# Report-Control Systems Lab

RollNo-190020021

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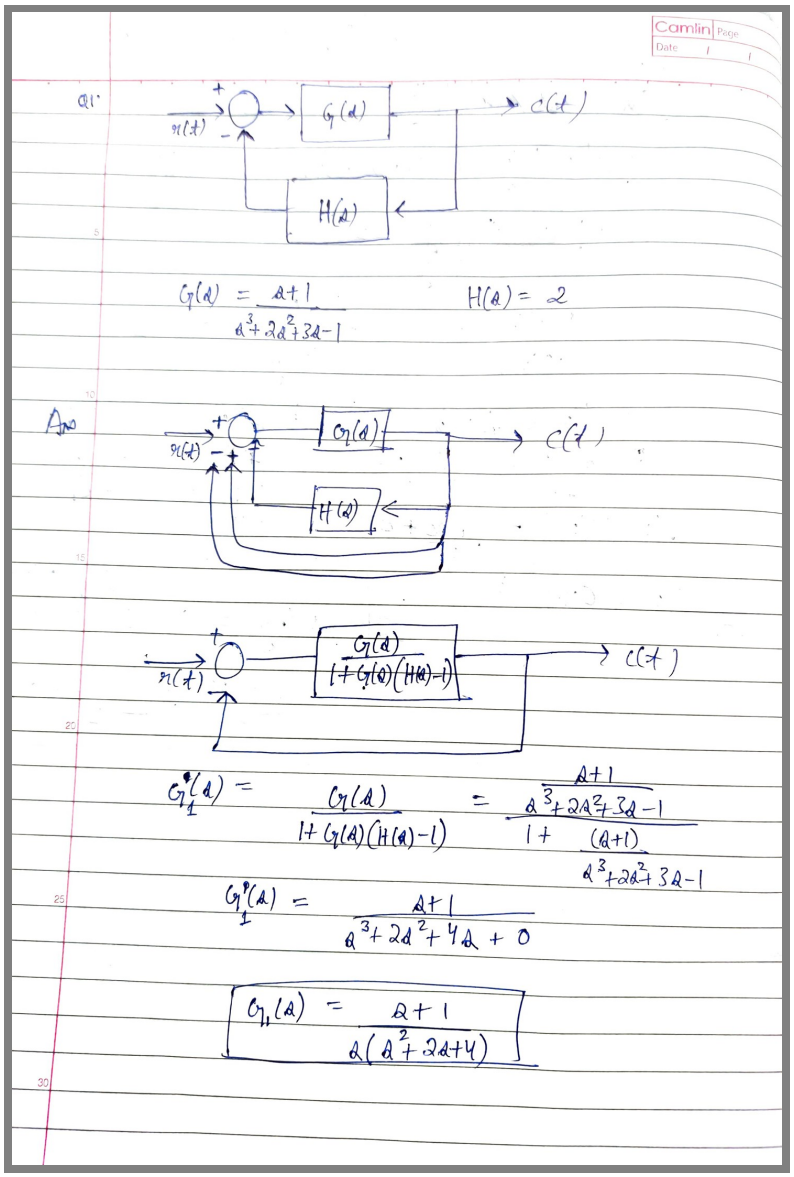
## Answers-

