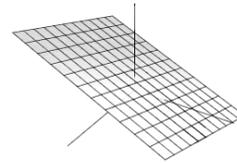
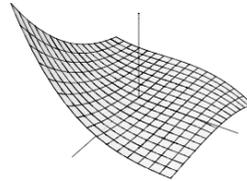
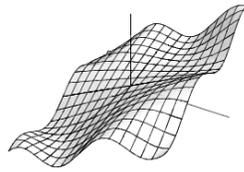
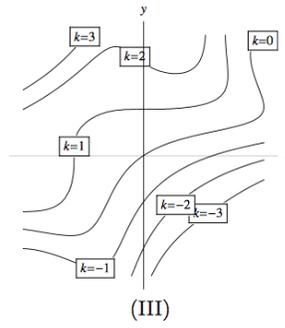
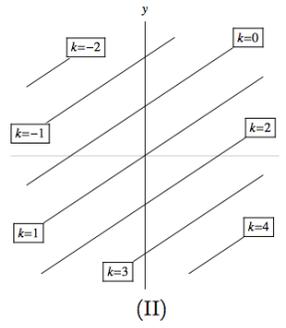
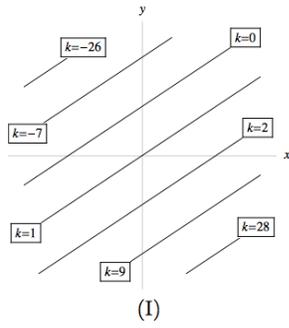


1. Match each level set with the correct function.



2. Match each function with the correct equation.

(a)  $f(x, y) = x^2$

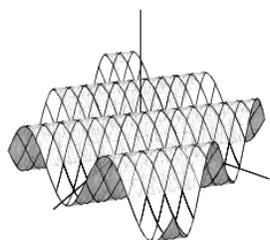
(b)  $f(x, y) = \sqrt{x^2 + y^2}$

(c)  $f(x, y) = e^{x^2+y^2} - 1$

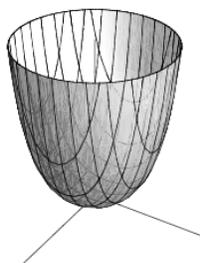
(d)  $f(x, y) = y \sin x$

(e)  $f(x, y) = \sin(x+y)$

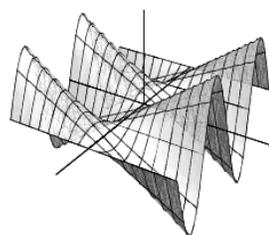
(f)  $f(x, y) = \sin(\sqrt{x^2 + y^2})$



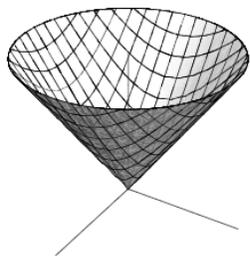
(I)



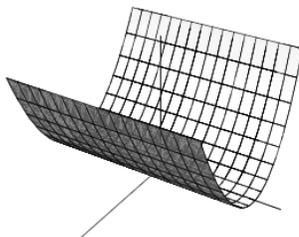
(II)



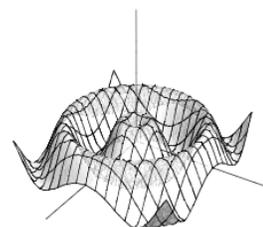
(III)



(IV)



(V)



(VI)

3. Find the following limits as  $(x, y) \rightarrow (0, 0)$  or show that they do not exist:

(a)  $f(x, y) = \frac{xy}{|xy|}$

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

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

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

(e)  $f(x, y) = \frac{x^2-xy}{\sqrt{x}-\sqrt{y}}$

4. (a) Find  $f_x$  and  $f_y$  for  $f(x, y) = \ln(x^2 + y^2)$ .

(b) Find  $f_x$  and  $f_y$  for  $f(x, y) = e^{y^2} \cos(2xy)$ .

(c) Find  $f_x$  and  $f_y$  for  $f(x, y) = x^2y^3e^{xy} + 5x + 1$ .

(d) Find  $f_x$  and  $f_y$  for  $f(x, y) = \frac{e^{xy}}{x^2 + x}$ .

(e) Find  $f_x$ ,  $f_y$ , and  $f_z$  for  $f(x, y, z) = \frac{1}{xyz}$ .

(f) Find  $f_x$ ,  $f_y$ , and  $f_z$  for  $f(x, y, z) = yze^{2x^2-y}$ .

---

5. Find the gradient,  $\nabla f$ , of  $f(x, y)$  and the directional derivative in the direction of  $\mathbf{u}$ .

(a)  $f(x, y) = 2xy - 3y^2$ ,  $\mathbf{u} = 4\mathbf{i} + 3\mathbf{j}$

(b)  $f(x, y) = 2x^2 + y^2$ ,  $\mathbf{u} = 3\mathbf{i} - 4\mathbf{j}$

(c)  $f(x, y, z) = xy + yz + zx$ ,  $\mathbf{u} = 3\mathbf{i} + 6\mathbf{j} - 2\mathbf{k}$