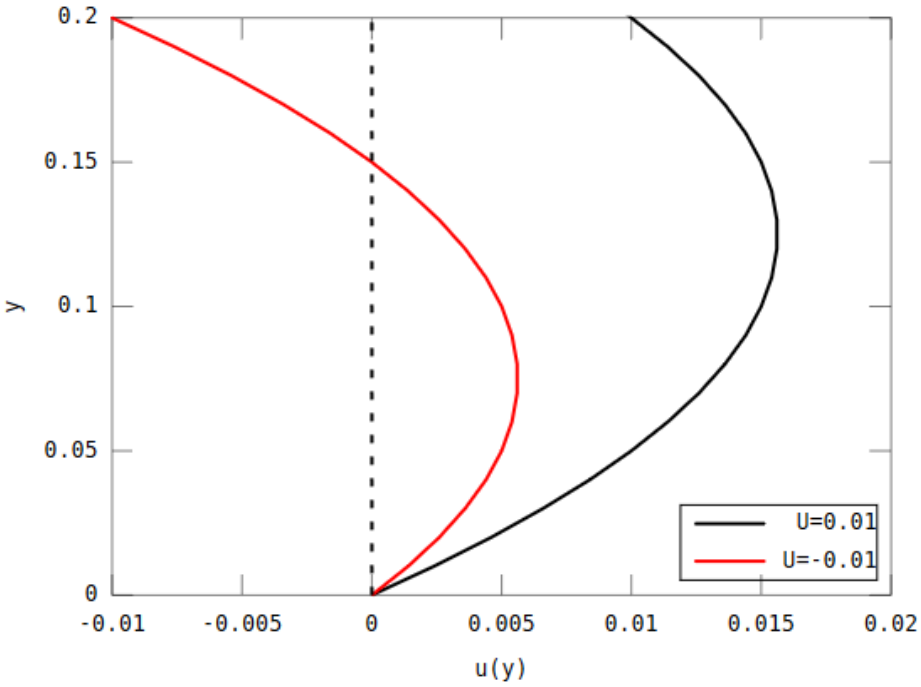
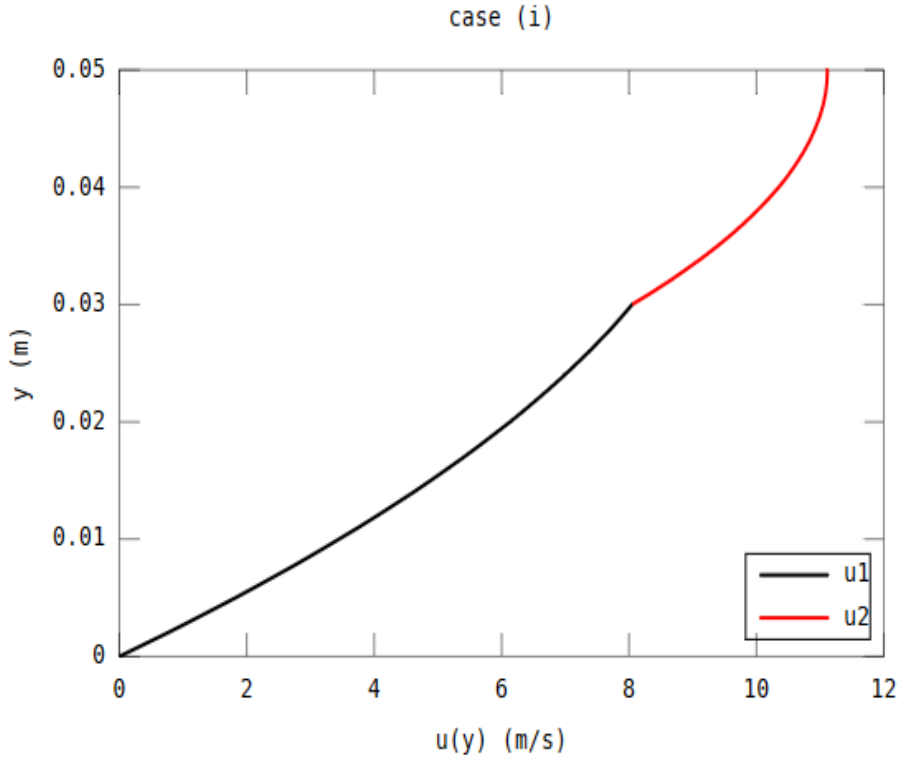
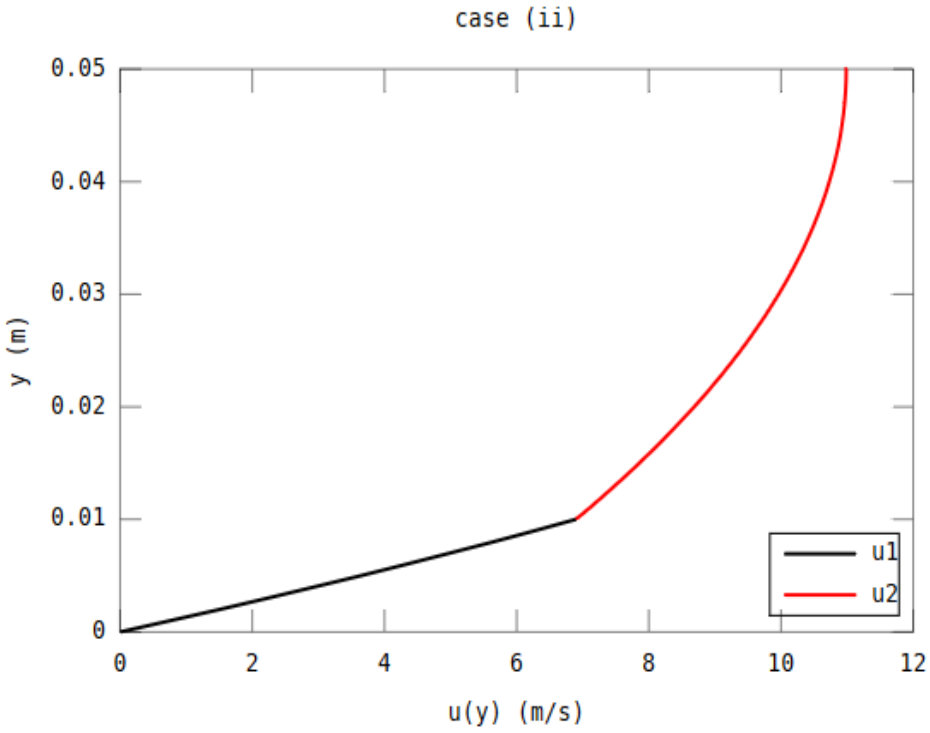
Prob 1. Plot



Prob 2. Plot





Prob 3.(a)

$$u(z,t) = \frac{LU}{\sqrt{L^2 + 4\nu t}} \exp\left(-\frac{z^2}{L^2 + 4\nu t}\right) \quad ; \quad M = \rho\, L\, U\, \pi^{1/2} = constant$$

Prob 3.(b)
The heating rate is

$$\frac{dT}{dt} = -\frac{\nu}{C_p}\left(\frac{1}{0.4m}\right) \int_{-0.2\,m}^{0.2\,m} u\, \frac{\partial^2 u}{\partial z^2}\, dz$$, where $u(z, t)$ is given in Part (a).

The numerical values are 2.23×10^{-10} °C/s at $t = 0$ and 1.617×10^{-10} °C/s at $t = 10$ min. Over 30 minutes, the box of water is heated up by only 2.65×10^{-7} °C which is insignificant.

Prob 4.
The velocity is around 37.7 m/s