### Q1-



Static error coefficients -

$$K_p = \lim_{s \to 0} G_1(s) = \infty$$

$$K_v = \lim_{s \to 0} s G_1(s) = 1/4$$

$$K_a = \lim_{s \to 0} s^2 G_1(s) = 0$$

Steady state error -

(i) unit input ($u(t)$) -

$$e(\infty) = \frac{1}{1 + K_p} = 0$$

(ii) ramp ($t\,u(t)$) -

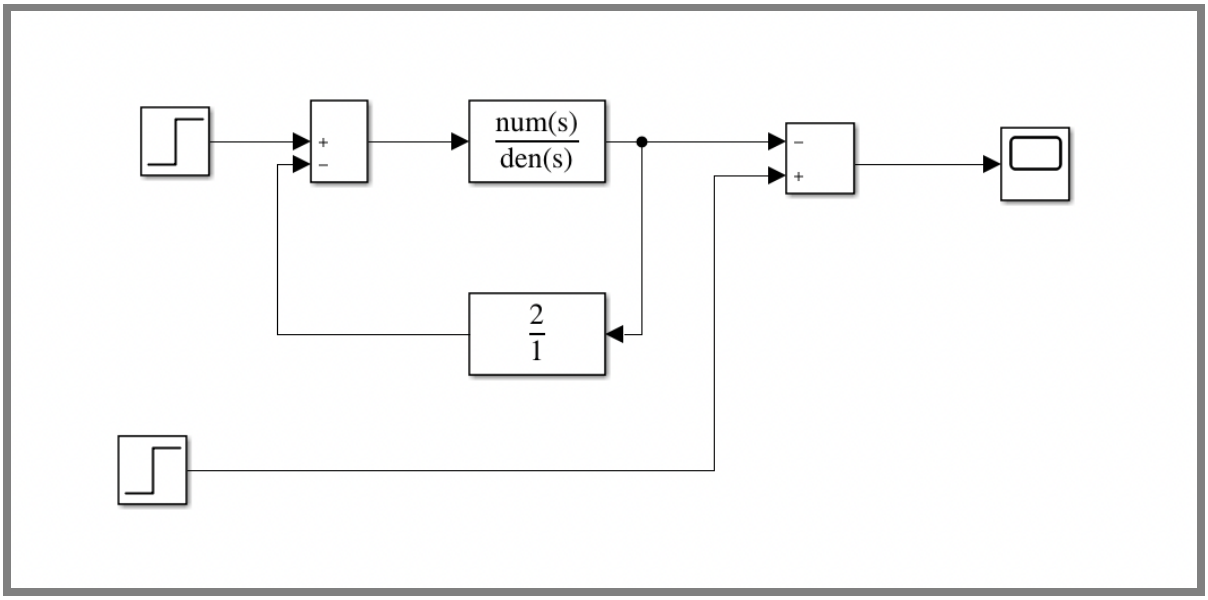
$$e(\infty) = \frac{1}{K_v} = 4$$

(iii) parabolic input ($t^2 u(t)$) -

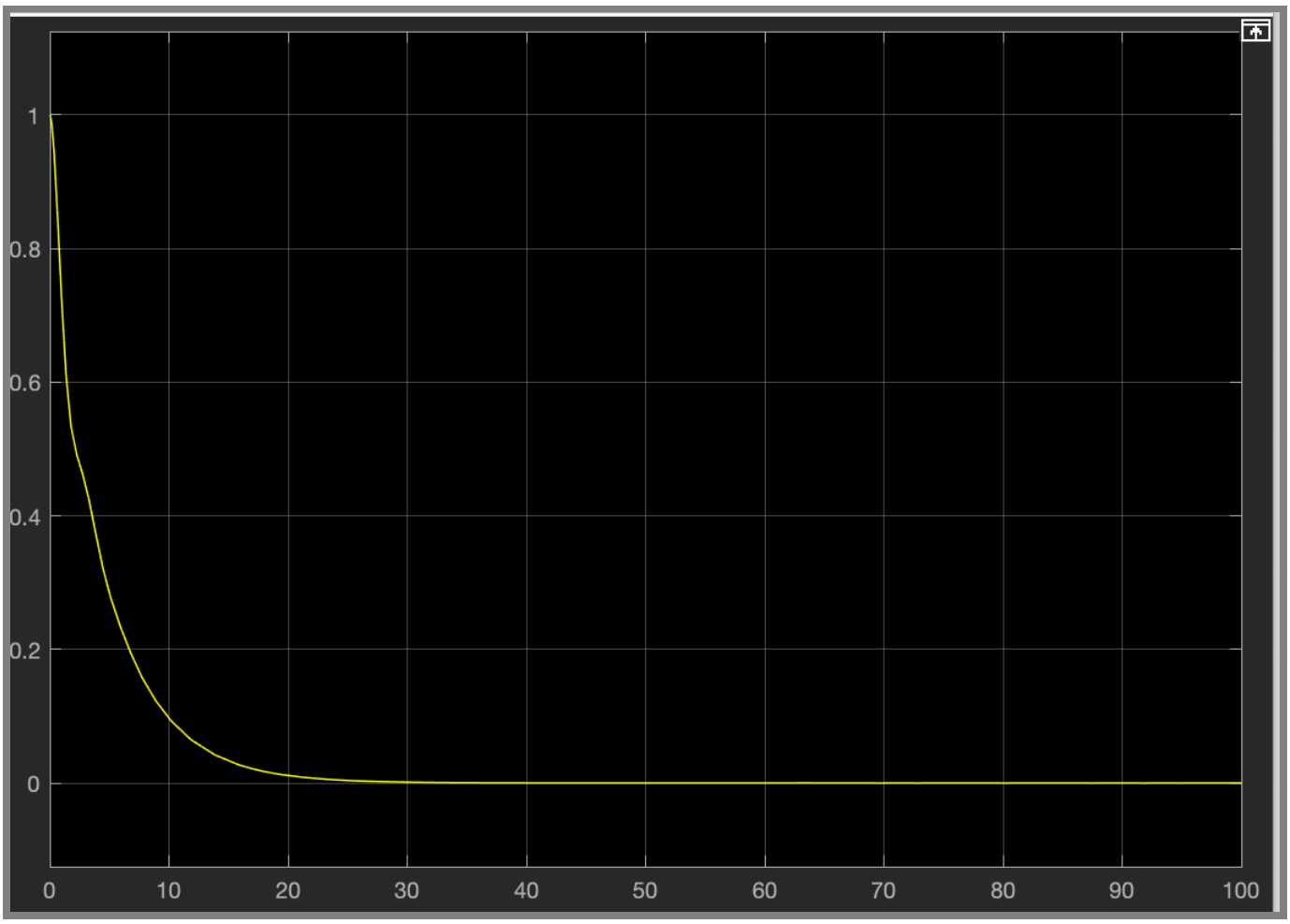
$$e(\infty) = \frac{1}{K_a} = \infty$$

**1)Step input-**

**Simulink model-**

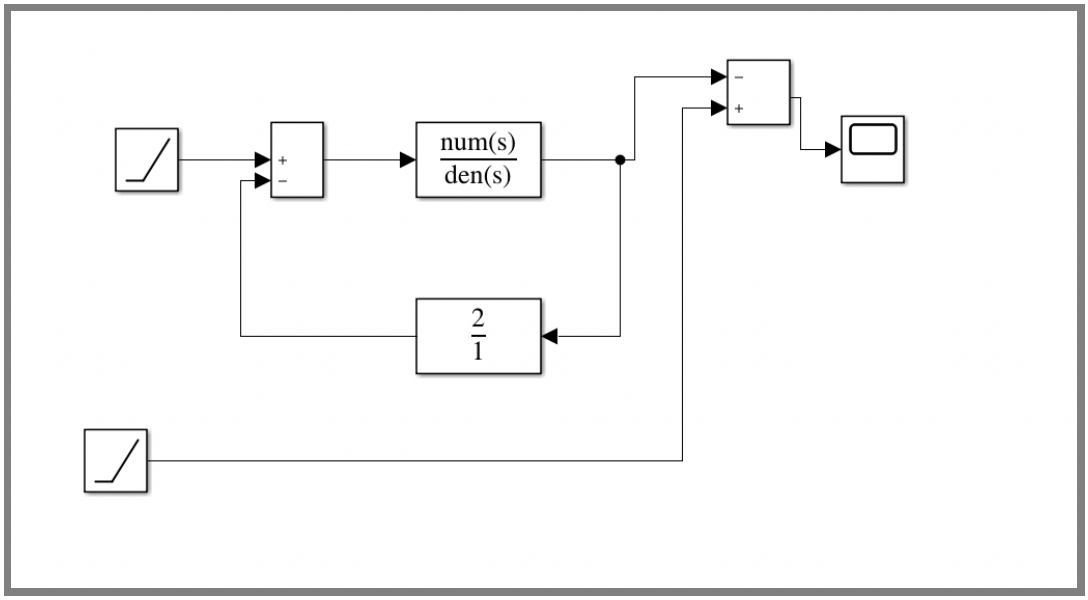



