

“Singularities, Black Holes, Thermodynamics in Relativistic  
Spacetimes”: Problem Set 6  
(singularities; Schwarzschild and Kerr metrics)

1. **Wald (1984)**: ch. 6, problems 1–2, 5; ch. 12, problems 1, 2, 4
2. Show by direct computation that the Kretschmann scalar ( $R^{mnr}sR_{mnr}s$ ) diverges as one approaches the Schwarzschild singularity along a timelike geodesic; argue that this shows that the singular structure of Schwarzschild spacetime (incomplete, inextendible causal geodesics) arises from a physical pathology.
3. Construct an example of a spacetime with non-zero  $T_{ab}$  that violates the strong energy condition but contains an incomplete, inextendible causal geodesic.
4. Does the fact that general relativity predicts that singular structure occurs generically herald the breakdown of general relativity as a physical theory, or does it point to the possibility of interesting new physical phenomena for us to explore?

## References

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