

**Problem statement** The figure below shows some level curves of an unspecified function  $f(x, y)$ . These are curves of the form  $f(x, y) = k$  for integer values of  $k$  from 1 to 11. The tick-marks on the axes are one unit apart. The questions below refer only to the region *inside* the  $k = 0$  curve. To help understand the diagram, note that the curves for  $k = 4$  and  $k = 8$  each intersect the  $x$ -axis *twice* at tick-marks.)

- Where is the quantity  $\|\nabla f\|$  greatest? Approximately what is its value there? What is the direction of  $\nabla f$  there?
- Where is the quantity  $\|\nabla f\|$  smallest? Approximately what is its value there? What is the direction of  $\nabla f$  there?
- Is  $\nabla f(0, 4)$  more nearly parallel to  $\mathbf{i} + \mathbf{j}$ ,  $\mathbf{i} - \mathbf{j}$ , or  $-\mathbf{i} + \mathbf{j}$ ?