**Plot-(Depicts steady state error as T->infinity)**

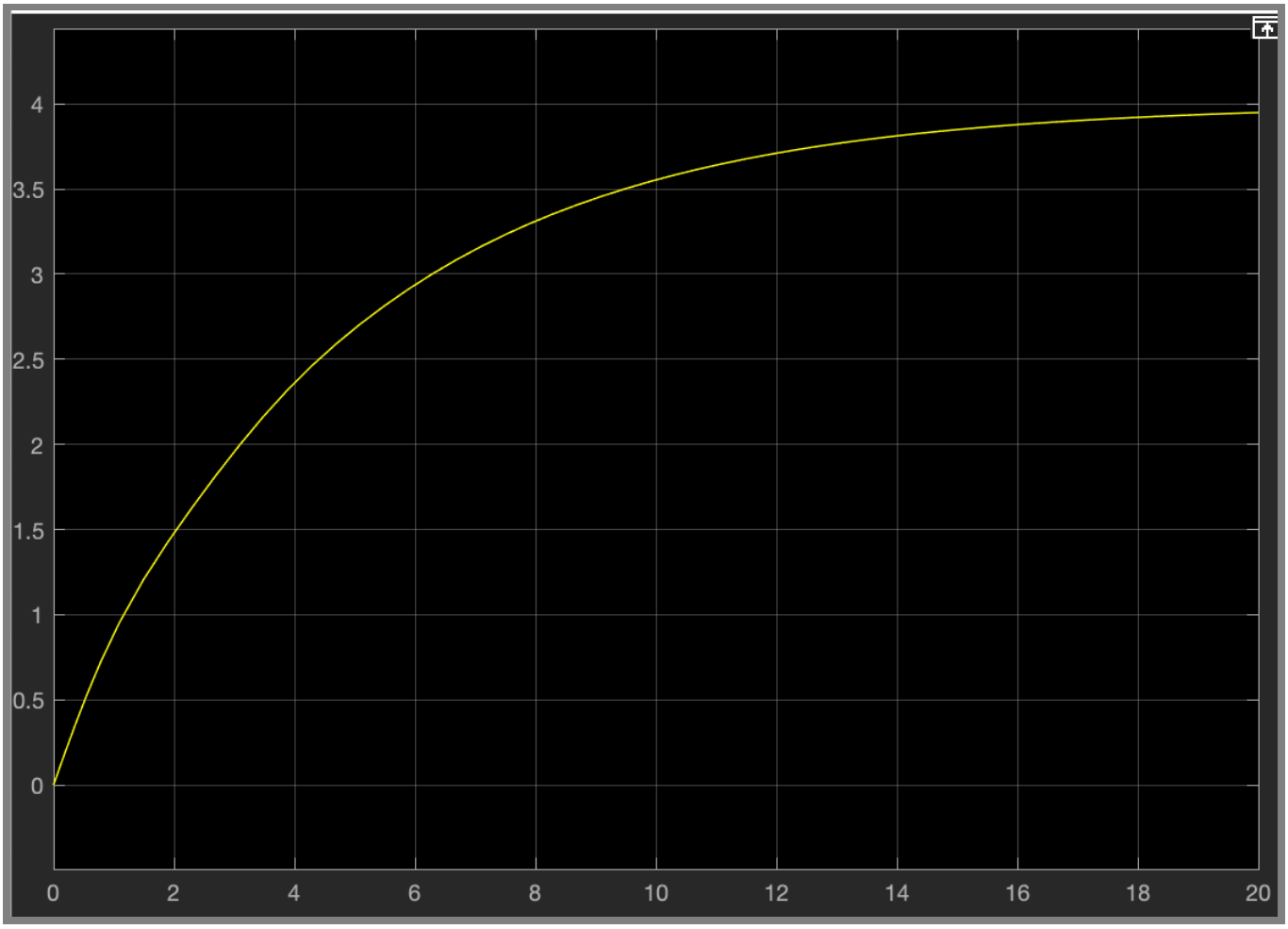


**2)Ramp function-**

**Simulink model-**

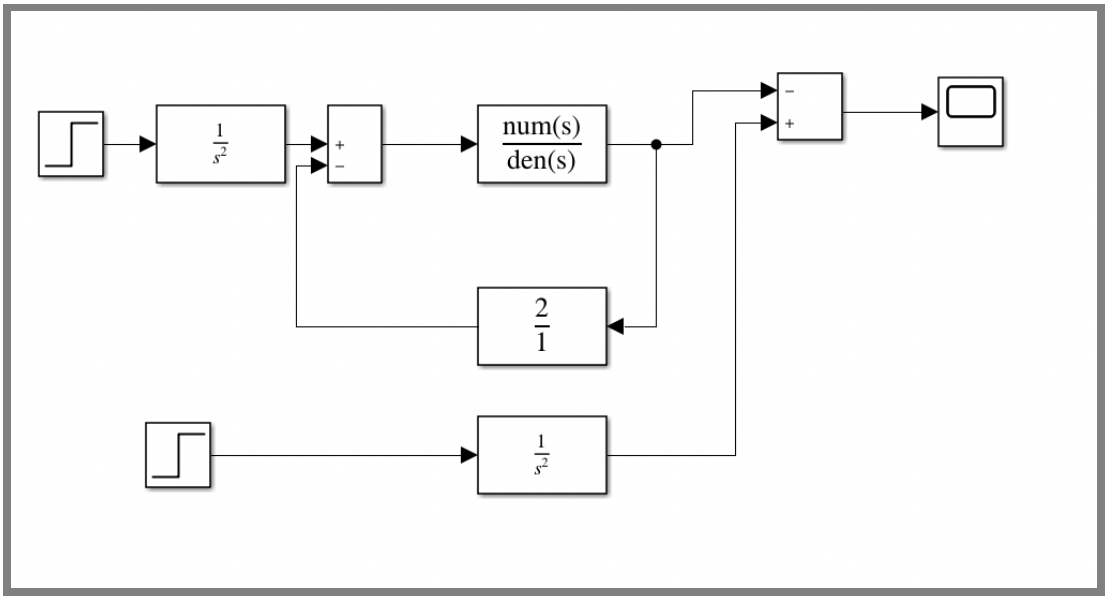



**Plot-(Depicts steady state error as T->infinity)**

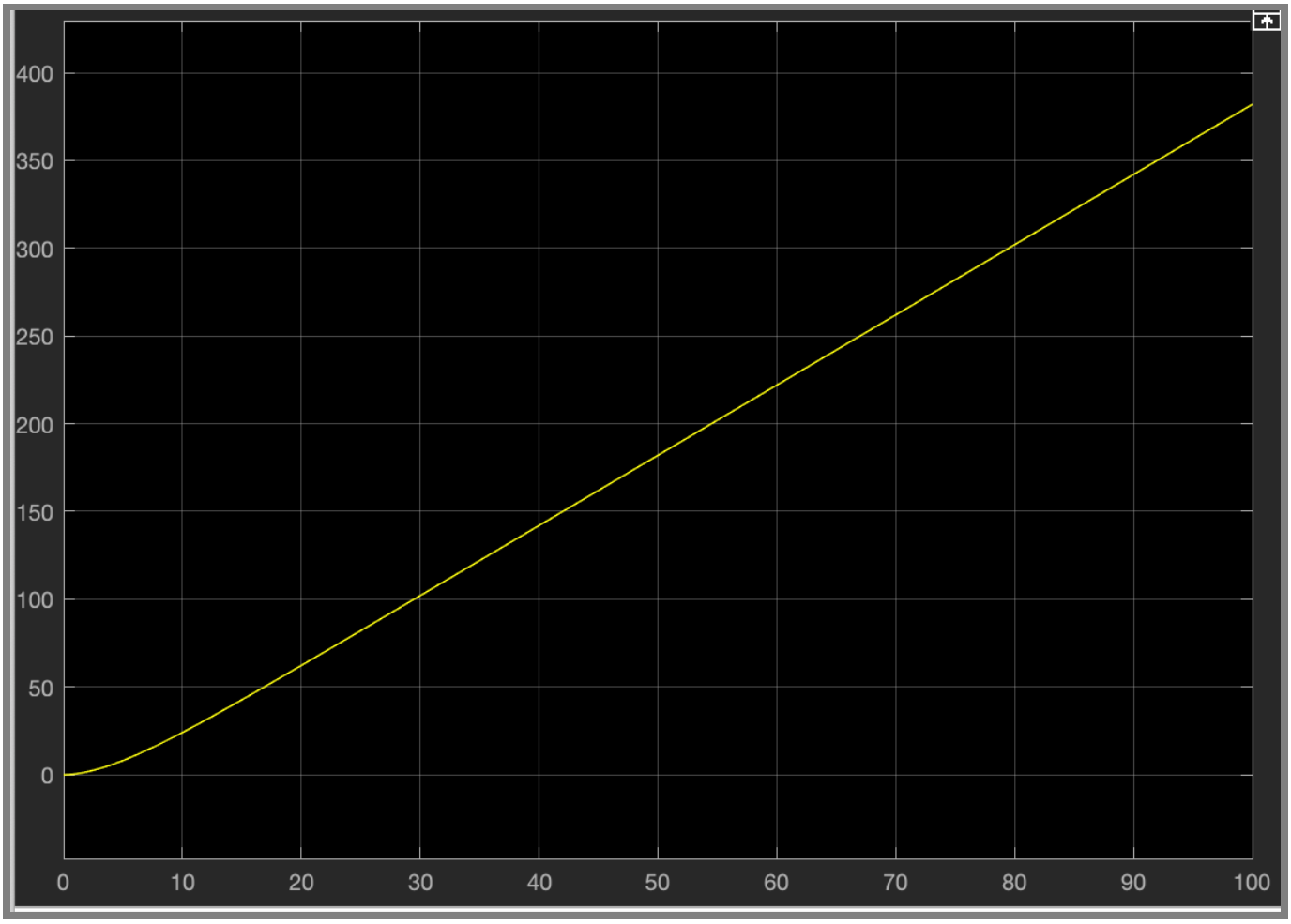


**2)Parabolic input-**

**Simulink model-**

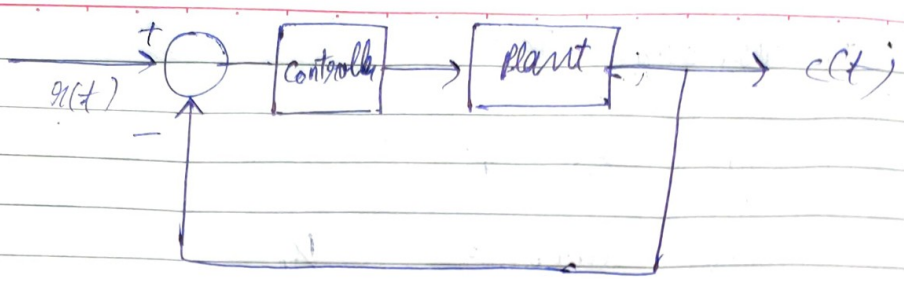



**Plot-(Depicts steady state error as T->infinity)**



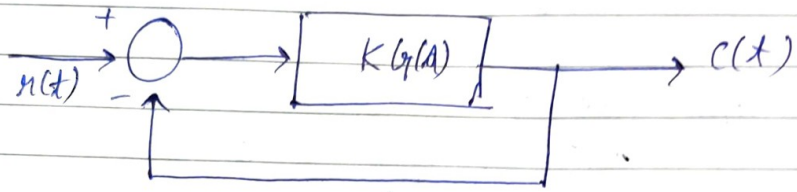
**Q2-**

Q 2.




$$G(s) = \frac{s+3}{s^4 + 3s^3 + 6s^2}$$

Ans




$$G_1(s) = K G(s) = \frac{K(s+3)}{s^2(s^2+3s+6)}$$

This is type II system as $n = 2$.

