Answer all the questions and show all your work.

1. Compute $E, F, G, L, M, N, K$ for the surface parameterized by $\mathbf{X}(u, v) = (\ln u, u \cos v, u \sin v)$

2. A parametrized surface has first fundamental form

$$du^2 + Gdv^2.$$

a) Prove that the $v$-parameter curves of this surface are geodesics.

b) If $G = \sin^2 u$, evaluate the Gaussian curvature of this surface.

3. Prove one of the following two propositions:

   a. On a sphere of radius $R$ the area of a geodesic triangle with angles $\alpha, \beta, \gamma$ is $(\alpha + \beta + \gamma - \pi)R^2$.

   b. If $\triangle ABC$ is a geodesic triangle with respective interior angles $\alpha, \beta, \gamma$ on a surface $S$, then its total curvature is

   $$\int \int_{\triangle ABC} dS = \alpha + \beta + \gamma - \pi$$