

$$y' = x + y, \quad y(x_0) = y_0$$

$$y' - y = x$$

$$P(x) = -1, \quad Q(x) = x$$

$$p = e^{\int P(x) dx} = e^{-x}$$

$$p y = \int p Q dx + C$$

$$e^{-x} y = \int e^{-x} x dx + C$$

$$\int x e^{-x} dx = \left| \begin{array}{l} u = x \\ du = dx \end{array} \quad \begin{array}{l} dv = e^{-x} dx \\ v = -e^{-x} \end{array} \right| = -x e^{-x} + \int e^{-x} dx =$$

$$= -x e^{-x} - e^{-x} + C$$

$$\therefore e^{-x} y = -x e^{-x} - e^{-x} + C \quad | \cdot e^x$$

$$y = -x - 1 + C e^x$$

$$y(x_0) = y_0 \Rightarrow y_0 = -x_0 - 1 + C e^{x_0} \Rightarrow C = (y_0 + x_0 + 1) e^{-x_0}$$

$$\therefore \boxed{y(x) = -x - 1 + (y_0 + x_0 + 1) e^{x - x_0}}$$

$$y(0) = 1 \Rightarrow x_0 = 0, y_0 = 1 \Rightarrow$$

$$\boxed{y(x) = -x - 1 + 2e^x}$$