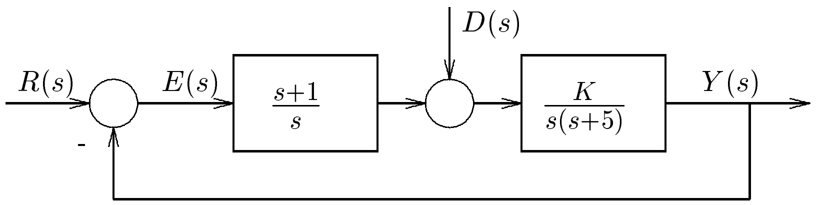
ECE 410 QUIZ #1A

Wednesday, October 7, 1997

Problem 1. In the following diagram, the inputs entering the summers are assumed to be positive, unless otherwise indicated, and the constant K satisfies $4 \leq K \leq 6$, but its precise value is unknown. Assume the closed-loop system is stable.



- Assuming $d(t) = 0$ and $r(t) \neq 0$, write $\frac{Y(s)}{R(s)}$ and $\frac{E(s)}{R(s)}$ as simplified rational functions.

- Assuming $r(t) = 0$ and $d(t) \neq 0$, write $\frac{E(s)}{D(s)}$ as a simplified rational function.

- What is $\lim_{t\to\infty} e(t)$ if $d(t) = 0$ and $r(t)$ is a unit step function?

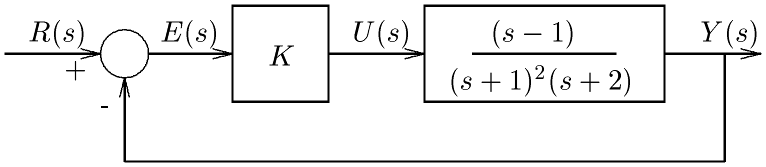
- What is $\lim_{t\to\infty} e(t)$ if $d(t) = 0$ and $r(t) = t$ (a ramp function)?

- What is $\lim_{t\to\infty} e(t)$ if $d(t) = 0$? and $r(t) = t^2$?

- What is $\lim_{t\to\infty} e(t)$ if both $r(t)$ and $d(t)$ are unit steps?

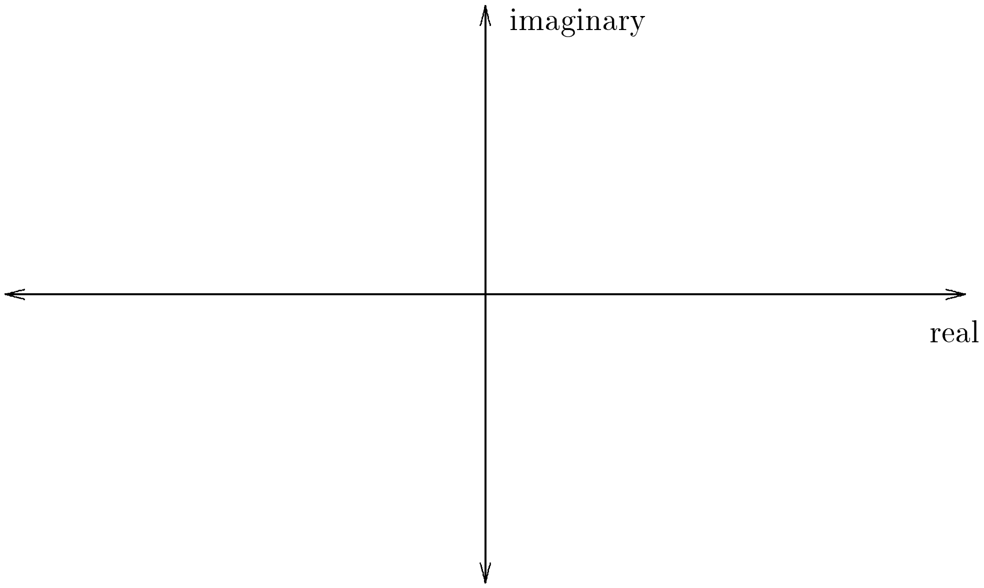
- What is $\lim_{t\to\infty} e(t)$ if $r(t) = t$ and $d(t)$ is a unit step?

Problem 2. Given the closed-loop system

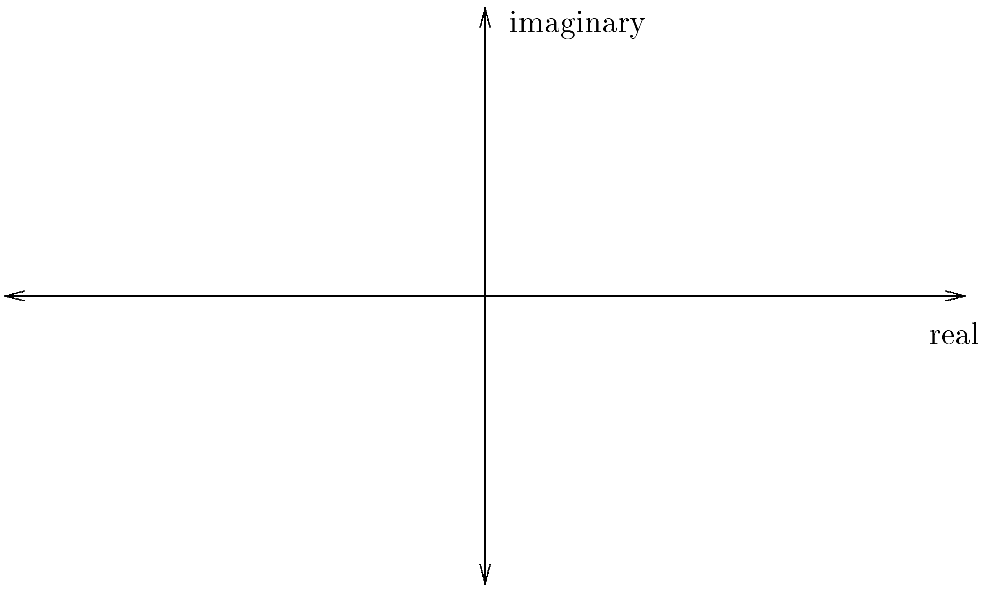


Draw the root locus (the closed-loop pole locations as a function of K) for **both** $K \geq 0$ and $K \leq 0$ below. Is there an interval $a < K < b$ for which the closed-loop system is stable? If so, find this range using a Routh array.

$\boldsymbol{K \geq 0}$:



$\boldsymbol{K \leq 0}$:



Range of K: