Ph217c, Homework 4.
Due Thursday, May 1, 2008.

1. [35%] **Superhorizon perturbations in the matter era.** Use the conservation of the curvature perturbation ζ to prove that after matter-radiation equality, and on superhorizon scales $k/aH \ll 1$, the density and potential obey

$$\delta = \frac{9}{5}\Phi(0) \tag{1}$$

and

$$\Phi = \frac{9}{10}\Phi(0), \tag{2}$$

where $\Phi(0)$ is the radiation-era potential.

2. [30%] **Horizon scale at equality.** Dodelson #7.5.

3. [35%] Λ **and growth of structure.** Numerically integrate the second-order differential equation for $\delta(a)$ derived in class (or in Dodelson) for a flat universe containing matter and a cosmological constant. Determine the final growth factor $D(a = 1)$ and its fractional derivative $(dD/da)/D$ as a function of the present-day $\Omega_{\Lambda 0}$.