PHYS 503/629 – Homework No. 4 – DUE TUESDAY, 04/26/2005

Problem 1. Problem 15.7 of Hartle's book.

Problem 2. Problem 15.10 of Hartle's book.

Problem 3. Problem 15.12 of Hartle's book.

Problem 4 (Only for 629 level or for extra credit). Consider a massive particle with zero angular momentum released from rest far from a Kerr black hole. Show that the particle "corotates with the geometry" as it spirals toward the black hole along a conical surface of constant θ. In other words, show that the particle acquires an angular velocity $d\phi/dt = \omega(r, \theta)$ as viewed from infinity, where

$$\omega(r, \theta) = \frac{2aMr}{(r^2 + a^2)^2 - \Delta a^2 \sin^2 \theta} \, .$$