*** Show each step of your work thoroughly to get a full credit.

1. (8 pts.) Consider the function of two variables:

   \[ f(x, y) = \frac{3x - y + 1}{\sqrt{x^2 - 2 + y}}. \]

   Find the domain \( D \) of \( f(x, y) \) and sketch the region \( D \) on \( xy \)-plane.

   \[
   \text{Domain} = D = \{(x, y) \mid x^2 - 2 + y > 0\}
   \]

   Set \( x^2 - 2 + y = 0 \) and draw the graph \( y = -x^2 + 2 \). Choose \((0, 0)\) and see if it satisfies the inequality. Since it doesn't satisfy, it is the region not containing \((0, 0)\).

2. (7 pts.) Consider the function \( f(x, y) = \frac{2xy}{5x^2 + 3y^2} \). Show that \( \lim_{(x, y) \to (0, 0)} f(x, y) \) does not exist.

   Path #1: \( y = 0 \Rightarrow \lim_{x \to 0} \frac{0}{5x^2} = 0 \)

   Path #2: \( x = 0 \Rightarrow \lim_{y \to 0} \frac{0}{3y^2} = 0 \)

   Path #3: \( y = x \Rightarrow \lim_{x \to 0} \frac{2x^2}{5x^2 + 3x^2} = \frac{2}{8} = \frac{1}{4} \)

   Since limit from Path #2 (0) is different from limit from Path #3 (\( \frac{1}{4} \)), limit DNE.