Test input → parabolic

Now $e(\infty) = 0.1$

So $e(\infty) = \frac{1}{K_a} = 0.1$

So $K_a = 10$

$$\lim_{s \to 0} s^2 G_1(s) = 10$$

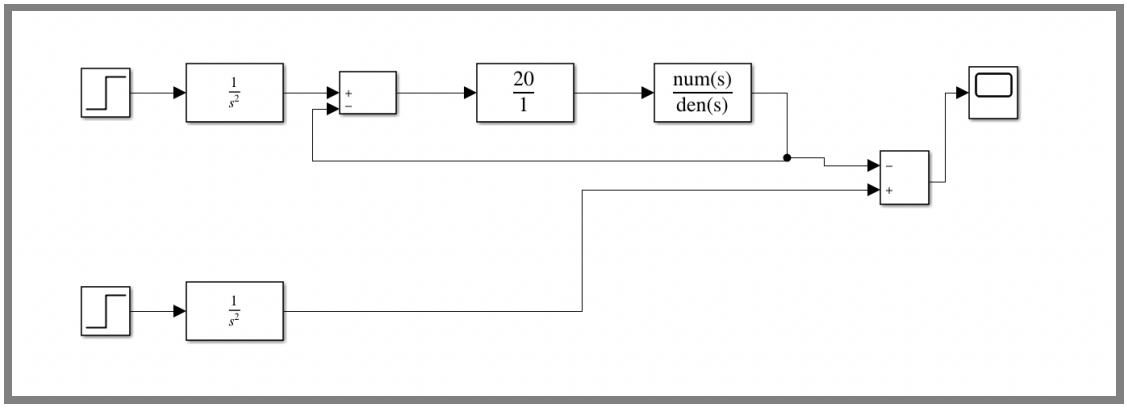
$$\lim_{s \to 0} \frac{K(s+3)}{s^2+3s+6} = 10$$

$$\frac{3K}{6} = 10$$

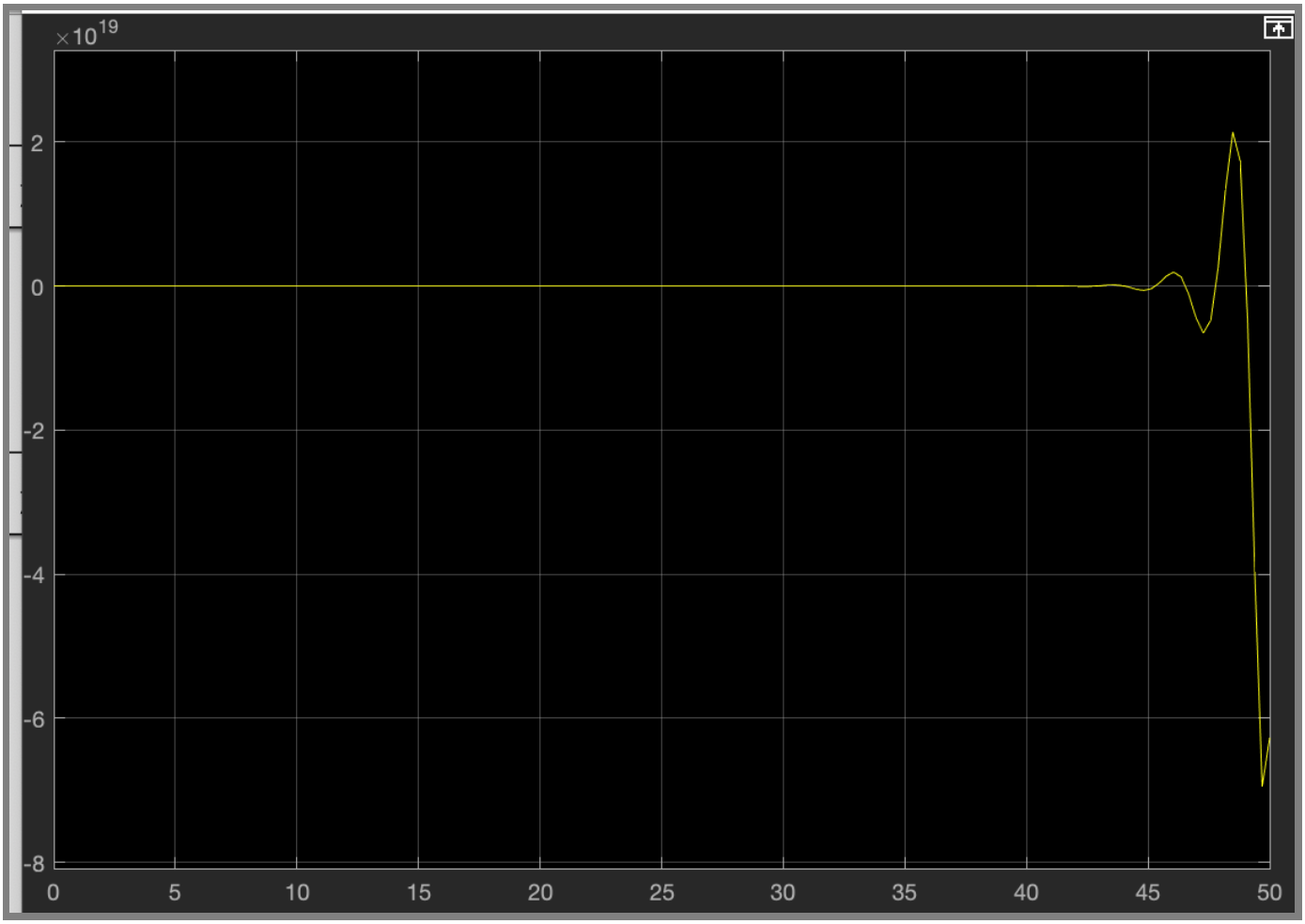
$$\boxed{K = 20}$$ (controller value)

