Exercise sheet 6

Hartle 9.7

Two particles falls radially in from infinity towards a point mass M. One starts with $e = 1$, the other with $e = 2$. A stationary observer at $r = 6M$ measures their speed when they pass by. How much faster is the second particle?

Hartle 9-11.

A small perturbation of an unstable circular orbit will grow (initially) exponentially with time. Show that a dispalcement δ will grow initially as $\delta r \propto \exp(\tau/\tau_*)$, where τ is the proper time along the trajectory. Evaluate τ_* and explain its behavior for $r_{\max} \to 6M$.

Hartle 9-5 and 9.5.

The different path length for light-rays lensed by ϑ_+ and ϑ_- lead to a geometric time-delay. Estimate this delay for $D_L = D_{LS} = D_S/2$ (result $\Delta D \sim 2\beta\vartheta_E D_S$) and compare it with the Shapiro time delay.

Solutions are discussed Monday, 01.03.10