1. In special relativity, the stress-energy tensor for electromagnetism is given by

$$T_{ab} = \epsilon_0 (F_a{}^c F^{cb} - \frac{1}{4} F_{cd} F^{cd} \eta_{ab}).$$

Show that

- $T_{ab} = T_{ba}$
- $T_{00} = \epsilon_0/2(E_a E^a + B_a B^a)$; (note, this is the classical energy of the electromagnetic field.)
- Moreover, for vacuum solutions of Maxwell's equations, $\nabla_a T^{ab} = 0$.

2. GR 7.1

3. GR 8.2

4. Consider a particle inside the event horizon of Schwarzschild, so $r < 2GM$. Show that $dr/d\tau$ is negative and

$$\left|\frac{dr}{d\tau}\right| \geq \sqrt{\frac{2GM}{r} - 1}.$$

Use this inequality to find an upper bound for the lifetime of a particle starting at $r = 2GM$. Express this time in seconds assuming that mass is measured in units of the mass of the sun.