Ph 161 Black Holes

Homework Assignment 4

Due Tuesday, February 28, 2006

This should be your own work; do not copy problem solutions.

(1.) Go over your notes from class and Hartle's book and show that if the metric functions for a given coordinate system do not depend on one of the coordinates then the corresponding *covariant* component of four-momentum is conserved for a freely falling particle. By "conserved" we mean that it is constant along the geodesic, the curve swept out by the freely falling particle. The covariant components of four-momentum are the functions $p_\mu \equiv g_{\mu\nu}\, p^\nu$. (Hint: we did all of this in class!)

(2.) Discuss why we do not have global "energy" conservation in General Relativity. (Of course, energy and momentum are always *locally* conserved.) How does symmetry replace this idea? (Hint: This is what problem (1.) is all about.)

(3.) Hartle Chapter 9: problem 6.