1. a. Draw the domain $D$ consisting of all $(x, y)$ with $\sin x \geq y \geq 0$.

There are 3 types of points on the boundary:

I. Points on the curve $y = \sin x$ for $2k\pi < x < (2k+1)\pi$, for $k \in \mathbb{Z}$.

II. Corner points $(n\pi, 0)$, new.

III. Points on the $x$-axis with $2k\pi < x < (2k+1)\pi$. 
In case I, if \((x, y)\) is a max, \(\Delta f = \Delta g\) where \(g(x, y) = \sin x - y\), and we have the constraint \(g(x, y) = 0\) (i.e., \(\sin x - y = 0\) or \(\sin x = y\)).

\[ \begin{cases} \Delta f = \Delta g \\ g(x, y) = 0 \end{cases} \Rightarrow \begin{cases} (1+\epsilon)g = \Delta f = \Delta g \\ 2x = \pi(-1) \\ \sin x = y = 0 \end{cases} \]

Solving this gives
\[(x, y) = (2k\pi, 0),\] which isn't in case I.
In case \( \frac{\pi}{2} \), we don't have a smooth curve, so we can't set \( af = b f \) for any \( g \).

We must consider these points by hand,

we have \( f(n\pi, 0) = \sin \).

Since \( n \) can be any integer,

we see that we don't have an absolute max. But that's OK, let's find the local or relative max is anyway.
In case (\(\bigcirc\)), the gradient must be normal to the x-axis.

So \(DF(x, y) = \lambda (0, -1)\) or since \((x, y) = (x, 0)\) in case \(\bigcirc\)

\([1 + 2x, 2x] = \lambda (0, -1)\)

Since \(1 + 2x = \lambda \neq 0\), this never happens so no max or min in case \(\bigcirc\).

Finally, we check the points in the interior of \(D\).
At these,

\[ D f = 0. \] Solving, we find

\[ \begin{cases} 1 + 2\eta = 0 \\ 2x = 0 \end{cases} \]

\[ \eta = 0, \quad x = -\frac{1}{2}, \]

This point does not lie inside \( D \).

So the only local max. came from case II, where we find \( f(n\pi, 0) = n\pi \).