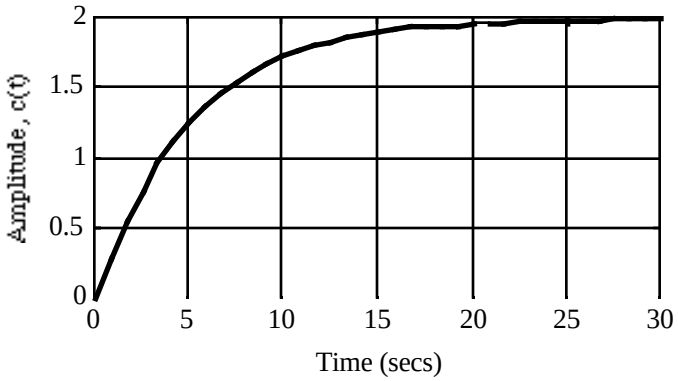
1.) A plant has the response, *c(t)*, to a unit step, *a(t) = u(t)* as shown below.





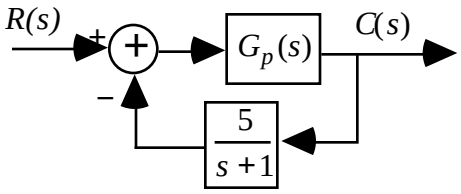
(10pts) a) What are the system's time constant and steady state gain. (Write your results in the boxes provided)

Time Constant (sec) Steady-State Gain

(5 pts) b) Find the transfer function, $G_p(s) = C(s)/U(s)$, between the plant output, *c(t)*, and the input, *u(t)*. (Write your result in the box provided)

$$G_p(s) = \frac{C(s)}{A(s)} =$$

(5 pts) c) What is the closed loop transfer function , T(s), of the controlled plant shown below?



$$T(s) = \frac{C(s)}{R(s)} =$$

(Give result as standard polynomial fraction)

(5 pts) d) What is the new time constant of the closed loop transfer function , *T(s)* ?

Time Constant (sec)

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2.) A plant has the transfer function, $T(s) = \frac{C(s)}{R(s)} = \frac{5}{s+9}$.

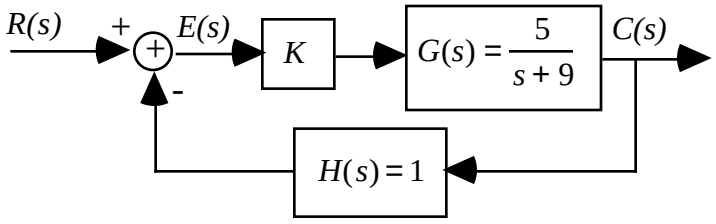
5 pts) a) What is the system settling time?

Settling Time (sec)

5 pts) b) What is the <u>amplitude</u> of the steady response to the input, $r(t) = 2\cos(3t)$?

Steady-State Response Amplitude

10 pts) 3. a) Given the closed-loop block diagram below, what is the sensitivity of $T(s) = C(s)/R(s)$ to variations in control gain, K ? <u>Express result as a polynomial fraction.</u>



Sensitivity of T(s) with respect to K(s)

5 pts) b) To what transfer function, $K(s)$, $G(s)$, or $H(s)$ is the closed-loop transfer function most sensitive ?

Most Sensitive Transfer Function

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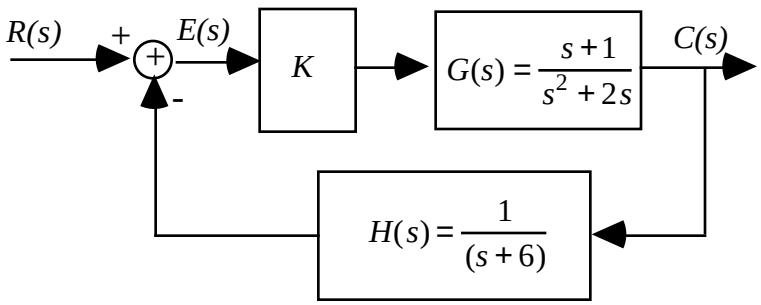
(25 pts) 4. For each characteristic equations below, determine the stable range of the parameter, K.

a) $3s^4 + s^3 + Ks + 10 = 0$

b) $s^3 + 2s^2 + 3s + (1 + K) = 0$

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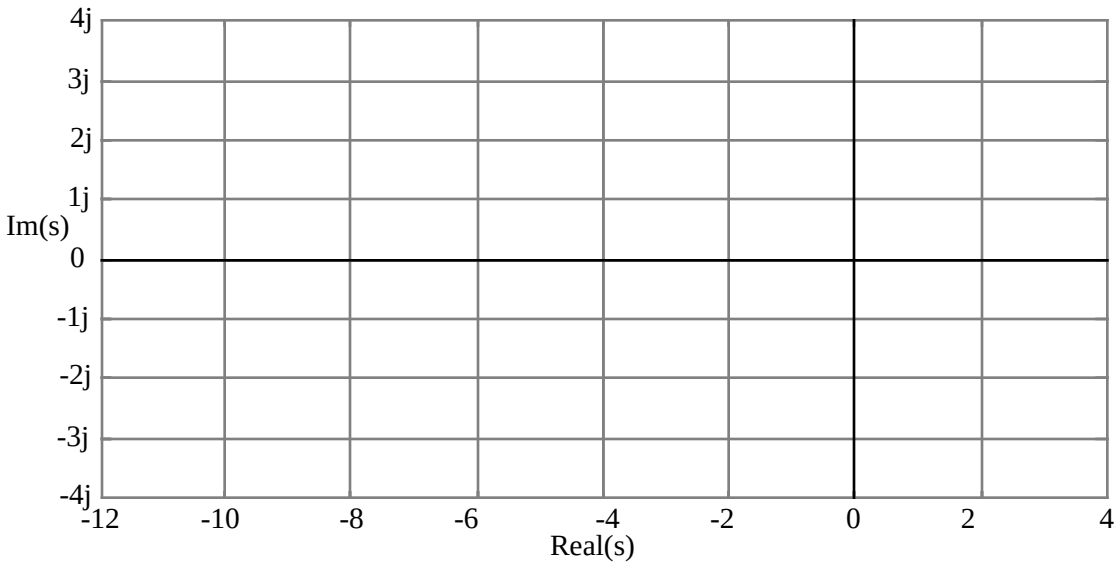
5. For the system shown below,



(5 pts) a) What is the steady state error, *e(t)*, for a unit step input, *r(t)*?

Steady − State Error, $e(\infty)$

(20 pts) b) Draw the root locus for K≥0 noting were possible, range of stable gain, breakaway/breakin points, angles of departure/arrival, asymptotes, etc.



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