References are to equations appearing in the course book.

Problem 7.1

Consider a boxcar spin-density distribution with width z_0, centered at $z = 0$, and given by $\rho(z) = \rho_0 \text{rect}(z/z_0)$. Find the signal $s(k)$ for this spin density from (9.15). The answer will involve the sinc function, $\text{sinc}(\pi k z_0)$. Then check, using integral tables for example, that the answer gives back the correct spin density through the inverse transform (9.17).

Problem 7.2

Spins with gyromagnetic ratio γ are uniformly distributed with uniform spin density ρ_0 along the z-axis from $-z_0$ to z_0 in a 1D imaging experiment. Suppose that they are excited at $t = 0$ by an rf pulse such that the signal at that instant would be given by

$$s(t = 0) = \int_{-z_0}^{z_0} dz \rho_0 = 2 z_0 \rho_0 \tag{9.40}$$

A negative constant gradient field $-G$ is immediately applied at $t = 0^+$ and flipped to the positive gradient field $+G$ at time $t = T$. Find an expression for the signal for $t > T$ and show that it exhibits a gradient echo at time $t = 2T$.

The problems are based on those in Robert W. Brown, Y.-C. Norman Cheng, E. Mark Haacke, Michael R. Thompson, Ramesh Venkatesan. *Magnetic Resonance Imaging: Physical Principles and Sequence Design*, 2nd Edition, Wiley, 2014.