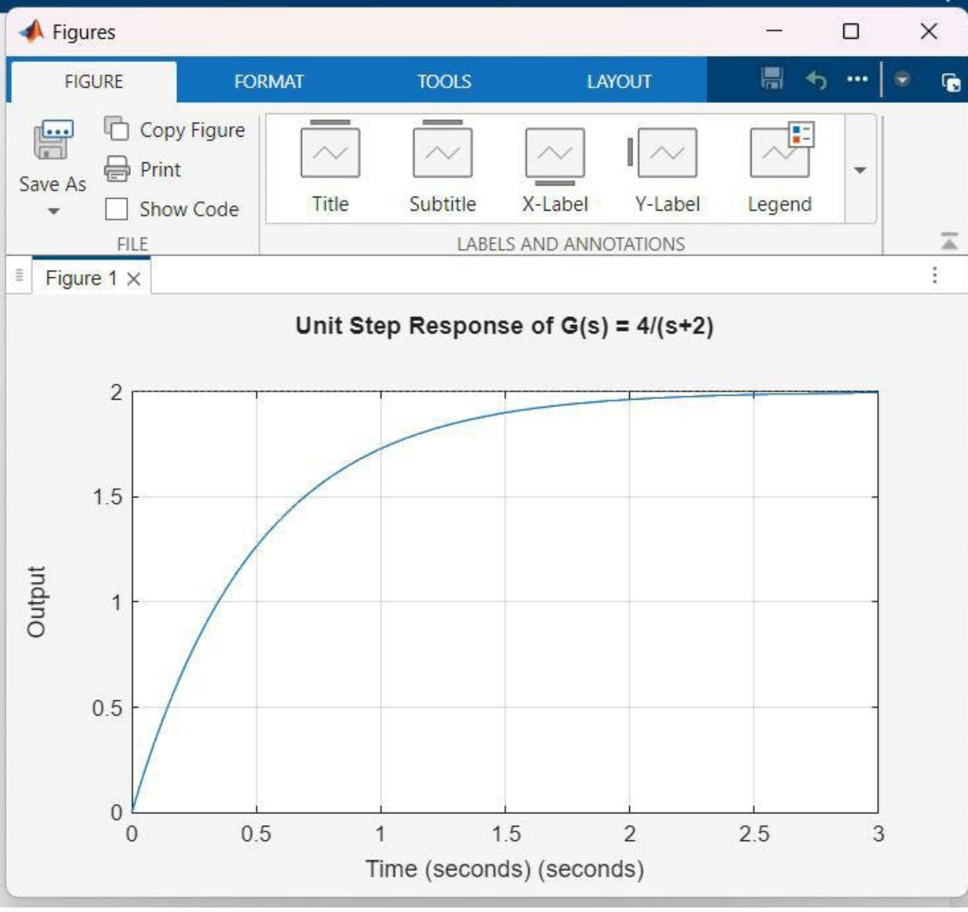
Command Window

```
>> s = tf('s');
G = 4/(s+2);
step(G), grid on
stepinfo(G)


ans =

  struct with fields:

         RiseTime: 1.0985
    TransientTime: 1.9560
     SettlingTime: 1.9560
      SettlingMin: 1.8090
      SettlingMax: 1.9987
        Overshoot: 0
       Undershoot: 0
             Peak: 1.9987
         PeakTime: 3.6611

>> G = tf(4,[1 2]);
figure;
step(G);
grid on;

% Labels
title('Unit Step Response of G(s) = 4/(s+2)');
xlabel('Time (seconds)');
ylabel('Output');
>>
```



Notes Date / /

Ans 1

1.2 $G(s) = \frac{4}{s+2} = \frac{2}{\frac{s}{2}+1}$

$\tau = 0.5$ sec

$t_r = 2.2\tau = 1.1$ sec

$t_s = 4\tau = 2$ sec

final value : $y_{ss} = \lim_{s\to 0} sY(s)$

$= \lim_{s\to 0} \frac{s\,4}{s(s+2)} = 2$

$e_{ss} = r(\infty) - y(\infty) = -1$

1.3 final value using formula: $\lim_{s\to\infty} G(s) = 2$

final value using MATLAB $= 2$

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Ans 2

2.1 Type 1, 1 integrator $G(s) = \frac{10}{s(s+5)}$

2.2

$$e_{ss} = \lim_{s \to 0} 1 - G(s)$$

$$= 1 - \frac{10}{s(s+5)} = -\infty$$

2.3 It should overshoot

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Ans 3

3.1 $\frac{4}{a} < 1.2 \Rightarrow a > 3.33$

$e_{ss} = \frac{1}{1+k} = \frac{1}{10} \Rightarrow \underline{k = 9}$

$G(s) = \frac{9}{s+5}$

3.2 $G(s) = \frac{9}{s+5}$

3.3 $\tau = 1/5 = 0.2 \text{ sec} < 0.5 \text{ sec.}$

$\therefore$ system is faster

final value $= \lim_{s \to 0} s \frac{9}{(s+5)s} = \frac{9}{5} = 1.8$

less than q ues1.

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Ans4

4.1 $$T(s) = \frac{3k(s+z)}{\cancel{(s+1)}(s+1+3k(s+z))}$$

to reduce rise time, $\boxed{z=1}$

$$T(s) = \frac{3k}{3k+1}$$

$$y_{ss} = 0.8 = \frac{4}{5} = \frac{3k}{3k+1} \Rightarrow 3k = 4 \quad \boxed{k = \frac{4}{3}}$$

$$M_p = e^{-\left(\frac{\delta\pi}{\sqrt{1-\delta^2}}\right)} < \frac{1}{10}$$

$$\frac{\delta\pi}{\sqrt{1-\delta^2}} > \ln 10$$

$$\delta > \frac{\ln 10}{\sqrt{(\ln 10)^2 + \pi^2}}$$

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4.2 $T(S) = 0.8$

4.3 → No change

→ $y_{ss} = \frac{3k}{3k+1}$ increase when k increases

$= 1 - \frac{1}{3k+1}$

→ as $t_s < 2s$ ∴ response is faster.

Ans 5

5.1 if ~~open~~ close loop, $T(s) = \frac{C(s)G(s)}{1+C(s)G(s)} = \frac{3k(s+2)}{(s+1+3k(2+s))}$: type 0

(No integrator)

if ~~close~~ open loop,

$T(s) = C(s)\,G(s) = \frac{3k(s+2)}{(s+1)}$:

Type 0

no integrator

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2.

$$e_{ss} = \lim_{s \to 0} s\left(\frac{1}{s^2} - \frac{T(s)}{s^2}\right) = \infty$$

(cant be tracked)

3. Done.

4. No effect.