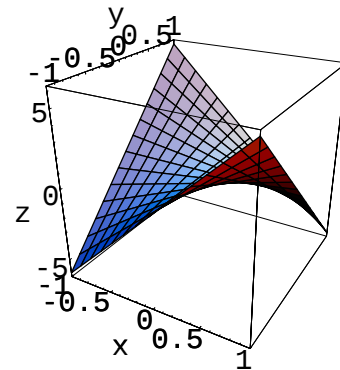
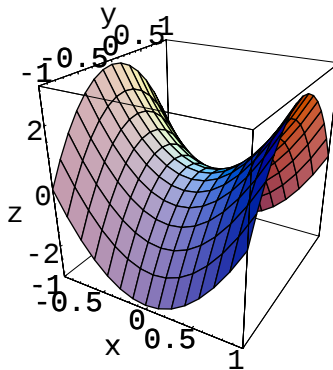
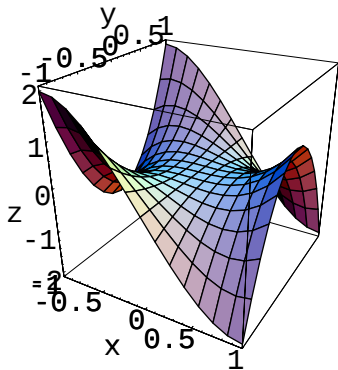


1. Show that the following limit fails to exist: (4 points)

$$\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 - y^2}{x^2 + y^2}$$

2. The following surfaces are graphs of functions $f(x, y)$, $f_x(x, y)$ and $f_y(x, y)$ for some function f . Label each graph to show which is which and briefly explain how you make your determination. (4 points)

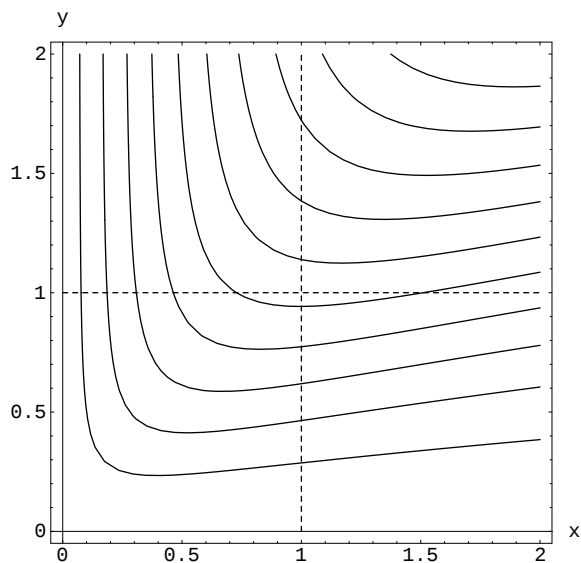


3. The contour plot below shows z -levels from 1 to 10 along the right edge from bottom to top. (6 points)

(a) Estimate the value of $f_x(1, 1)$.

(b) Estimate the value of $f_y(1, 1)$.

(c) Determine the signs of $f_{xx}(1, 1)$, $f_{xy}(1, 1)$, and $f_{yy}(1, 1)$.



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4. For the function $f(x, y) = \sqrt{x^2 + y^2}$ (6 points)

(a) calculate the total differential df ;

(b) find an equation of the tangent plane to the graph of $f(x, y)$ when $x = 3$ and $y = 4$.