"Singularities, Black Holes, Thermodynamics in Relativistic Spacetimes": Problem Set 5 (singularities)

1. Wald (1984): ch. 9, problems 2–3
2. Prove or give a counter-example: every spacetime is conformally related to one which is timelike and null geodesically complete.
3. Prove or give a counter-example: every spacetime is conformally related to one which is timelike and null geodesically incomplete.
4. Prove or give a counter-example: in a geodesically complete spacetime, two points, one of which chronologically precedes the other, can be connected by a timelike geodesic.
5. Prove or give a counter-example: every compact spacetime is geodesically complete.
6. Prove or give a counter-example: in a geodesically complete spacetime, every maximally extended timelike curve has infinite proper-time length.
7. Explain why the Big Bang singularity does not violate the spirit or the letter of standard formulations of the Cosmic Censorship Hypothesis.
8. Do you think the fact that general relativity predicts singularities will occur generically indicates the breakdown of general relativity as a physical theory? Why or why not?
9. Describe the psychological experience of an astronaut traversing an incomplete, inextendible timelike geodesic that encounters no pathology in curvature or other physical quantities.

References

Wald, R. (1984). *General Relativity*. Chicago: University of Chicago Press.