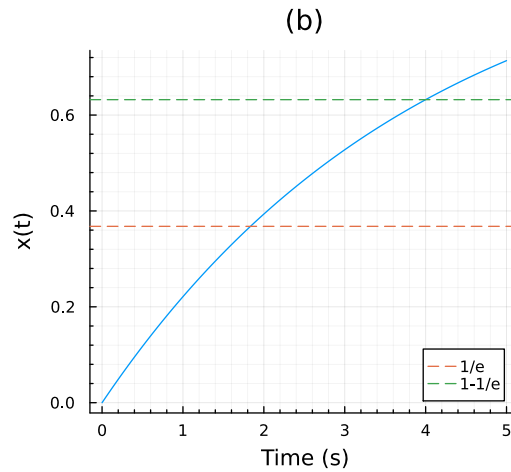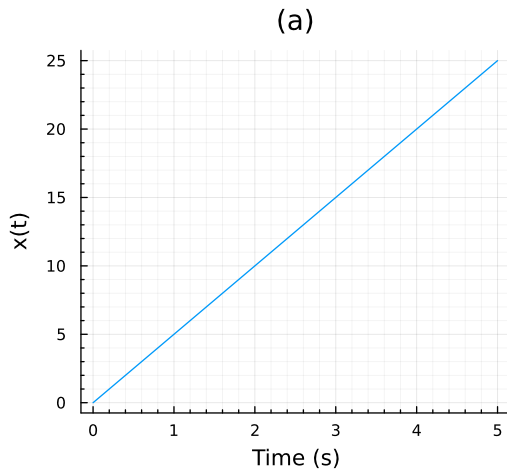**Problem 1** *Laplace Transform*   20 points
Find the Laplace transform of the following functions:

(c) $e^{-2t} - e^{-5t}$
(d) $2e^{-3t} - 4e^{-6t}$
(e) $5 + 3e^{-10t}$

Problem 2 *Inverse Laplace Transform*   20 points
Find the inverse Laplace transform of the following functions:

(a) $\dfrac{10}{s+5}$ (c) $\dfrac{5s+4}{s^2+5s+20}$

(b) $\dfrac{10}{s\,(s+5)}$ (d) $\dfrac{5s+4}{s\,(s^2+5s+20)}$
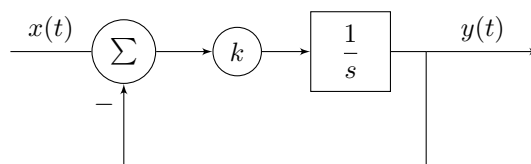
Problem 3 *Step response*   15 points
Find the unit step response of the following system using Laplace transforms. Then plot the output for each of

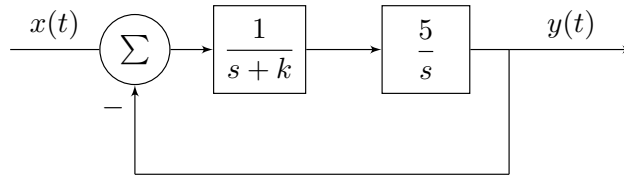(a) $k = 0.1$ (b) $k = 1$ (c) $k = 10$

with MATLAB.

Problem 4 *More step response*   10 points
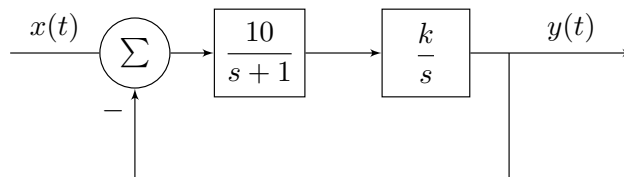For the system given below, find the unit step response if $k = 5$.
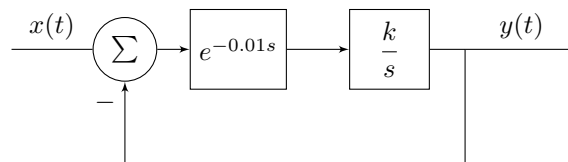

Problem 5 *Impulse response*   10 points
Given the system below. Find the impulse response with $k = 1$ and $k = 0.1$. Use MATLAB to plot
both responses. How does decreasing k change the output?

Problem 6 *System spectrum*   15 points
Given the system below, use Laplace analysis to find the transfer function. Then find the response
to a step input of magnitude 10 setting $k = 20$. Plot the magnitude and phase of the system from
1 to 200 rad/sec and use `unwrap` command for phase greater than $180°$.

Problem 7 *System responses*   10 points
For the system shown below, with $K = 1$, find the response to

(a) a function stepping from 0 to 4 (on the y-axis)
(b) a function equivalent to 4 times the impulse function

$$x(t) \quad \Sigma \quad + \quad \Sigma \quad \boxed{\dfrac{1}{s}} \quad \boxed{\dfrac{10}{s}} \quad y(t)$$

$$- \qquad -$$

$$\boxed{k}$$