

AST 250 – Spring 2018

Homework Due: Friday April 27

43. In class, we derived the time dependence of the scale factor $a(t) \sim \exp(H_0 \Omega_{\Lambda,0}^{1/2} t)$, in a Universe that is dominated by Dark Energy. Using this proportionality, show that the Hubble parameter is really a constant with time. Find the equation for this Hubble constant in the Dark Energy-dominated Universe. Calculate the e-folding time for this exponential expansion. The e-folding time is the time required for $a(t)$ to increase by a factor of e . Assume $\Omega_{\Lambda,0} = 0.69$ and give your answer in terms of Gyrs.
44. Re-write the Friedmann Equation (the version with Ω s) to solve for da/dt (assuming curvature = 0 or flat geometry). Now take the time derivative of both sides of the equation to get d^2a/dt^2 , the acceleration of the scale factor (don't forget to use the chain rule!). Pull out da/dt from your three Ω terms and substitute for it using the expression you derived at the beginning of this problem. Explain why Ω_{Λ} results in acceleration of the scale factor while Ω_m and Ω_r result in deceleration of the scale factor.

