Assignment 2: Due Friday, April 3 AST 354, Spring 2009

Write a code to compute the relation between redshift and the following cosmological quantities: comoving distance D_C, luminosity distance D_L, angular diameter distance D_A, and the total comoving volume of a sphere out to that redshift V_C. The code should work for any combination of cosmological parameters that result in a flat universe. The parameters are: the hubble constant $\boldsymbol{h}$, the matter density parameter $\boldsymbol{\Omega_m}$, the dark energy density parameter $\boldsymbol{\Omega_\Lambda}$, and the dark energy equation of state parameter $\boldsymbol{w}$.

Run your code for the following four cosmological models:

1. Flat universe, no dark energy: h=1, Ω_m=1.00, Ω_Λ=0.00
2. Flat universe, "cosmological constant" dark energy: h=1, Ω_m=0.25, Ω_Λ=0.75, w=-1
3. Flat universe, dark energy with a high w: h=1, Ω_m=0.25, Ω_Λ=0.75, w=-0.8
4. Flat universe, dark energy with a low w: h=1, Ω_m=0.25, Ω_Λ=0.75, w=-1.2

Make the following four plots, showing all four of the above models in each plot:

a) comoving distance D_C vs. redshift z

b) luminosity distance D_L vs. redshift z

c) angular diameter distance D_A vs. redshift z

d) comoving volume of a sphere V_C vs. redshift z

In all plots make the redshift (x-axis) run from 0 to 3. In the three distance plots show the distances in units of h^{-1}Gpc. In the last plot, show the volume in h^{-3}Gpc^3.

Hand in a printout of your code in addition to the four plots.