(1) Prove assertions (iii) and (iv) in Lemma 4.4 of the text.

(2) For the right helicoid $f(u, v) = (v \cos u, v \sin u, u)$, let $X = \frac{\partial f}{\partial u}$ and $Y = \frac{\partial f}{\partial v}$. Compute the directional derivatives $D_X Y$ and $D_Y X$, the covariant derivatives $\nabla_X Y$ and $\nabla_Y X$, and the directional derivatives $D_X \nu$, $D_Y \nu$.

(*Hint:* there are actually only four calculations to do here.)