

**PHYS 480/581**  
**Cosmology**

Worksheet #7  
Wednesday 09/14/2022

**Question 1.**

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In the following, express the different ages as functions of the Hubble time,  $1/H_0$ .

- (a) Compute the age of a flat ( $k = 0$ ) universe entirely dominated by matter ( $\Omega_m = 1$ , all other density parameters are zero).
- (b) Compute the age of a flat ( $k = 0$ ) Universe with  $\Omega_m = 0.3$  and  $\Omega_\Lambda = 0.7$ . You can do the integral numerically if you want, although it also has an analytical solution (see below). Is this Universe younger or older than the purely matter-dominated universe of part (a)?
- (c) Compute the age of a curved matter-dominated universe with  $\Omega_m = 0.9$  and  $\Omega_K = 0.1$ ? You can Taylor expand the integrand to perform the integral. Is this universe younger or older than a purely matter-dominated flat ( $k = 0$ ) universe?

*Hint: you may find this integral useful:*

$$\int_0^1 \frac{\sqrt{x}}{\sqrt{1+bx^3}} dx = \frac{2}{3\sqrt{b}} \sinh^{-1}(\sqrt{b}) \quad (1)$$

