Relativistic Physics (FYS T 320)

The absolutely final exam 22 I 2010 (4 hours).

1. Describe the phenomenon of gravitational spectral shift
in the framework of Schwarzschild's field.

2. What is meant by the Einstein spacetime? How is it
related to "Einstein's dilemma"?

3. Let the geodetic deviation equation for null geodesics be
$\frac{\delta^2 \rho^\alpha}{\delta u^2} = 0$ such that $\rho^\alpha(0) = 0$. Find the solution of this
equation in terms of a geodetic parallel propagator.

4. The quadratic form of a spacetime is $Q = d\ell^2 +$
$(\ell^2 + a^2)(d\theta^2 + \sin^2\theta \, d\phi^2) - c^2 \, dt^2$, where a is a constant
and ℓ is a coordinate measuring proper radial separation
at fixed t. Construct an embedding diagram for the
slice $\theta = \frac{\pi}{2}$ with $t = $ constant. An interpretation of

this embedding? $\left[\int \frac{dx}{\sqrt{x^2 - x_0^2}} = \text{ar cosh}\left(\frac{x}{x_0}\right) + C = \right.$

$\left. \cosh^{-1}\left(\frac{x}{x_0}\right) + C \right]$

5. Show that in an incoherent fluid the streamlines are

geodesics. What is the significance of this result in

general relativity?