## Parabolic input-

## Simulink model-

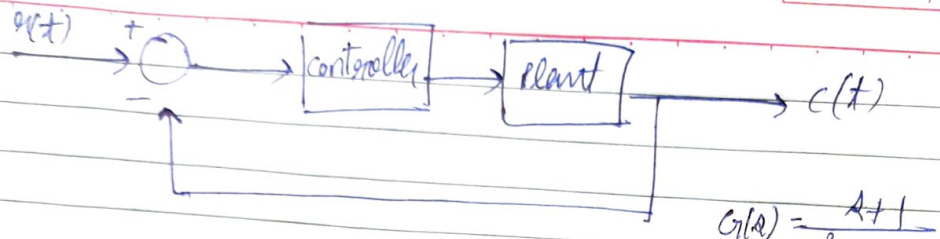



## Plot-(Depicts steady state error as T->infinity)

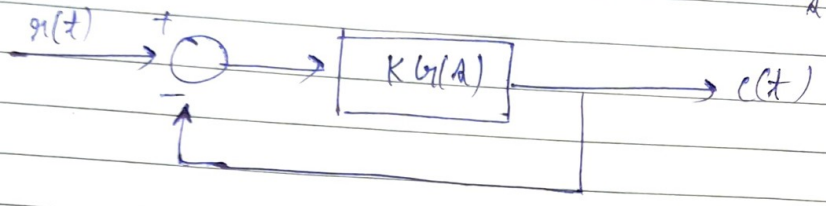



The value of K was calculated assuming that system is stable.But from the output plot we can see the system was unstable so no value of K exists.

**Q3-**

Q3. 


