1) Let $a \in \mathbb{R}$ be a nonzero real number. The map $\varphi : \mathbb{R}^2 \to \mathbb{R}^3$ given by

$$\varphi(u, v) = (v \cos u, v \sin u, au),$$

parametrizes a helicoid $S$. Find its first and second fundamental forms, its Gaussian and mean curvature, and its principal curvatures.

Recall that the mean curvature $H$ and principal curvatures $k_1, k_2$ are

$$H = \frac{1}{2} \frac{eG - 2fF + gE}{EG - F^2}, \quad k_1, k_2 = H \pm \sqrt{H^2 - K}$$
2) Can you find an oriented surface with mean curvature $H = 0$ and with Gaussian curvature $K = 1$ everywhere?