1 Let $S$ be a compact regular surface, $q \in \mathbb{R}^3$ a point in space and $p \in S$ a point on $S$ close to $q$ (so that for all other $x \in S$ we have $||x-q|| \geq ||p-q||$). Prove that $q-p$ is perpendicular to the tangent plane $T_pS$ to $S$ at $p$.

2 Let $S$ be a compact regular surface. Show that the Gauss map $N : S \to S^2$ is onto. Hint: for a point $p \in S^2$ consider the function $f_p : S \to \mathbb{R}$ defined by $f_p(q) = \langle p, q \rangle$. The function $f_p$ has a critical point on $S$ (why?). What happens at this critical point?

3 Show that the surface $S$ parametrized by
\[ F(r, \theta) = (\theta, r \sin \theta, -r \cos \theta), \]
with $r > 0$, is minimal. [In the original version the first coordinate was $r$, not $\theta$. So the surface was a cone, which is not minimal.]