### 2.3 Linear Equation

1. Solve the equation $x \frac{d y}{d x}+3\left(y+x^{2}\right)=\frac{1}{x}$
2. Solve the initial value problem

$$
\sin x \frac{d y}{d x}+y \cos x=x \sin x, \quad y\left(\frac{\pi}{2}\right)=2
$$

### 2.4 Exact Equations

1. Determine whether the equation is exact. If it is, then solve it.

$$
(2 x y+3) d x+\left(x^{2}-1\right) d y=0
$$

2. Solve the initial value problem

$$
\left(e^{t} x+1\right) d t+\left(e^{t}-1\right) d x=0, \quad x(1)=1
$$

### 3.2 Compartmental Analysis

1. A brine solution of salt flows at a constant rate of $4 \mathrm{~L} / \mathrm{min}$ into a large tank that initially held 100 L of pure water. The solution inside the tank is kept well stirred and flows out of the tank at a rate of $3 \mathrm{~L} / \mathrm{min}$. If the concentration of salt in the brine entering the tank is $0.2 \mathrm{~kg} / \mathrm{L}$, determine the mass of salt in the tank after t min. When will the concentration of the salt in the tank reach $0.1 \mathrm{~kg} / \mathrm{L}$ ?
