Exercise sheet 5

Hartle 9.8
A spaceship is moving without power in a circular orbit about a star with mass M. The radius in Schwarzschild coordinates is $r = 7M$.
0.) Show that $\Omega = \mathrm{d}\phi/\mathrm{d}t = (M/r^3)^{1/2}$.
a.) What is the period measured by an observer at infinity?
b.) What is the period measured by a clock onboard the spaceship?

Hartle 9-17.
Calculate the deflection of light in Newtonian gravity assuming the photon is a "non-relativistic" particle moving with speed c when far from all sources of gravity.

Hartle 9-18.
In a different theory of gravity the line-element is

$$\mathrm{d}s^2 = \left(1 - \frac{2M}{r}\right)\left[-\mathrm{d}t^2 + r^2(\mathrm{d}\vartheta^2 + \sin^2\vartheta\mathrm{d}\phi^2)\right] .$$

Calculate the deflection of light in this theory.

Solutions are discussed Monday, 22.02.10