler, Effectiveness of guided group work in graduate level quantum mechanics, Phys. Rev. Phys. Educ. Res. 16, 020127 (2020).