1. Carroll, Chapter 4, problem 6.

2. Compute the bending of light in Newtonian gravity assuming light acts like a particle with mass $m = E/c^2$ moving with speed $v = c$. (You can assume the scattering angle is small). Compare your answer with general relativity.

3. Isotropic coordinates:
   a) Show that any three dimensional spherically symmetric metric can be written

   $$ds^2 = H(r)[dr^2 + r^2d\Omega^2]$$

   This shows that every three dimensional spherical metric is conformally flat. These coordinates are called isotropic coordinates.

   b) Show that the Schwarzschild solution in isotropic coordinates is given by

   $$ds^2 = -\frac{(1 - M/2\bar{r})^2}{(1 + M/2\bar{r})^2}dt^2 + \left(1 + \frac{M}{2\bar{r}}\right)^4[dr^2 + \bar{r}^2d\Omega^2]$$

4. Consider Einstein’s equation with nonzero cosmological constant:

   $$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = 0$$

   a) Find the static, spherically symmetric solution to this equation. Treat both the case $\Lambda > 0$ and $\Lambda < 0$. You can use the fact that Carroll gives the components of the Ricci tensor for a general static, spherically symmetric metric in section 5.1.

   b) Write down the radial equation of motion for geodesics in this spacetime in terms of an effective potential analogous to eq. (5.66) in Carroll. Sketch the effective potential for massive particles when the angular momentum is large.