$$CH_3Cl + NaOH \longrightarrow CH_3OH + NaCl$$

Methyl chloride combines with sodium hydroxide to produce methyl alcohol and sodium chloride.

$$CH_3Cl + NaOH \longrightarrow CH_3OH + NaCl$$

Suppose one mole of methyl chloride combines with one mole of sodium hydroxide to eventually produce one mole of methyl alcohol.

At $t = 0$, 1 mole of methyl chloride is added to 2 moles of sodium hydroxide to form 1 liter of solution. Eventually, the reaction will produce 1 mole of methyl alcohol with 1 mole of sodium hydroxide left over, but the reaction takes time. At $t = 1$ minute, $\frac{2}{3}$ mole of methyl alcohol is produced. We wish to find how many moles of methyl alcohol are produced after t minutes.

We will assume the following chemical reaction rate law. As the number of moles of available methyl chloride and sodium hydroxide decrease, there are fewer collisions of molecules of reactant per unit time and so the rate of increase of methyl alcohol diminishes.

The rate of increase of the product is jointly proportional to the remaining concentrations of reactants

Let $x(t)$ denote the number of moles of methyl alcohol that are produced after t minutes.

The number of moles of reactants after t minutes are:

$$1 - x \quad \text{and} \quad 2 - x$$

So, $\frac{dx}{dt}$ is proportional to $(1 - x)(2 - x)$

$$\frac{dx}{dt} = k(1-x)(2-x)$$

$$x(0) = 0 \qquad x(1) = \frac{2}{3}$$