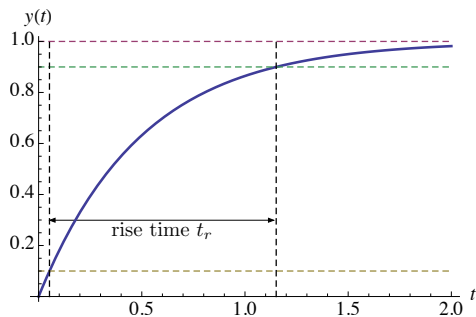


## Rise Time

Step response:  $y(t) = 1(t) - e^{-at}$



Rise time  $t_r$ : the time it takes to get from 10% of steady-state value to 90%

In this example, it is easy to compute  $t_r$  analytically:

$$1 - e^{-at_{0.1}} = 0.1 \quad e^{-at_{0.1}} = 0.9 \quad t_{0.1} = -\frac{\ln 0.9}{a}$$

$$1 - e^{-at_{0.9}} = 0.9 \quad e^{-at_{0.9}} = 0.1 \quad t_{0.9} = -\frac{\ln 0.1}{a}$$

$$t_r = t_{0.9} - t_{0.1} = \frac{\ln 0.9 - \ln 0.1}{a} = \frac{\ln 9}{a} \approx \frac{2.2}{a}$$