Name_____

Date_____

Vector Calculus Independent Study

Unit 3 Sample Test

1. Let $f(x, y, z) = x^2 + y^2 - z^2$.

   (a) [20 points] Graph at least three level sets of f.

   (b) [20 points] Find the tangent plane to the surface $x^2 + y^2 - z^2 = 12$ at the point $(3, 2, 1)$.

   (c) [20 points] Compute $\frac{\partial f}{\partial \vec{v}}$ where $\vec{v} = \frac{1}{\sqrt{3}}(1, 1, 1)$.

   (d) [20 points] When I die, my soul will spiral to nirvana along the helix $\sigma(t) = (\cos t, \sin t, t)$. If my karma at a point is given by f, use the chain rule to determine my $\frac{d\text{karma}}{dt}$.

2. [20 points] If f is a function of x, y, and z, and f's zeroth, first, second, and third partial derivatives are all continuous, then how many of f's third derivatives can be different?