p17

(c) Find the flow rate that is sufficient to achieve the concentration 0.02 g/gal within 4 hr.

1.3 Classification of Differential Equations

The main purpose of this book is to discuss some of the properties of solutions of differential equations, and to describe some of the methods that have proved effective in finding solutions, or in some cases approximating them. To provide a framework for our presentation we describe here several useful ways of classifying differential equations.

single variable calc.

$Q(t)$

Ordinary and Partial Differential Equations. One of the more obvious classifications is based on whether the unknown function depends on a single independent variable or on several independent variables. In the first case, only ordinary derivatives appear in the differential equation, and it is said to be an **ordinary differential equation.** In the second case, the derivatives are partial derivatives, and the equation is called a **partial differential equation.**

All the differential equations discussed in the preceding two sections are ordinary differential equations. Another example of an ordinary differential equation is

$$L\frac{d^2Q(t)}{dt^2} + R\frac{dQ(t)}{dt} + \frac{1}{C}Q(t) = E(t), \tag{1}$$

for the charge $Q(t)$ on a capacitor in a circuit with capacitance C, resistance R, and inductance L; this equation is derived in Section 3.8. Typical examples of partial differential equations are the heat conduction equation

$u(x,t)$

$$\alpha^2\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{\partial u(x,t)}{\partial t}, \tag{2}$$

and the wave equation

multi-var. calculus

$$a^2\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{\partial^2 u(x,t)}{\partial t^2}. \tag{3}$$

Here, α^2 and a^2 are certain physical constants. The heat conduction equation describes the conduction of heat in a solid body and the wave equation arises in a variety of problems involving wave motion in solids or fluids. Note that in both Eqs. (2) and (3) the dependent variable u depends on the two independent variables x and t.