1. Eötvös tested the equivalence principle on Lake Balaton in Hungary. Would his method for testing the equivalence principle work at the north pole? Would it work on the equator?

2. Einstein's field equation, $G^{\mu\nu} = -8\pi G T^{\mu\nu}$, where $G^{\mu\nu} = R^{\mu\nu} - \frac{1}{2}Rg^{\mu\nu}$, ties together two seemingly unrelated ideas: that $G^{\mu\nu}_{;\mu} = 0$ and $T^{\mu\nu}_{;\mu} = 0$.

   (a) (5 pts.) What elementary idea does $T^{\mu\nu}_{;\mu} = 0$ express?

   (b) (5 pts.) We derived $G^{\mu\nu}_{;\mu} = 0$ from the Bianchi identity. What elementary idea does the Bianchi identity express?

3. In one of Einstein's attempts at writing his field equation (Sitzungsber. preuss. Acad. Wiss. 1915, p. 799), he tried $R^{\mu\nu} = -8\pi G T^{\mu\nu}$, where $R^{\mu\nu}$ is the Ricci tensor.

   (a) (5 pts.) This equation is correct for the region in the solar system outside the sun. Using it, Einstein was able to calculate the correct values for the precession of the orbit of Mercury and the bending of light. Explain why it is correct for this case.

   (b) (5 pts.) Is this equation correct for computing the expansion of the universe? Explain.

4. About superposition, whether it applies for Einstein's field equations.

   (a) Simplicio reasons: "Superposition applies for Newton's law of gravity. If I know the gravitational potential generated by a set of masses, the gravitational potential of twice the mass is double the original potential." Is Simplicio correct? Explain.

   (b) Simplicio reasons: "Superposition also applies for Einstein's field equations. Suppose I know the field produced by a cluster of stars. If I double the number of stars, $T^{\mu\nu}$ also doubles, and the field $G^{\mu\nu}$ doubles. Is Simplicio correct? Explain.