PHYS 4247 — Assignment #2

Due: 9/28/17

1. Show that a radiation-dominated universe has $q_0 = \Omega_0$.

2. Calculate the circumference C, area A, and volume V of a sphere of proper radius s in a three-dimensional space for $k = 1, 0$ and -1.

3. Is it possible for a closed universe to evolve to become an open universe? Use equations to give a reason for your answer.

4. By considering both the Friedmann and acceleration equations, and assuming a pressureless universe, demonstrate that in order to have a static universe we must have a closed universe with a positive vacuum energy. Using either physical arguments or mathematics, demonstrate that this solution must be unstable.

5. Show that the following relationship between $\Omega_m(z)$ and $\Omega_{m,0}$ holds. Assume $\Omega_\Lambda = 0$.

$$\Omega_m(z) = \frac{\Omega_{m,0}(1+z)}{1+\Omega_{m,0}z} \tag{1}$$