

# COSMOLOGY ASTM108

## PROBLEM SET 5

1. Just one question this week – asking you to work through the steps of Section 6.5 in the printed lecture notes to derive the age of a flat universe containing a cosmological constant and pressureless matter. Starting from the Friedmann equation (6.24), verify Eq. (6.30), where

$$\Omega_{M0} = \frac{8\pi G\rho_0}{3H_0^2}, \quad \Omega_{\Lambda 0} = \frac{8\pi G\Lambda}{3H_0^2} \quad (1)$$

for the matter and cosmological constant respectively. (Hint: recall the density of matter falls as  $\rho \propto a^{-3}$  and normalize at the present epoch to eliminate  $\rho_0$  in terms of  $\Omega_{M0}$ ). Substitute (6.30) into the general expression for the cosmic age, Eq. (5.27):

$$t_0 = \int_0^{a_0} \frac{da}{aH(a)} \quad (2)$$

and go through the steps to Eq. (6.37).

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