# University of Delaware
# Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
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Fall 2012

Homework 8

Due date: October 29, 2012

## Problems

Based on Sections 14.5 and 14.6 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. Use the Chain Rule to find $\dfrac{dz}{dt}$ from $z = \sqrt{1 + x^2 + y^2}$ if $x = \ln t$ and $y = \cos t$.
2. Use the Chain Rule to find $\dfrac{dw}{dt}$ from $w = xe^{y/z}$ if $x = t^2$, $y = 1 - t$, and $z = 1 + 2t$.
3. Use the Chain Rule to find $\dfrac{\partial z}{\partial s}$ and $\dfrac{\partial z}{\partial t}$ from $z = \sin\theta\cos\phi$, if $\theta = st^2$ and $\phi = s^2t$.
4. Use the Chain Rule to find $\dfrac{\partial z}{\partial s}$ and $\dfrac{\partial z}{\partial t}$ from $z = e^{x+2y}$, if $x = s/t$ and $y = t/s$.
5. The length $l$, width $w$, and height $h$ of a box change with time. At a certain instant the dimensions are $l = 1$m and $w = h = 2$m, and $l$ and $w$ are increasing at a rate of 2 m/s while $h$ is decreasing at a rate of 3 m/s. At that instant find the rates at which the following quantities are changing: a) The volume, b) The surface area, and c) The length of a diagonal.
6. Find the directional derivative of $f(x, y) = x\sin(xy)$ at (2,0) in a direction $\pi/3$ radians with respect to the positive $x$-axis.
7. Find the gradient of $f(x, y) = y^2/x$, evaluate it at (1,2), and find the rate of change of $f$ at that point in the direction of the vector $\langle 2/3, \sqrt{5}/3\rangle$.
8. Find the directional derivative of the function $f(x, y, z) = xe^y + ye^z + ze^x$ at (0,0,0) in the direction of $\vec{v} = \langle 5, 1, -2\rangle$.

9. Find the directions in which the directional derivative of $f(x, y) = ye^{-xy}$ at the point (0,2) has the value 1.

10. Use the fact that the gradient is perpendicular to a function's level surfaces to find the tangent plane to the surface represented by $x^2 - 2y^2 + z^2 + yz = 2$ at the point (2,1,-1).