Homework 10

Introduction to General Relativity and Gravitation - 2025

1 Exercise 1

Where can observers from universes I and II meet in the Kruskal conformal space-time diagram of page of 17 in Lesson 10? What is their ultimate fate?

2 Exercise 2

Write down the transformation from the Minkowkski coordinates (t, r) used in eq (70) on page 14 from Lesson notes 10 to the the coordinates (T, R) from eq (78) on page 15. Find the curves $t = constant$ and $r = constant$ in terms of T, R and draw them on the Penrose diagram of Minkowski space time.

3 Exercise 3

Use eqs (55) and (56) from page 12 on Lesson 10 to find T_{ab} as in eq (51). Show that the two independent Einstein-Maxwell field eqs are (59) and (60) from page 12 on Lesson 10. Find the Reissner Nordstrøm metric.

4 Exercise 4

Find the character of coordinates t and r in eq (62) page 13, Lesson 10 for $q^2 < m^2$ in the regions I, II and III (see figure at the end of section 12 Lesson notes 10 on page 14). Find the surfaces of infinite redshift.

5 Exercise 5

Find the equation for the congruence of ingoing radial null geodesics for the line element (62) in the case $q^2 < m^2$.

6 Exercise 6

Find the advanced Eddington-Finkelstein form of the Reissner-Nordstrøm solution.

7 Exercise 7

Find g^{11} for the Boyer-Lindquist form of the Kerr solution -eq (105) on page 19, Lesson 10-.