$$G(s) = \frac{s+1}{s^2+6s+1}$$

And 


$$G_1(s) = KG(s) = \frac{K(s+1)}{s^2+6s+1}$$

For zero steady state error for step input -

$$e(\infty) = \frac{1}{1+K_p} = 0$$

$$K_p \to \infty$$

$$\lim_{s\to 0} G_1(s) = \infty$$

$$\lim_{s\to 0} \frac{K(s+1)}{s^2+6s+1} \to \infty$$

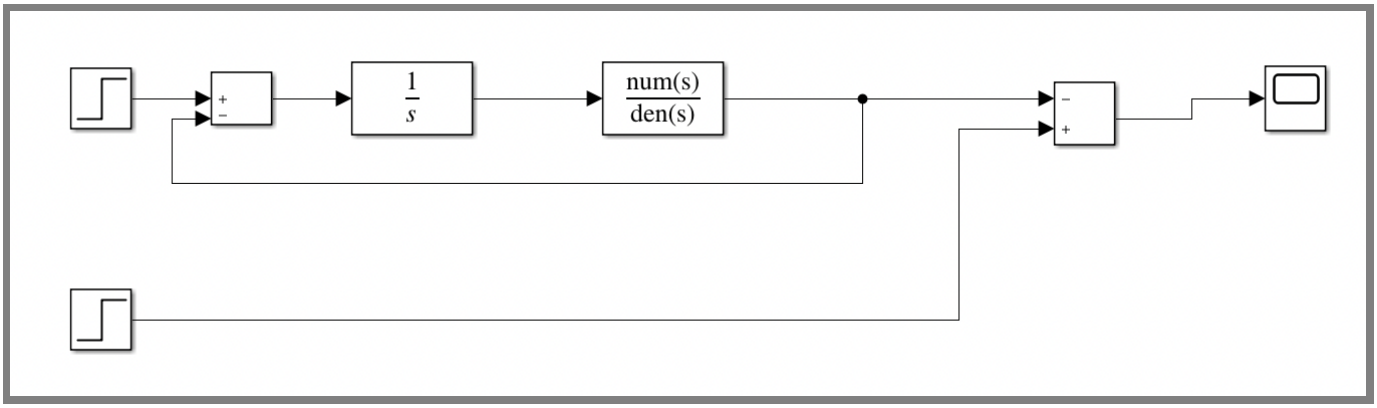
so let $K = \frac{1}{s}$

then $K_p \to \infty$

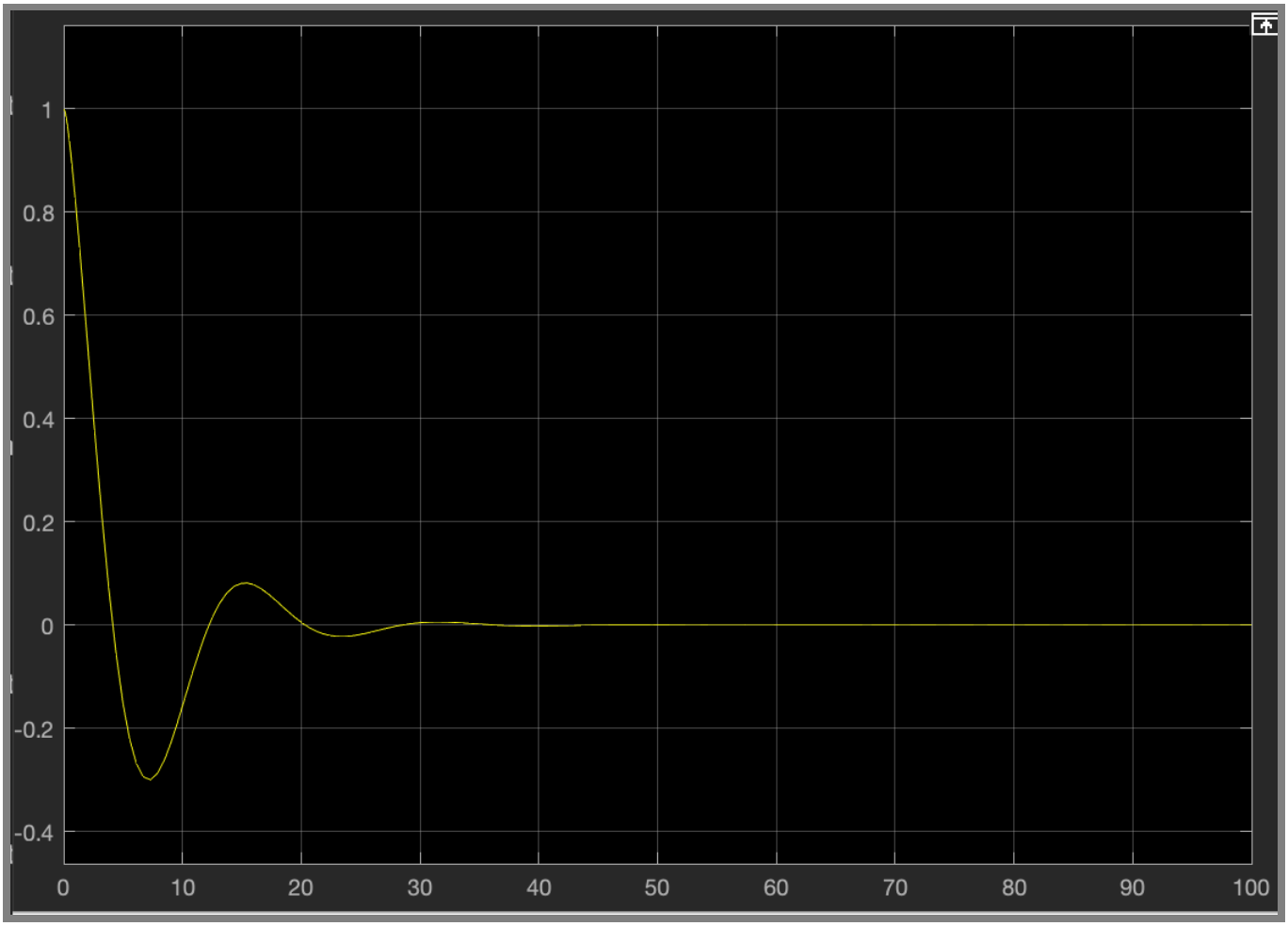
so $\boxed{K = \frac{1}{s}} \to$ integrator

**Step input-**

**Simulink model-**




**Plot-(Depicts steady state error as T->infinity)**




We can see as T->infinity the steady state error approaches zero so design for controller is correct.