

WebAssign**Hw 15 (14.6): Directional Der. and Grad. Vector (Homework)**

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MA 261 Fall 2012, section 121, Fall 2012

Instructor: David Daniels

Current Score : 20 / 20**Due :** Tuesday, September 25 2012 11:00 PM EDT**1.** 2.85/2.85 points | [Previous Answers](#)

SCalcET7 14.6.021.

Find the maximum rate of change of f at the given point and the direction in which it occurs.

$$f(x, y) = 4y\sqrt{x}, \quad (4, 1)$$

maximum rate of change



direction vector

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SCalcET7 14.6.023.MI.

Find the maximum rate of change of f at the given point and the direction in which it occurs.

$$f(x, y) = 3 \sin(xy), \quad (0, 7)$$

maximum rate of change



direction vector

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3. 2.85/2.85 points | [Previous Answers](#)

SCalcET7 14.6.025.

Find the maximum rate of change of f at the given point and the direction in which it occurs.

$$f(x, y, z) = \sqrt{x^2 + y^2 + z^2}, \quad (9, 2, -9)$$

maximum rate of change



direction vector



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SCalcET7 14.6.027.

(a) Show that a differentiable function f decreases most rapidly at \mathbf{x} in the direction opposite the gradient vector, that is, in the direction of $-\nabla f(\mathbf{x})$.

Let θ be the angle between $\nabla f(\mathbf{x})$ and unit vector \mathbf{u} . Then $D_{\mathbf{u}}f = |\nabla f| \cos \theta$. Since the minimum value of $\cos \theta$ is -1 occurring, for $0 \leq \theta < 2\pi$, when $\theta =$



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, the minimum value of $D_{\mathbf{u}}f$ is $-|\nabla f|$, occurring when the direction of \mathbf{u} is the opposite of the direction of ∇f (assuming ∇f is not zero).

(b) Use the result of part (a) to find the direction in which the function $f(x, y) = x^4y - x^2y^4$ decreases fastest at the point $(4, -5)$.



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SCalcET7 14.6.029.MI.

Find all points at which the direction of fastest change of the function $f(x, y) = x^2 + y^2 - 4x - 8y$ is $\mathbf{i} + \mathbf{j}$. (Enter your answer as an equation.)



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SCalcET7 14.6.031.

The temperature T in a metal ball is inversely proportional to the distance from the center of the ball, which we take to be the origin. The temperature at the point $(1, 2, 2)$ is 130° .

(a) Find the rate of change of T at $(1, 2, 2)$ in the direction toward the point $(4, 3, 5)$.



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(b) Show that at any point in the ball the direction of greatest increase in temperature is given by a vector that points towards the origin.

The gradient of T is in a direction of $-\langle x, y, z \rangle$, which always towards the origin. So, the gradient of T must always towards the origin as well.

Score: 1.43 out of 1.43

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7. 2.9/2.9 points | [Previous Answers](#)

SCalcET7 14.6.033.

Suppose that over a certain region of space the electrical potential V is given by the following equation.

$$V(x, y, z) = 3x^2 - 5xy + xyz$$

- (a) Find the rate of change of the potential at $P(3, 2, 7)$ in the direction of the vector $\mathbf{v} = \mathbf{i} + \mathbf{j} - \mathbf{k}$.



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- (b) In which direction does V change most rapidly at P ?



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- (c) What is the maximum rate of change at P ?



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