COSMOLOGY Homework 3 Fall 2018

Due on Saturday September 22 by 14.00.
From now on, the exercise sessions are in room SCI253 on Thursdays at 9.00-10.50.

1. **Redshift.** Derive the relation between the scale factor and redshift using conformal time.

2. **Einstein–de Sitter model.** Consider the case $a \propto t^{2/3}$ and $K = 0$. (This corresponds to a spatially flat universe filled with non-relativistic matter.)

   a) Calculate the age-redshift relationship $t(z)$ and the angular diameter distance $d_A(z)$. (Express the age and distance in units of the Hubble time H_0^{-1}.)

   b) What is the particle horizon today in units of H_0^{-1}? (Defined as the proper distance to $z = \infty$.)

   c) What is the age of the universe (in years) today and at $z = 1090$ if $H_0 = 70$ km/s/Mpc?

   d) What is the angular diameter distance (in Mpc) to redshift $z = 1090$ if $H_0 = 70$ km/s/Mpc?

   e) The function $d_A(z)$ has a maximum. At which redshift is it?

3. **Effect of spatial curvature on angular diameter distance.** Consider the same scale factor as in the previous problem but $K = -0.1H_0^2$.

   a) At which redshift is the angular diameter distance higher than in the case $K = 0$ by 10%? What about 100%?

   b) To what proper distance do these correspond to?