

Ast/Phys 5022
Fall 2008
Problem Set #3 (due Oct 14)

1. For a flat, $\Omega_m + \Omega_\Lambda = 0$ Universe model, with $\Omega_m = 0.3$ write down the expressions for the following:

- (i) angular diameter distance, D_A ,
- (ii) luminosity distance, D_L ,
- (iii) comoving distance,
- (iv) light travel distance, i.e. age.

Calculate the values of these distances, in units of c/H_0 for sources at redshifts $z = 1$ and $z = 10$.

2. Recall the well known problem of a small object traveling inside a straight tunnel drilled from the surface of the Earth, through the center, and emerging on the opposite side. Let the object be released from rest at the surface. Write down its equation of motion assuming that the density of the Earth's interior is uniform, ρ_0 , and the dirt removed to make the tunnel is a tiny fraction of Earth's total mass. Write down the solution to this equation.

Now write down the equation of motion of the expansion of the Universe if its energy density is completely dominated by cosmological constant. Write down the solution to this equation.

Compare the solutions to the two problems and comment on the similarities and differences in the two cases.