1. Find the following limits, if they exist.

   a. $\lim\limits_{(x,y)\to(1,3)} e^{2x+y}$

   b. $\lim\limits_{(x,y)\to(\infty,1)} \frac{arctg2x}{y^2+1}$

   c. $\lim\limits_{(x,y)\to(0,0)} \frac{\sin xy}{xy}$

   d. $\lim\limits_{(x,y)\to(0,0)} \frac{1}{x^2+y^2} e^{-\frac{1}{x^2+y^2}}$

   e. $\lim\limits_{(x,y)\to(3,1)} \frac{xy}{x^2+y^2}$

   f. $\lim\limits_{(x,y)\to(0,0)} \frac{xy}{x^2+y^2}$

2. Find the limits, if they exist, of the indicated branched functions.

   a. $\lim\limits_{(x,y)\to(0,0)} f(x,y)$, where $f(x,y) = \begin{cases} y\sin\frac{1}{x}, & \text{if } \ x \neq 0, \quad y \in \mathbb{R} \\ 0, & \text{if } \ x = 0, \quad y \in \mathbb{R}. \end{cases}$

   b. $\lim\limits_{(x,y)\to(0,0)} f(x,y)$, where $f(x,y) = \begin{cases} \frac{\sin xy}{xy}, & \text{if } \ x \neq 0, \quad y \neq 0 \\ 0, & \text{otherwise.} \end{cases}$

   c. $\lim\limits_{(x,y)\to(\frac{3}{\pi},0)} f(x,y)$, where $f(x,y) = \begin{cases} y\sin\frac{1}{x}, & \text{if } \ x \neq 0, \quad y \in \mathbb{R} \\ 0, & \text{if } \ x = 0, \quad y \in \mathbb{R}. \end{cases}$

   d. $\lim\limits_{(x,y)\to(2,2)} f(x,y)$, where $f(x,y) = \begin{cases} \frac{x^2-y^2}{x-y}, & \text{if } \ x \neq y \\ 2x, & \text{otherwise.} \end{cases}$

3. Determine the points for which the functions are continous. At the points, where the function is discontinous, tell why.

   a. $f(x,y) = e^{x-3y}$

   b. $f(x,y) = \frac{xy}{x^2+y^2}$

   c. $f(x,y) = \frac{x^2y}{3+y^2}$

   d. $f(x,y) = \ln(x^2+y^2)$

   e. $f(x,y) = \begin{cases} y\sin\frac{1}{x}, & \text{if } \ x \neq 0, \quad y \in \mathbb{R} \\ 0, & \text{if } \ x = 0, \quad y \in \mathbb{R}. \end{cases}$

   f. $f(x,y) = \begin{cases} \frac{x^2-y^2}{x-y}, & \text{if } \ x \neq y \\ 2x, & \text{otherwise.} \end{cases}$

g. $f(x,y) = \begin{cases} \frac{\sin xy}{xy}, & \text{if} \quad x \neq 0, \quad y \neq 0 \\ 0, & \text{otherwise.} \end{cases}$

h. $f(x,y) = \begin{cases} \frac{xy}{x^2+y^2}, & \text{if} \quad (x,y) \neq (0,0) \\ 0, & \text{otherwise.} \end{cases}$