

Written Homework for 14.4-14.7

1. Values of a function  $f(x, y)$  are given in the table at the right. Use this table to estimate the following quantities or equations. Be sure to include proper notation throughout.

		x		
		3.99	4.00	4.01
y	6.95	5.56	5.23	5.05
	7.00	5.79	5.45	5.25
	7.05	5.92	5.73	5.64

A.  $\left. \frac{\partial f}{\partial x} \right|_{(4,7)}$  and  $\left. \frac{\partial f}{\partial y} \right|_{(4,7)}$ .

B. the rate of change of  $f$  at  $(4, 7)$  in the direction of  $2\vec{i} + 3\vec{j}$ .

C. the maximum slope of  $f$  as you move away from the point  $(4, 7)$ .

D. a vector tangent to the level curve of  $f$  at the point  $(4, 7)$ .

E. a plane tangent to the surface of  $f$  at the point  $(4, 7)$ .

2. The temperature  $T$  inside a metal ball is inversely proportional to the distance from the center of the ball. You can assume the center is at the origin. Show that at any given point in the ball the direction of greatest increase in temperature is given by a vector that points toward the origin.

3. Consider the two surfaces  $x^2 + y^2 + z^2 - 4y - 2z + 2 = 0$  and  $3x^2 + 2y^2 - 2z = 1$ .

A. What are these surfaces? Be specific.

B. Use the method shown in section 14.5 to verify that the surfaces are perpendicular to each other at the point  $(1, 1, 2)$ .

4. A ship sailing eastward at 10 km/hr passes an island. Let  $p(x, t)$  be the air pressure as a function of the distance from the island in the eastward direction and time.

A. Express the following quantities in terms of mathematical symbols:

Air pressure decreases at a rate of 2 pascals/km.

Air pressure drops 50 pascals in 2 hours.

B. Estimate  $\frac{\partial p}{\partial t}$ . Show the chain rule needed to support your answer.