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 $D_A$, total comoving volume of a sphere out to that redshift $V_C$, and lookback time t. The code should work for any combination of cosmological parameters that result in a flat universe. The parameters are: the hubble constant **h**, the matter density parameter $\Omega_m$, the dark energy density parameter $\Omega_\Lambda$, and the dark energy equation of state parameter **w**.

Run your code for the following four cosmological models:
1. Flat universe, no dark energy:                                            $h=1$, $\Omega_m=1.00$, $\Omega_\Lambda=0.00$
2. Flat universe, "cosmological constant" dark energy:  $h=1$, $\Omega_m=0.25$, $\Omega_\Lambda=0.75$, $w=-1$
3. Flat universe, dark energy with a high $w$:                 $h=1$, $\Omega_m=0.25$, $\Omega_\Lambda=0.75$, $w=-0.8$
4. Flat universe, dark energy with a low $w$:                   $h=1$, $\Omega_m=0.25$, $\Omega_\Lambda=0.75$, $w=-1.2$

Make the following four plots, <u>showing all four of the above models in each plot</u>:

**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

**e)** lookback time 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 volume plot show the volume in $h^{-3}$Gpc$^3$. In the last plot show the lookback time in Gyr.

Clearly show all your steps in a write-up, including the equations you used. Please don't make me try to see what equations you used by looking at your code! Hand in a printout of your code in addition to the four plots.