Solve the problems in the space provided below.

1) Let $S$ be the unit sphere in $\mathbb{R}^3$ and let $R$ be the region in $S$ given by
   \[ R = \{(x, y, z) \in S \mid z > 0\}. \]
   Verify directly the Gauss-Bonnet formula for $R$ by computing
   \[ \int_R KdA + \int_{\partial R} \kappa_g ds + \sum_i \alpha_i, \]
   and showing that the result matches with what is predicted by Gauss-Bonnet.
2) Let $\varphi : U \rightarrow \mathbb{R}^3$ be a global parametrization of a surface $S$, which has the property that the coordinate curves $\gamma(u) = \varphi(u, v_0)$, for $v_0$ fixed are all geodesics, the coordinate curves $\alpha(v) = \varphi(u_0, v)$, for $u_0$ fixed are all geodesics, and any such curve $\gamma$ intersects any curve $\alpha$ orthogonally. Prove that $S$ has vanishing Gaussian curvature.