1 Petersen, Chapter 1, Exercise 5 (a) on p. 18

2 Consider the upper-half plane

$$\mathbb{R}^2_+ = \{(x, y) \in \mathbb{R}^2 \mid y > 0\}$$

with the hyperbolic metric

$$\frac{dx^2 + dy^2}{y^2}.$$

Show that the vertical line segment between $(0, 1)$ and $(0, 2)$ is the shortest path between these points.

3 Consider $\mathbb{R}^2_+$ with the hyperbolic metric as above. Let $v_0 = (0, 1)$ be a tangent vector at the point $(0, 1)$ of $\mathbb{R}^2_+$. Let $v(t)$ be the parallel transport of v_0 along the curve $x = t$, $y = 1$. Show that $v(t)$ makes an angle t with the direction of the y-axis, measured in the clockwise sense.

4 Petersen, Chapter 2, Exercise 5 on p. 56

5 For any point p in a Riemannian manifold (M, g), show that there exist coordinates $x^1, \ldots, x^n$ near p such that $\partial_i = e_i$ and $\nabla \partial_i = 0$ at p.

6 Petersen, Chapter 2, Exercise 10 (e) on p. 57

7 Petersen, Chapter 2, Exercise 11 on p. 58

8 Petersen, Chapter 2, Exercise 13 on p. 58