(1) do Carmo, page 56, #1, on parallel transport.
(2) do Carmo, page 57, #4, on parallel transport for regular surfaces.
(3) Prove that $SU(2)$ is simply connected and homeomorphic to the three sphere $S^3$ using the map:

$$x \in S^3 \rightarrow x_1 I_2 + i(x_2, x_3, x_4) \cdot \sigma,$$

where $\sigma$ is the vector formed from the three Pauli matrices.
(4) Continuation of do Carmo, page 46, #4: Prove that the mappings

$$\alpha_A(z) = \frac{az + b}{cz + d}$$

for

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in SL(2, \mathbb{R}),$$

are isometries of the left-invariant Riemannian metric constructed in the problem.