Problem Set 15 — Also Goes with Chapter 11

For Quantum Mechanics, Monday, Apr. 6, 2026

The reading that goes with this problem set is III-11-6. Also look ahead and read III-13-1 and III-13-2, which is a buildup to the Schrodinger Equation. The Schrodinger Equation applies to probability amplitudes that depend on position. Feynman is getting us going on this by considering an electron that can be at an infinite number of discrete positions.

1. Exponential and Trig Functions of Pauli Matrices

This is just a bit more mechanical practice, but quite suggestive practice, that helps you start seeing the convenience of working with Pauli matrices.

(a) Derive/check the identities in Table 11-2 using Table 11-1.
(b) What is $\cos \alpha\sigma_x$? Use the Taylor series for cosine to define the cosine of a matrix.
(c) What is $\sin \alpha\sigma_x$? Use the Taylor series for sine.
(d) What is $e^{i\alpha\sigma_x}$? Use the Taylor series for the exponential.
(e) What is the relation between the quantities in (b), (c), and (d)?
(f) With no significant additional work what is the relationship between $e^{-i\mu B_x \sigma_x t/\hbar}$, $\cos(\mu B_x \sigma_x t/\hbar)$, and $\sin(\mu B_x \sigma_x t/\hbar)$?
(g) As a rhetorical question, can you see that the result you got in (f) might be extremely useful?

2. Feynman Problem for 78.4 for Chapter 11

You will need Section III-11-6 for this problem. Feynman has a sneaky way of attacking the problem that does not require the determinant of a 6x6 matrix. Read what he suggests as an approach for finding E_I, E_{II}, etc., and the associated $C_{I,i}$, $C_{II,i}$, etc.

It might be helpful to do the same problem but with only 3 atoms in the ring first. There will be less algebra to balloon the problem up with. However, once you have done it for 3 and 6 atoms, probably you can write your answer in a nice way that does it once and for all for a ring of N atoms.