

Physics 480/581 General Relativity

Homework Assignment 6

Due date: Monday 09/28/2026 8pm, submitted electronically on UNM Canvas

Question 1 (4 points).

Moore Problem 8.6

Question 2 (3 points).

Moore Problem 17.5

Note that the metric in the p, q coordinate system is

$$g'_{\mu\nu} = \begin{pmatrix} 1 & 0 \\ 0 & (bq)^{-2} \end{pmatrix}. \quad (1)$$

Question 3 (2 points).

Show that if we impose the metric compatibility requirement

$$\nabla_\alpha g_{\mu\nu} = 0, \quad (2)$$

then the connection admits the standard Christoffel form

$$\Gamma_{\mu\nu}^\rho = \frac{1}{2} g^{\rho\sigma} (\partial_\mu g_{\nu\sigma} + \partial_\nu g_{\sigma\mu} - \partial_\sigma g_{\mu\nu}). \quad (3)$$

Question 4 (2 points).

Show that the components of the covariant derivative of a vector A^ν

$$\nabla_\mu A^\nu = \partial_\mu A^\nu + \Gamma_{\mu\alpha}^\nu A^\alpha, \quad (4)$$

transform like a tensor under the coordinate transformation $x^\mu \rightarrow x'^\mu$.