1. In class (6 April) we found that the Ricci tensor of a homogeneous and isotropic 3-dimensional space is $\tilde{R}_{ij} = -2/r_0^2 \tilde{g}_{ij}$.

   (a) Find the curvature scalar.

   (b) Is $\tilde{R}_{ij} = -2/r_0^2 \tilde{g}_{ij}$ true in 2 dimensions?

2. For a homogeneous and isotropic 3-dimensional space (no time), the Riemann curvature tensor

$$R_{\lambda\rho\sigma\nu} = \frac{1}{6} R \left(g_{\nu\rho} g_{\lambda\sigma} - g_{\sigma\rho} g_{\lambda\nu} \right),$$

   where g is the metric and R is the curvature scalar. Suppose you carry a vector around a unit square. How much does it change? Recall our definition of the Riemann tensor on 23 March.

3. Curvature of space. Let Hubble's length be 4300 Mpc and the Hubble time be 14 Byr.

   (a) For reasonable values of the present density parameter, say $0.1 < \Omega_0 < 2$, what is the range of the radius of curvature r_0?

   (b) Suppose you want to calculate formation of a galaxy cluster. What is the simpliest metric for the physics? A typical size is 10 Mpc, and the formation time is billions of years.

   (c) Suppose you want to calculate the bending of light around a galaxy cluster. What is the simpliest metric for the physics? A big cluster at redshift $z = 0.4$ may magnify a galaxy at $z = 2$.