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1. (1 pt)

Find the directional derivative of $f(x,y) = x^2y^3 + 2x^4y$ at the point (4, 0) in the direction $\theta = 2\pi/3$.

The gradient of f is:

$\nabla f = \langle$_____,_____$\rangle$

$\nabla f(4,0) = \langle$_____,_____$\rangle$

The directional derivative is:

_____

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2. (1 pt)

Consider the function $f(x,y) = 5xy^2 + 2x^3y$.

Find the gradient of f:

$\langle$_____, _____$\rangle$

Find the gradient of f at the point (1, 0).

$\langle$_____, _____$\rangle$

Find the rate of change of the function f at the point (1, 0) in the direction $\mathbf{u} = \langle -4/13, \sqrt{153}/13\rangle$.

_____

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3. (1 pt)

Consider the function $f(x,y,z) = xy + yz^2 + xz^3$.

Find the gradient of f:

$\langle$_____, _____, _____$\rangle$

Find the gradient of f at the point (-3, 1, 5).

$\langle$_____, _____, _____$\rangle$

Find the rate of change of the function f at the point (-3, 1,5) in the direction $\mathbf{u} = \langle 5/\sqrt{66}, 5/\sqrt{66}, -4/\sqrt{66}\rangle$.

_____

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4. (1 pt)

Find the directional derivative of $f(x,y,z) = z^3 - x^2y$ at the point (-3, 3, -3) in the direction of the vector $\mathbf{v} = \langle -1, 1, -1\rangle$.

_____

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5. (1 pt)

The temperature at a point (x,y,z) is given by $T(x,y,z) = 200e^{-x^2-y^2/4-z^2/9}$, where T is measured in degrees celcius and x,y, and z in meters. There are lots of places to make silly errors in this problem; just try to keep track of what needs to be a unit vector.

Find the rate of change of the temperature at the point (1, -1, 2) in the direction toward the point (0, 3, -4).

_____

In which direction (unit vector) does the temperature increase the fastest at (1, -1, 2)?

$\langle$_____, _____,_____$\rangle$

What is the maximum rate of increase of T at (1, -1, 2)?

_____

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6. (1 pt)

Suppose that you are climbing a hill whose shape is given by $z = 498 - 0.09x^2 - 0.07y^2$, and that you are at the point (25, 45, 300).

In which direction (unit vector) should you proceed initially in order to reach the top of the hill fastest?

$\langle$_____,_____$\rangle$

If you climb in that direction, at what angle above the horizontal will you be climbing initially (radian measure)?

_____

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7. (1 pt)

Find equations of the tangent plane and normal line to the surface $z - 2 = xe^y \cos z$ at the point (-2, 0, 0).

Tangent Plane: (make the coefficient of z equal to 1).

_____ $= 0$.

Normal line: $\langle -2,$_____, _____ $\rangle$

$+t\langle$ _____, _____, $1\rangle$.

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8. (1 pt)

Find the points on the surface $5x^2 + 3y^2 + 5z^2 = 1$ at which the tangent plane is parallel to the plane $4x + 2y + 3z = 7$.

(_____, _____,_____) and

(_____, _____,_____)