Section 9.1

Direction Fields

DIRECTION FIELD

A **direction field** is basically a "flow pattern" used to establish the existence of, and possibly locate an ***approximate*** solution curve for a first-order differential equation that cannot be solved by standard techniques.

For example, the techniques we have learned do not apply to the differential equation

$$\frac{dy}{dx} = x^2 + y^2$$

LINEAL ELEMENTS AND ISOCLINE

A **lineal element** is a short line segment, with a given slope (m), and whose midpoint is at a given point (a, b).

An **isocline** is a curve along which the inclination (of the tangents) is the same.

ISOCLINES, DIRECTION FIELDS, AND DIFFERENTIAL EQUATIONS

For the differential equation $y' = f(x, y)$, each member of the one-parameter family of curves $f(x, y) = c$, c a constant, is an **isocline** on which we can construct ***lineal elements***, all of which have the same slope.

The totality of all lineal elements on all members of the family of curves, $f(x, y) = c$, is called a **direction field**, **slope field**, or **lineal element field** of the differential equation $y' = f(x, y)$.

APPROXIMATE SOLUTIONS TO A DIFFERENTIAL EQUATION

A solution to the differential equation $y' = f(x, y)$ that passes through the point (a, b) can be represented, ***approximately***, by a curve through the point (a, b) and through the isoclines with the appropriate slopes.