

# Chapter 1

1

A thermometer is removed from a room where the temperature is 70 F and is then taken outside, where the air temperature is 10 F. After one-half minute the thermometer reads 50 F. What is the reading of the thermometer at  $t = 1$ ? How long will it take for the thermometer to reach 15 F?

[ Newton's law of cooling: the rate at which the temperature of a body changes is proportional to the difference between the temperature of the body and the temperature of the surrounding medium]

2

Suppose a student carrying a flu virus returns to an isolated college campus of 1000 students. Determine a differential equation for the number of people  $x(t)$  who have contracted the flu if the rate at which the disease spreads is proportional to the number of interactions between the number of students who have the flu and the number of students who have not yet been exposed to it.

3

At a time denoted as  $t = 0$  a technological innovation is introduced into a community that has a fixed population of  $n$  people. Determine a differential equation for the number of people  $x(t)$  who have adopted the innovation at time  $t$  if it is assumed that the rate at which the innovations spread through the community is jointly proportional to the number of people who have adopted it and the number of people who have not adopted it.

# Chapter 1

4

Find the value of  $k$  so that the given differential equation is exact:

$$(y^3 + kxy^4 - 2x)dx + (3xy^2 + 20x^2y^3)dy = 0$$

$$y' = -\frac{6xy^3 + \cos y}{2kx^2y^2 - x \sin y}$$

5

Solve:

$$y'(x + y) + x + y = 1$$
$$y(0) = 1$$

$$y'(3x + y) = x + 3y$$
$$y(0) = 1$$

$$y^2 = x^2 y' + y + 2$$

$$(x^2 + y^2)dx + (x^2 - xy)dy = 0$$

$$xy' + y - (xy)^2$$

# Chapter 2

**1) Solve the linear system**

$$2x + y - z = -2$$

$$3x + 2y + 3z = 21$$

$$7x + 4y + z = 17$$

**2) Solve the linear system**

$$2x - 3y + 6z = 3$$

$$x + 2y - 4z = 5$$

$$3x + 4y - 8z = 7$$

# Chapter 2

## 3) Consider the linear system

- Find all values of  $A$  for which the system has no solution
- Find all values of  $A$  for which the system has a unique solution

$$\begin{aligned}x - 3y - 2z &= A^2 \\2x - 5y + Az &= 9 \\2x - 8y + z &= 18\end{aligned}$$

## 4) Consider the linear system

- Find all values of  $A$  for which the system has no solution
- Find all values of  $A$  for which the system has a unique solution
- Find all values of  $A$  for which the system has an infinite number of solutions

$$\begin{aligned}x + 2y + z &= A^2 \\-2x - 3y + Ax &= 1 \\7x + 12y + A^2z &= 4A^2 - 3\end{aligned}$$