1) By considering different paths of approach, show that

\[
\lim_{(x,y) \to (0,0)} \frac{x + y}{x - y}
\]
does not exist.

**Solution:** First we try approaching \((0,0)\) along the \(y\) axis (where \(x = 0\)). This gives us

\[
\lim_{(x,y) \to (0,0) \text{ with } x = 0} \frac{x + y}{x - y} = \lim_{y \to 0} \frac{0 + y}{0 - y} = -1.
\]

Now let us try approaching \((0,0)\) along the \(x\) axis (where \(y = 0\)). This gives us

\[
\lim_{(x,y) \to (0,0) \text{ with } y = 0} \frac{x + y}{x - y} = \lim_{x \to 0} \frac{x + 0}{x - 0} = 1.
\]

Since two different results were obtained for different paths of approach, we conclude that

\[
\lim_{(x,y) \to (0,0)} \frac{x + y}{x - y}
\]
does not exist.

2) For the function

\[
f(x,y) = \sin(2x - 3y),
\]
find \(\partial f/\partial x, \partial f/\partial y, \partial^2 f/\partial x \partial y, \text{ and } \partial^2 f/\partial y \partial x\). Do not just write down answers. You must include intermediate steps in your calculations.

**Solution:**

\[
\frac{\partial f}{\partial x} = \cos(2x - 3y) \cdot (2) = 2\cos(2x - 3y).
\]

\[
\frac{\partial f}{\partial y} = \cos(2x - 3y) \cdot (-3) = -3\cos(2x - 3y).
\]
\[
\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial}{\partial x} (-3 \cos (2x - 3y)) \\
= -3 (-\sin (2x - 3y)) (2) \\
= 6 \sin (2x - 3y).
\]

\[
\frac{\partial^2 f}{\partial y \partial x} = \frac{\partial}{\partial y} (2 \cos (2x - 3y)) \\
= 2 (-\sin (2x - 3y)) (-3) \\
= 6 \sin (2x - 3y).
\]