8.5: Math Tutorial – Partial Derivatives

In order to understand the generalization of Newtonian mechanics to two and three dimensions, we first need to understand a new type of derivative called the *partial derivative*. The partial derivative is used in functions of more than one variable. It is just like an ordinary derivative, except that when taking the derivative of the function with respect to one of the variables, the other variables are held constant. As an example, let us consider the function

$$f(x,y) = Ax^4 + Bx^2y^2 + Cy^4 \tag{8.5.1}$$

where *A*, *B*, and *C* are constants. The partial derivative of *f* with respect to *x* is

$$\frac{\partial f}{\partial x} = 4Ax^3 + 2Bxy^2 \tag{8.5.2}$$

and the partial derivative with respect to *y* is

$$\frac{\partial f}{\partial y} = 2Bx^2y + 4Cy^3. \tag{8.5.3}$$

That's it! Note that a special symbol " ∂" is used in place of the normal "d" for the partial derivative. This is sometimes called a "curly d".