January 13, 2004

PHYS 5970 sec. 001 (Cosmology)
Assignment #1
Due 5:00pm Tuesday January 20, 2004

Read: Chapter 16 of Rindler

1. Show by direct substitution that

\[ dx^2 + dy^2 + dz^2 = dr^2 + r^2(d\theta^2 + \sin^2 \theta d\phi^2), \]

when spherical polar coordinates are substituted for rectangular Cartesian coordinates.

2. Rewrite (16.29) using coordinates \((t, \psi, \phi, \theta)\) where \(\eta = \sin \psi, \psi, \sinh \psi\)
   respectively for \(\kappa = 1, 0, -1\).

3. Rewrite (16.29) using coordinates \((t, r, \phi, \theta)\) where \(r\) is defined in (16.20).

4. (a) Calculate the length of the “straight line” \((t, \phi, \theta)\)=constants, \(0 \leq \eta \leq \eta_0\).
   (b) Calculate the length of the “straight line” \((t, \phi, \theta)\)=constants, \(0 \leq \psi \leq \psi_0\).
   (c) Calculate the length of the “straight line” \((t, \phi, \theta)\)=constants, \(0 \leq r \leq r_0\).

5. (a) Calculate the area of the surface \((t, \eta)\)=constant.
   (b) Calculate the area of the surface \((t, \psi)\)=constant.
   (c) Calculate the area of the surface \((t, r)\)=constant.