Section 2.6  Exact Equations and Integrating Factors

In the section, we consider a special class of first order equations known as exact equations.

Example 1. Solve the differential equation

\[ 2x + y^2 + 2xyy' = 0. \]

Let the differential equation be

\[ M(x, y) + N(x, y)y' = 0. \]

Suppose we can identify a function \( \psi(x, y) \) such that

then

In this case, the equation is called an ________ differential equation.
**Question:** How can we tell whether a given equation is exact?

**Theorem** Let $M$, $N$, $M_y$, and $N_x$ be continuous on some rectangular region $R$. Then the equation

**Question:** Given an equation is exact, how to find the function $\psi$?

**Example 2. (Problem #5) Solve the differential equation**

$$(y \cos(x) + 2xe^y) + (\sin(x) + x^2e^y - 1)y' = 0.$$